LARGE-SCALE RINGING RECOVERY ANALYSIS OF EUROPEAN WHITE STORKS (*Ciconia ciconia*)

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ABSTRACT

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In a cooperative project, the European Union for Bird Ringing (EURING) and Vogelwarte Radolfzell started a series of large-scale ringing recovery analyses of European bird species. One of the first selected species is the European White Stork.

Approximately 30 000 recoveries of ringed White Storks are available for this study, which aims to show migratory behaviour, recent changes in timing and direction of migration and effects of direct human activity or probably climatic and environmental changes at the scale of the whole European White Stork population. Data entry is not yet completed and therefore only some preliminary results are given.

In the 1970s in parts of the Netherlands and North-eastern Germany, mean departure directions in autumn changed from easterly to more westerly directions. In northern German Storks, the mean distance from the place of birth to the place of recovery during second summer (as non-breeders) decreased from 2500 km in 1923-1975 to 700 km since 1976. Mean distances in the third summer decreased from 1400 to 350 km. In the same area, mean recovery distances between November and January also decreased remarkably in the 1970s while they keep stable in the area east of 15° longitude.

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INTRODUCTION

Recent changes in migratory behaviour of bird species show the importance of migration research, and in particular demand documentation of the present state of European bird migration. Moreover, it is usually essential to know the spatial features of seasonal migration in order to investigate ecological, physiological, evolutionary or ethological questions in any particular bird species.

In September 1997 it has been proposed to the European Union for Bird Ringing (EURING) to start a joint Vogelwarte Radolfzell – EURING Migration Project

to continue pan-European ringing recovery analyses and to concentrate on species where large-scale analyses are still lacking or where new developments request a revision of the analyses since they have been performed by Schüz and Weigold (1931), Zink (1987), Zink and Bairlein (1995) and others. In the same year, all 34 EURING member schemes announced cooperation within that project.

It has been decided to start with a number of non-passerine species, among which the White Stork is present on the top of the list. While data entry (especially data from the first half of the century) is not yet completed, some preliminary results of the study will be presented here.

METHODS

Up to now, 28 000 recoveries of ringed White Storks have been included in the analysis. As indicated in Figure 1, almost entire breeding range of the species within Europe is covered. In Eastern Europe, data from the first half of the century forms a higher proportion of all data than in the western parts.

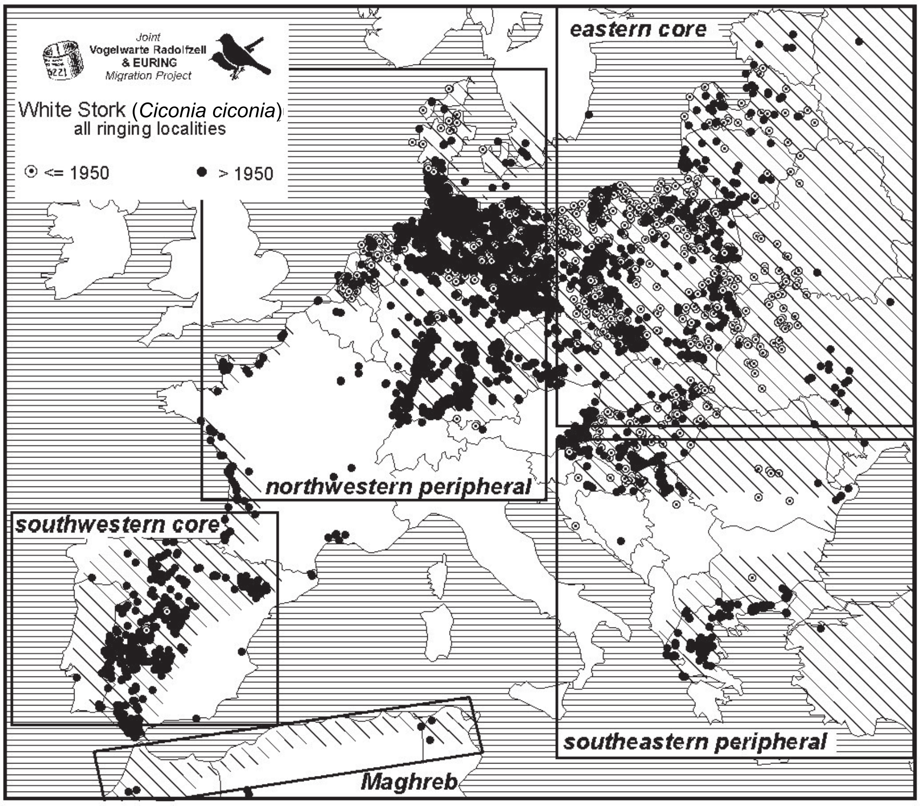

Fig. 1. Ringing localities corresponding to 27 864 recoveries of White Storks included in the analysis so far

As a first approach to analyse differences between different parts of the whole European White Stork „population", the core-peripheral population model of Schulz (1999) is used. Recovery localities range from western Africa to India and from southern Finland to South Africa (Fig. 2).

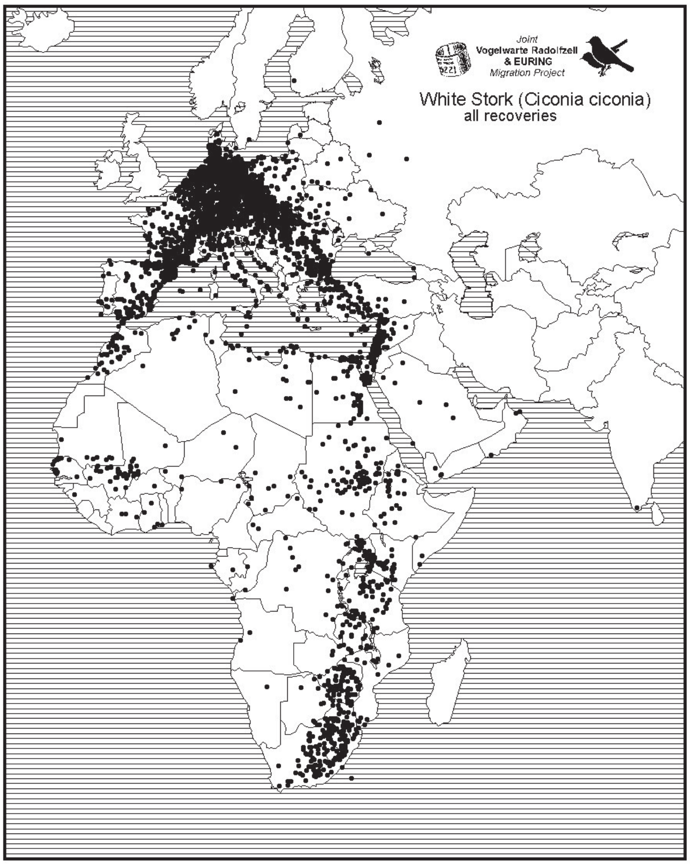

Fig. 2. Localities of 27 864 recoveries of White Storks included in the analysis so far.

All data are stored in electronic databases following the rules of EURING (1979). Data of different ringing centres, as well as data from literature were homogenized and checked for duplicates, inconsistent coding and other errors with a set of database tools programmed under dBase IV (Borland) and FoxPro (Microsoft). All database operations were performed with FoxPro 6.0. For calculations and statistical graphics, the software Statistica 4.5 (STATSOFT) was used and all GIS-based operations and printouts were done with ArcView 3.0 a (ESRI).

Mean departure directions were calculated for storks ringed as nestlings in the same 1 × 1° geographic grid cell. To avoid effects of movements within the breeding grounds or within the wintering area only recoveries south of the ringing locality and north of 30° latitude with a minimum distance of 100 km were included.

To estimate changes in migratory distances, mean recovery distances per time units were calculated as loxodromes between ringing and recovery coordinates as described by Imboden and Imboden (1972). Only recoveries with given minimum ringing and recovery coordinate accuracy of 10' and data of birds ringed as nestlings were included. To avoid effects of few storks with unusually high reporting rates from ring readings the maximum number of datasets included per bird was restricted to 2.

In all analyses presented here, birds that were coded as „handraised" or „kept in captivity for more than 24 hours" were excluded.

RESULTS

Mean departure directions show a westward switch in parts of the Netherlands and northeastern Germany, when birds ringed until 1975 (n = 1009) are compared to those ringed afterwards (n = 1384). In northeastern Germany, this pattern is explained by a new fraction of birds, migrating in southwestern directions. While still recoveries from eastern Africa and along the eastern migration route are reported from northeastern German storks, since 1975, the new southwestern oriented fraction seems not to continue the western migration route to African wintering grounds. Recoveries of these birds were reported from western and southwestern Germany, western France, Switzerland and neighbouring areas.

Mean recovery distances of different populations for recoveries with accurate date in November, December and January are shown in Figure 3. Storks of the north-western peripheral population that were recovered in eastern African wintering quarters or along the eastern migration route (Fig. 3A) had shown mean distances around 6000 km until the early 1970s, when mean distances decreased to lower values. The western migrants of the northwestern peripheral population (Fig. 3B) also showed a decrease in mean migratory distances in the early 1970s. Since the beginning of the 1980s mean distances in this group have increased again. In White Storks breeding east of 15° longitude (eastern core and south-eastern peripheral population – Fig. 3C) mean migratory distances have been stable since the 1950s and did not show any remarkable changes in the 1970s. Storks of the Iberian Peninsula (south-western core population – Fig. 3D) generally show small mean recovery distances below 2000 km. Since the second half of the 1970s, values have been decreasing.

White Storks generally spend their second summer (first year after birth) as non-breeders and in most cases do not return to their originating areas (Bairlein 1981). The mean recovery distance during second summer (May to August) was 2517 km (n = 126) in 1923-1975 for storks born in Northern Germany (north of 52° latitude) and it changed significantly (t-test, $p < 0.001$) to 720 km in 1976-1996 (Fig. 4). In the third summer, mean recovery distances were 1369 km (n = 88) in the first, and 345 km (n = 98) in the second period. Mean distances in the fourth summer were 231 km (n = 184) and 92 km (n = 344), respectively. Both differences between periods are statistically significant (t-test, $p < 0.001$).

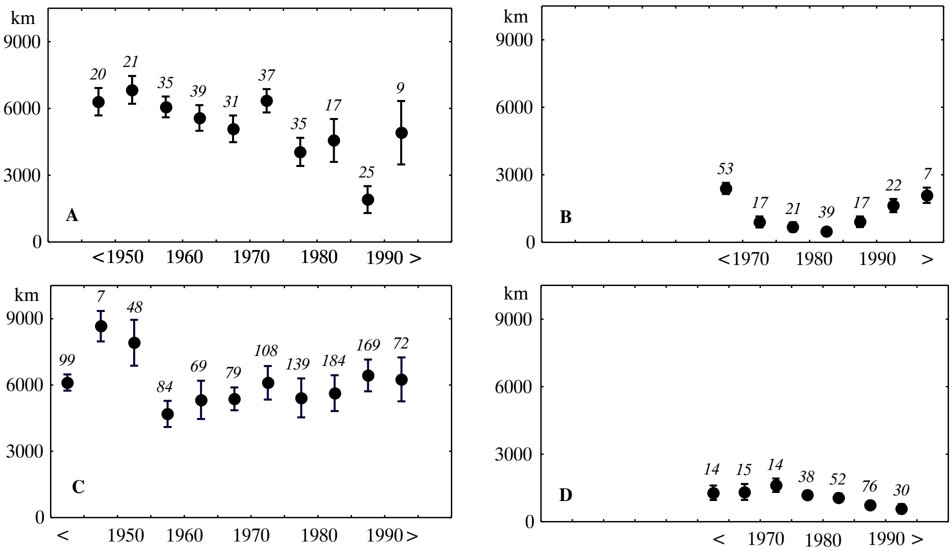

Fig. 3. Mean recovery distances with standard error bars calculated for 5-year intervals for recoveries within Nov.-Jan. A – eastern migrants and B – western migrants of the northwestern peripheral population, C – eastern core and southestern peripheral population, D – southwestern core population. Numbers above the plots indicate sample size.

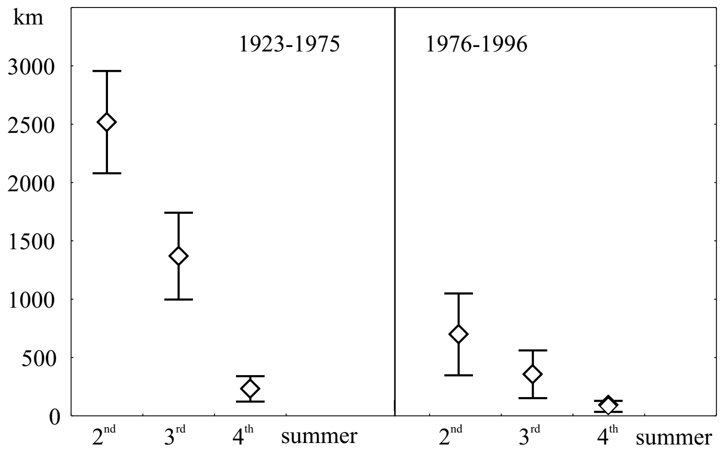

Fig. 4. Mean recovery distances with 95%-confidence limits of northern German Storks recovered within May-Aug. of their second, third or fourth summer. Left side: ringing date 1923-1975, right side: ringing date 1976-1996. For sample sizes see text.

In Figure 5 recovery distances of the northern German storks during their second summer, as used in the previous analysis, are plotted for the period since 1945. Since 1975, only one single recovery in second summer has exceeded a distance of 3000 km while there were 41 cases between 1945 and 1975.

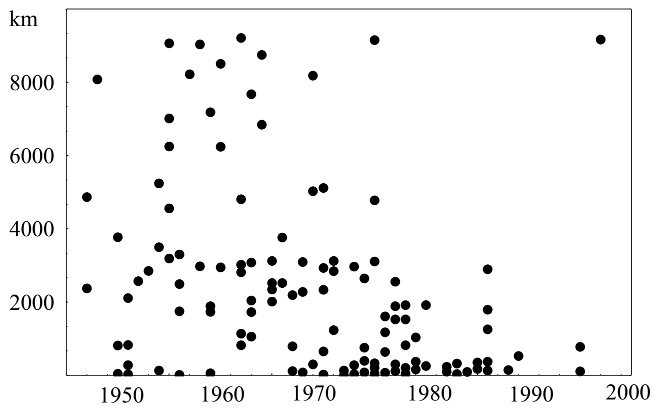

Fig. 5. Recovery distances of northern German White Storks for recoveries within May-Aug. of their second summer. $n = 198$.

DISCUSSION

Despite their preliminary character, the results presented here can give strong evidence that a large-scale ringing recovery analysis of European White Stork data will provide us with new insights into the general migration pattern of that species, as well as into changes in migratory behaviour in parts of the whole population during this century.

Especially in the 1970s, remarkable changes in recovery patterns of central European Storks can be detected and interpreted as changes in migratory behaviour. The main features are: (1) changes in mean migratory directions in some regions of central Europe, mainly caused by an increase of the proportion of birds migrating in south-westerly direction, (2) decrease of mean recovery distances for winter recoveries and (3) decrease of mean recovery distances for recoveries during the second summer of young storks.

More detailed analyses on further completed datasets are necessary to identify factors affecting these changes (such as human activities, climatic and environmental changes) and to exclude errors caused by different ringing activities and recovery probabilities in time and space or other methodical problems, which occur in the analysis of ringing recovery data (Perdeck 1977).

REFERENCES

Bairlein F. 1981. *Analyse der Ringfunde von Weißstörchen (Ciconia ciconia) aus Mitteleuropa westlich der Zugscheide: Zug, Winterquartier, Sommerverbreitung vor der Brutreife.* Vogelwarte 31: 33-44.

EURING. 1979. *Code manual: New EURING.* Institute for Terrestrial Ecology, Arnhem.

Imboden C., Imboden D. 1972. *Formel für Orthodrome und Loxodrome bei der Berechnung von Richtung und Distanz zwischen Beringungs- und Wiederfundort.* Vogelwarte 26: 336-346.

Perdeck, A. C. 1977. *The analysis of ringing data: pitfalls and prospects.* Vogelwarte 29: 33-44.

Schüz E., Weigold H. 1931. *Atlas des Vogelzuges nach den Beringungsergebnissen bei paläarktischen Vögeln.* Friedländer & Sohn, Berlin.

Schulz H. 1999. *The world population of the White Stork (Ciconia ciconia) – Results of the 5th International White Stork Census 1994/95.* In: Schulz H. (Ed.). *White Stork on the up?* – Proc. Int. Symp. on the White Stork, Hamburg 1996. NABU, Bonn: 351-365.

Zink G. 1987. *Der Zug europäischer Singvögel.* Vol. I + II. Aula, Wiesbaden.

Zink G., Bairlein F. 1995. *Der Zug europäischer Singvögel, Band III.* Aula, Wiesbaden.