Mass of Ruffs *Philomachus pugnax* wintering in West Africa

OAG Münster

OAG Münster 1998. Mass of Ruffs *Philomachus pugnax* wintering in West Africa. *International Wader Studies* 10: 435-440.

This paper presents data on mass variation in Ruffs *Philomachus pugnax* wintering in the Senegal delta. Adult males increased their body mass dramatically from low mid-winter levels prior to their spring migration at the beginning of February. Adult females started pre-migratory fattening a little later, from mid-February onwards. First-year birds are lighter than adults. Their increase in mass prior to spring migration was less evident than in adults, confirming the hypothesis that at least a proportion of first-year birds do not migrate far north in their first spring. The masses recorded for Ruffs wintering in Senegal were on average greater than those recorded in east Africa, a difference which maybe linked to their different migration strategies. Based on estimates of theoretical flight ranges with about 5,090 km for adult males and 5,240 km for adult females, there is some evidence that Ruffs are able to migrate from the Senegal to western and central Europe in one non-stop flight.

OAG Münster, Biological Station, Coermühle 181, 4400 Münster, Germany.

OAG Münster (Рабочая группа по орнитологии города Мюнстер, ФРГ) 1998. Масса зимующих в Западной Африке турухтанов *Philomachus pugnax. International Wader Studies* 10: 435-440.

В настоящей статье представлены данные по изменению массы тела у турухтанов *Philomachus pugnax*, зимующих в Сенегальской дельте. Перед отлетом в начале февраля у взрослых самцов вес увеличивался драматически по сравнению с низким среднезимним уровнем. Взрослые самки начинали предмиграционное увеличение слоя жира немного позже, в середине февраля. Первогодики легче взрослых. Накопление массы тела у молодых птиц было менее очевидным, чем у взрослых турухтанов, подтверждая гипотезу о том, что, по крайней мере, часть первогодиков не мигрирует далеко на север первой их весной.

Массы тела у турухтанов на зимовках в Сенегале были в среднем больше, чем было отмечено в Восточной Африке, что, может быть, связано с их разными стратегиями миграции. Оценки теоретической дальности полета, приблизительно 5090 км для взрослых самцов и 5240 км для взрослых самок, дают основание для предположения, что турухтаны могут перелетать из Сенегала в западную и среднюю Европу одним броском.

Introduction

The Ruff *Philomachus pugnax* is a long distance migrant spending a major part of the annual cycle in southern wintering grounds. The main winter quarters of Ruffs are south of the Sahara desert in the freshwater wetlands of western and central Africa, especially in the Senegal delta, the inundation zone of the river Niger in Mali, the Chad basin and in the Nile basin (*e.g.* Cramp & Simmons 1983). Migrating north to their breeding areas in northern Europe and Asia, birds have to cross some great ecological barriers like the desert and the Mediterranean Sea. First results of a study on the migratory strategy of Ruffs returning to their breeding grounds from the Senegal delta led to the hypothesis that the birds cover the distance to their first important stopover sites in western and central Europe in one long non-stop flight (OAG Münster 1989). Of course, such a strategy has high energy requirements. Therefore we would expect fattening and increasing body mass in preparation for spring migration.

The work carried out so far on year round variations in the body mass of wintering Ruffs (*e.g.* Pearson 1981; Schmitt & Whitehouse 1976) has mostly been carried out in the winter quarters in east and south Africa. Depending on the location of the winter quarters there might be differences not only in the migration routes, but also the migration patterns and strategy of birds. The population of Ruffs wintering in western and central Africa outnumbers the smaller population in east and south Africa. Other papers on mass variations of Ruffs are from studies during the migration periods.

As part of several year's research on the spring migration of Ruffs wintering in the Senegal Delta, we ringed and measured birds. In this paper we present results on mass variations of the birds in winter and prior to migration.

Methods

In the winters of 1984 to 1988, we organized four expeditions to the Senegal delta, the most westerly winter quarters of Ruffs. There, Ruffs were mist-netted at their night roosts. The location of catching sites is shown in Figure 1. All night roosts were located in the shallow water of the river systems or at lakesides. Lakes were both of an artifical nature (water reservoirs) and of a more natural kind (the "Grand Lac" in the Djoudj - National Park and the Guembuel lagoon at St. Louis). Some of the roosts were used by birds feeding far away during the day in rice fields or elswhere. The distance from feeding sites to the roost could amount to more than 30 km.

During our expeditions we caught and ringed a total of 1,988 Ruffs. Japanese nets with a total length of 80-160m were used to catch the birds. Mass was measured with a Pesola spring balance to an accuracy of 1 g. Primaries of all birds were examined for signs of moult. The condition of each of the primaries was classified from 0 (old) to 5 (new). Therefore the primary index of one bird could vary from 0 to 50. The method is described in detail by Koopman (1986).

Additional data was provided by Patrick Dugan and Jonathan Wallace, who had taken measurements at some of the same sites in Senegal in the winter 1984/85, and by Bernard Treca who had shot birds for other studies (Treca 1979). The accuracy of the methods used for the latter, mean that the data are less exact than from live birds.

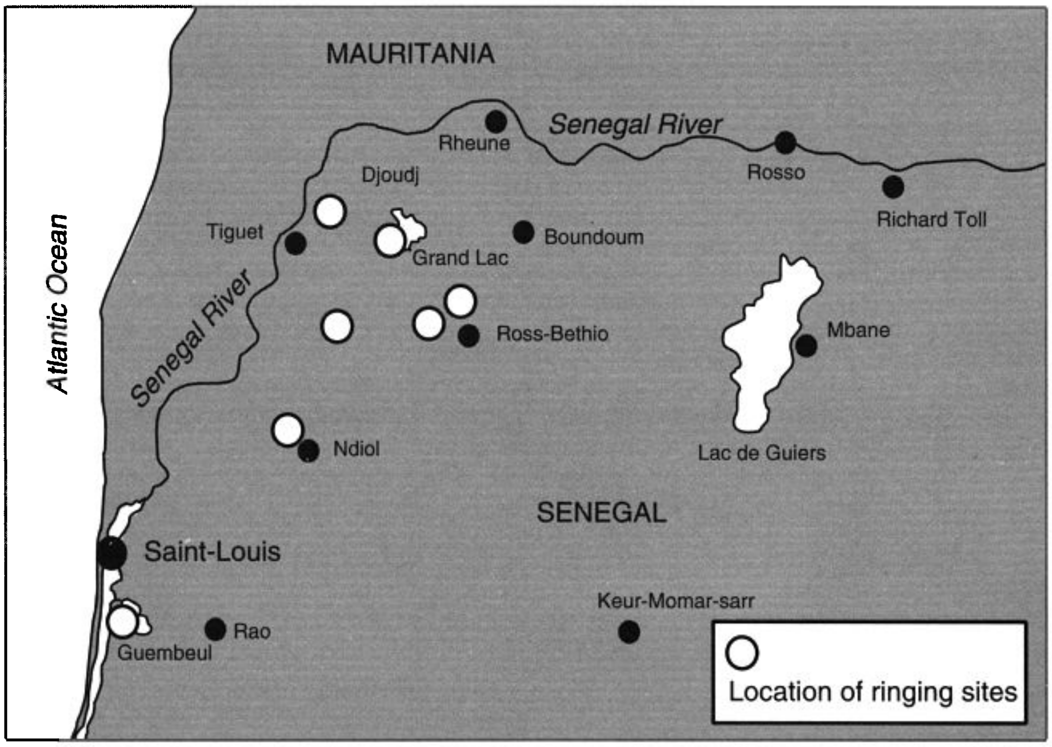

Figure 1. Location of ringing sites in the Senegal delta.

Results

Adult males

Mean mass of adult males measured in the Senegal is plotted in Figure 2 by ten-day periods. After arriving at the winter quarters, mean mass first decreased somewhat but then remained at a constant level, somewhere between 180 g and 190 g for the majority of the winter. The average mass of males was slightly above means from Kenya, given by Pearson (1981).

We have few data on the moult pattern of Ruffs caught in Senegal. However, there is no evidence that the mass of birds in active moult decreased significantly below the midwinter level.

Nevertheless, the lowest means were recorded at the end of primary moult in November/December. The primary score of nine birds (in moult or with completely new feathers) in mid-November was 48.

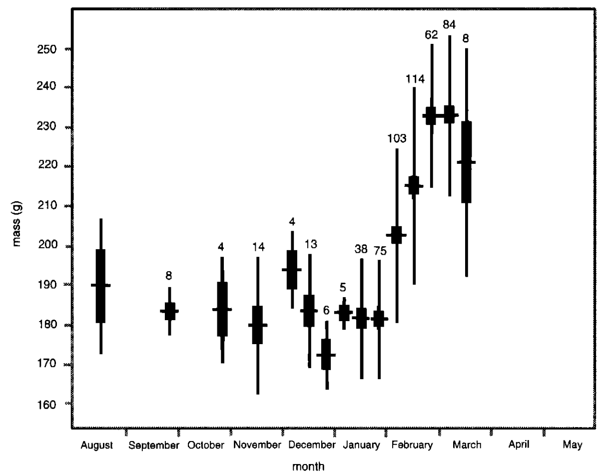

Figure 2. Mean mass of adult males per ten-day period. Horizontal lines mark the mean, vertical lines the standard deviation and vertical bars the error of the mean. Small numbers indicate the sample sizes.

Even after completion of primary moult, mean mass remained at a low winter level. Minimum masses of individuals were 146 g (on 16 November) and 145 g (on 19 November). Initiation of premigratory fattening started at the beginning of February. Peak mean mass (233 g) was measured before March, although not all birds would have finished fattening. This is a likely explanation for the high standard deviation of the data.

Depending on individual variations in the timing of preparation for spring migration, we would expect a further increase in mass. Unfortunately, there are no good data for the period from the end of March to April. The highest individual masses were 272 g and 273 g (first week of March). One individual increased its mass from 179 g on 11 February 1985 to 222 g on 2 March, an average rate of 2.3 g. day $^{-1}$. Based on mean masses, the average daily increase rate was 1.7 g day^{-1} from February to March.

Adult females

Mean masses of adult females caught in Senegal are

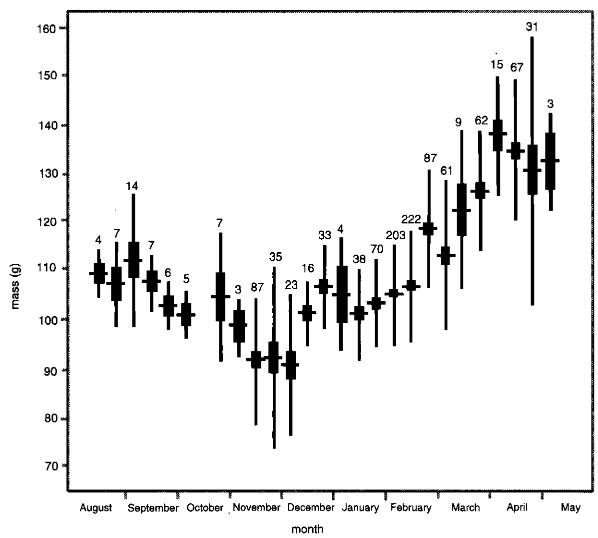

Figure 3. Mean mass of adult females. Further explanations see Figure 2.

shown in Figure 3. After arrival in the winter quarters masses decreased continuously. They reached a minimum at the end of November, corresponding with the completion of primary moult. As found for males, the primary score of 61 birds was 48 in mid-November. After finishing moult, masses increased to the levels recorded in September/October.

Premigratory fattening started in February. Peak mean mass was measured in late March/April. At this time the first birds have probably started their spring migration whilst others have not finished fattening for flight preparation. Especially in April, there is a large amount of standard deviation in the data. The mean daily increase rate was 0.6 g day^{-1} from mid-February to the beginning of April. Due to the lack of retraps, we have no data on individual increase rates. Minimum masses of individual adult females were 65 g and 66 g (on 20th January) and maximum masses were 162 g and 163 g (April 1974.

Juveniles

Mean masses of first-year birds, especially of females, were relatively constant through the winter (Figure 4). The mean masses were almost always

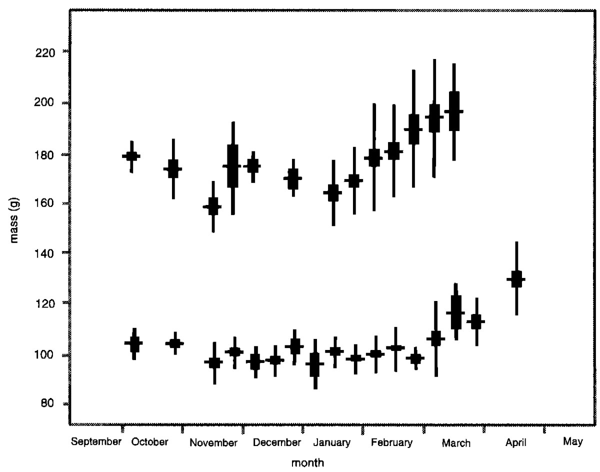

Figure 4. Mean mass of first-year birds. Above: males; below: females. Further explanations see Figure 2.

those of adults (u test, $p < 0.001$). There was no minimum in mean masses which could be related to primary moult. In any case only a small proportion of first year birds moult their primaries in their first winter and moult is restricted to the outermost primaries (7th - 10th).

The mean mass of juvenile Ruffs increased slightly in the second half of the winter from February onwards, but the absolute increase is less evident than in adults. Similarly to adults, juvenile males seem to start fattening earlier than females. The highest individual mass recorded was 243 g (on 1 March 1985) for males, and 154 g (on 12 April 1974) for females. So, these values are also much lower than adult masses. The other extremes in first year birds were 140 g for males (on 20 January 1987) and 79 g for females (on 20 February 1985).

In contrast to east and south Africa, few data have been obtained from the other important winter quarters of Ruffs in west-Africa. The few data on mass of Ruffs from these regions (*e.g.* Mali, Chad basin) are mainly within the range of this study (Altenburg *et al.* 1986; van der Kamp 1989; OAG Münster 1991).

Discussion

There is some evidence that shortly after their arrival in the west African winter quarters, Ruff mass can be somewhat above the later mid-winter weights. These results are similar to those from east Africa. Pearson (1981) mentioned that birds

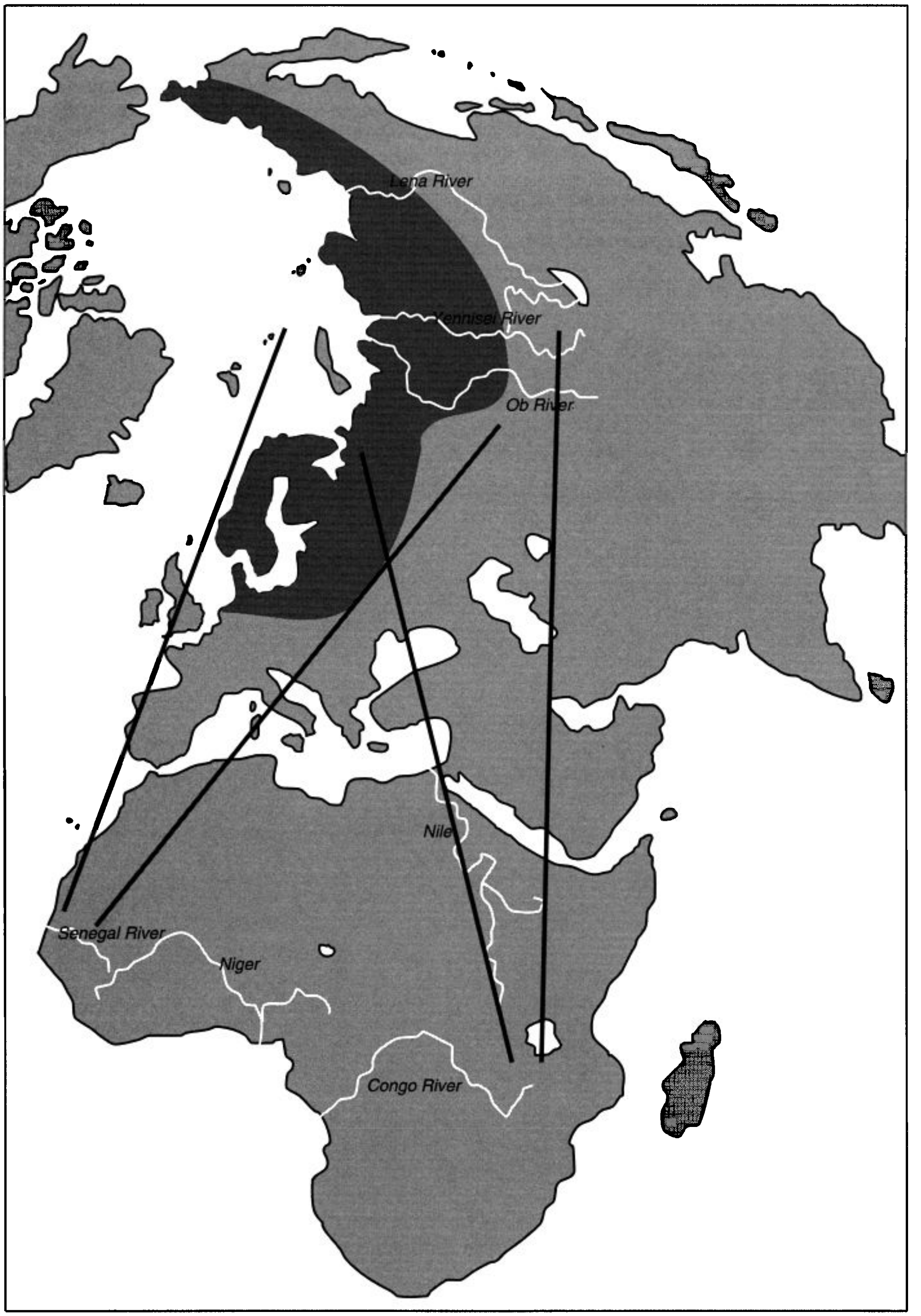

Figure 5. Migration corridor (flyway) of Ruffs wintering in western and eastern Africa. Heavily shaded area marks the breeding range.

possibly arrive with spare reserves at their winter quarters. These reserves may serve as a form of insurance for a long distance migrant. After arrival at their winter quarters, refuelling or maintaining high energy reserves is not necessary. From an aerodynamic and energetic point of view, the extra fat load might also be a hindrance. Indeed, body mass is maintained at a relatively constant low level during the winter. Similar to results from Kenya, lowest masses were measured in Senegal at the end of primary moult. The relationship between moult and mass is not as clear as that described for European stop-over sites, where parts of the population have already moulted flight feathers (Koopmann 1986; OAG Münster 1991).

Compared to data on mass published from African wintering grounds (*e.g.* Schmitt & Whitehouse 1976; Pearson 1981) it is most remarkable that the average mass in Senegal is much higher. These differences concern not only mid-winter masses, but become noticeable at the end of the winter when birds prepare for homeward migration. For example, mean mass of adults exceeded that of males in Kenya by about 40 g and that of females by about 20-30 g in March/April. Moreover, fattening in preparation for migration starts in west Africa about four weeks earlier than in eastern Africa.

The population of Ruffs wintering in Kenya was estimated at about 19,000 birds (Summers *et al.* 1989). Recoveries suggest that these birds mostly originated from breeding grounds east of 70° longitude. Accordingly, migration routes of this population could go through the Near East (Figure 5). Then, after crossing the Arabian desert and peninsula, the first suitable stopover sites would probably be the Euphrates/Tigris region in Iraq. The distance from there to Kenya is about 3,500 to 4,000 km. Certainly, it cannot be discounted that some birds migrate north following the Nile.

Nikolaus (in Summers *et al.* 1989) gave an estimate of the high numbers of Ruffs wintering in the Sudd area, but little precise information has been obtained on the migration routes of these birds. First recoveries came from the Black Sea coast and the Caspian Sea. (Vandewalle 1988). The origin of birds wintering in Senegal ranges from Scandinavia to eastern Siberia, thus there is a high degree of overlap with the birds wintering in eastern Africa. The population size in west Africa is much higher than in eastern parts of the continent. In the Senegal delta the number of birds was estimated at about 1,000,000 birds some years ago (Morel & Roux 1972) but there is information that this population recently decreased to less than 250,000 birds (Trolliet & Girard 1991; own observations). The migration routes of these birds mostly follow the great circle through western Europe. Their first suitable stop-over sites after crossing the Sahara desert and the Mediterranean Sea are therefore within about 4,000 to 5,000 km (OAG Münster 1989). For a successful long distance migration, birds should have accumulated sufficient energy reserves. Our results on mass gain by Ruffs in preparation for spring migration fit very well with this prediction.

Of course, from ringing results we do not know if mass gain is based only on fattening, or if the birds also store protein (*e.g.* Davidson & Evans 1989). However, it is possible to estimate the theoretical flight range of birds using a formula based on fat-free masses and departure weights of birds and an estimated flight speed (Davidson 1984). Certainly flight speeds depend to a large extent on weather and wind conditions. Nevertheless, these formula can supply a rough estimate.

For nature conservation reasons we did not kill birds for fat extraction, but lowest recorded masses of individuals can serve as a clue to fat-free weights of the birds. Estimation of departure masses presents more problems. Firstly, mean masses consist of masses from birds in various physiological states of condition, *e.g.* in one sample some birds might have finished fattening for migration, whilst others might be at their low mid-winter level. Secondly, we do not know how long birds stay in their winter quarters after trapping and measuring their body condition. It is quite possible that even the heaviest birds increased their masses further, but we have to use masses of these birds as a reference value for departure weights.
The formula (Davidson 1984) is:

$$R = S * 95.447 * (T\ 0.302 - M\ 0.302)$$

(T = departure mass, M = fat free mass,
S = flight speed -km/h)

Taking into account the problems mentioned above, we calculated theoretical flight range with the following masses:

	Males	Females
fat free weight	160 g	80 g
departure weight	265 g	150 g

The flight speed was assumed to be about 70 km/h^{-1}.

Based on these assumptions, theoretical flight ranges of Ruffs wintering in the Senegal are 5,092 km for males and 5,245 km for females. In view of the estimates required we have to consider these values to be minimun flight ranges. However, these results confirm our hypothesis that birds are able to fly non-stop from Senegal to western and central Europe. It is possible that Ruffs wintering in western and eastern Africa use different migration strategies on their homeward migration.

Compared to adults, juveniles are lighter. Moreover, the increase in mass happened later in the year and did not reach the adult peak. This fits with the hypothesis that at least a proportion of first year birds do not intend to migrate far north in their first year, therefore they do not need high energy reserves.

Acknowledgements

We would like to thank P. Dugan, J. Wallace and B. Treca for making available their data, C.R.B.P.O., G. Jarry and F. Roux for sending the rings, and R.I. Sylla, I. Diop & S. Diouf for their co-operation and offering good working possibilities. P. Dugan and R. Seargant kindly made comments on a draft of this paper and improved the English. Thanks also go to Umweltstiftung WWF-Germany and the Forschungs -kommission of the Deutsche Ornithologen-Gesellschaft for providing financial help for parts of the study.

Data were collected by B. Beckers, B. Beyer, I. Bindia, L. Gizart, H. Hötker, T. Kepp, T. Kölsch, P. Mann, J. Melter, E. Reinke, K. Boa Sane, A. Sauvage, C, Schmidt, M. Scholten and our colleagues from the Netherlands: L.v.d. Berg, G. Gerritsen, T.v.d. Have, P. Meininger, G. Müskens, E. Osiek, H. Visser and J. Winkelmann.

This paper was prepared by Johannes Melter.

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