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Autumn migration of the Redshank *(Tringa t. totanus)* in the region of the Gulf of Gdańsk (Poland)

By Włodzimierz Meissner

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Redshanks were counted daily at three sites at the Gulf of Gdańsk. The dynamics of migration differed between studied seasons. However, in the majority of years the pattern showed a clear wave structure. It is known that two different populations ("northern" and "southern"), which differ in biometrics and the migration time, migrate through the Gulf of Gdańsk. The differences in migration timing of these groups are probably the main purpose of the observed wave structure. Weather conditions both in breeding areas and on route, have probably a remarkable influence on the observed multimodal pattern. The analysis of recoveries of ringed birds showed that in the first two decades of August juvenile Redshanks from "southern" population passed through the study area. They migrated both over inland and along the seacoast and the majority of them stayed in Europe for wintering. Late August and September migrants, which form main migration peak of juveniles in the Gulf of Gdańsk, followed exclusively the coasts of Baltic and of the North Sea. These birds apparently belong to the "northern" population and they cross Europe finishing migration in Africa. They carry larger fat reserves than earlier migrants and the majority of them probably flies directly to the Wadden Sea or even to the Mediterranean. The heaviest birds are able to reach northern Africa in one step.

Key words: Redshank *(Tringa totanus),* migration, ringing, Gulf of Gdańsk.

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1. Introduction

In many western European countries the knowledge of Redshank migration is quite good (GLUTZ et al. 1975, MELTOFTE 1993, MELTOFTE et al. 1994), but still comparatively little is known about the phenology in Central and Eastern Europe (CRAMP & SIMMONS 1983). Concentrations exceeding 100 migrating Redshanks are scarce there, but a remarkable proportion of Russian and Fenno-Scandian breeding population passes through the Baltic (GLUTZ et al. 1975, CRAMP & SIMMONS 1983).

The migration strategy of adults from the "northern" and the "southern" populations was described by MELTOFTE (1993, 1994), whereas little is known about differences between juveniles from these populations.

A previous analysis of recoveries showed that Redshanks migrating through the Gulf of Gdańsk come from vast area: from Norway, Sweden, Finland and the Baltic countries (GROMADZKI 1985). A part of them probably originate also from northern Russia. Among these birds at least two migratory populations can be distinguished. The first, called "southern", inhabits southern Scandinavia, southern and south-eastern Baltic coast, whereas the "northern" one comes from Scandinavian mountains, northern Norwegian coast and Finland (MELTOFTE 1993).

The aim of this paper is to describe directions, timing and phenology of migration and to determine the migration strategy of various populations of juvenile Redshank passing in autumn through the Gulf of Gdańsk region.

2. Methods

Research on wader migration was carried out at two sites in the western part of the Gulf of Gdańsk (Fig. 1). The study area near Jastarnia consisted of the communal sewage plant, dry and wet meadows and narrow sandy beach. In the region of the Reda Mouth counts were conducted at the electric power station ash-dumping place, a fragment of the sandy coast and on sandy islands near the river mouth (for details see: MEISSNER (1996) and

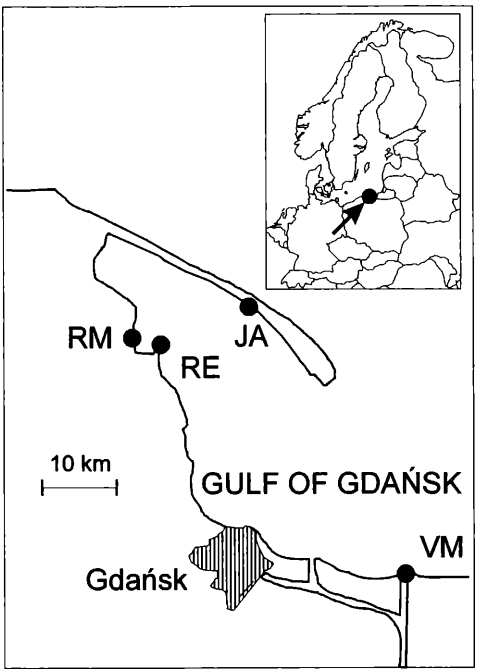

Fig. 1: Study area. All places mentioned in text were indicated by black dots: JA – Jastarnia, RM – Reda mouth, RE – Rewa, VM – Vistula mouth.

Abb. 1: Untersuchungsgebiet. Alle im Text genannten Gebiete sind durch schwarze Punkte gekennzeichnet. JA – Jastarnia, RM – Redamündung, RE – Rewa, VM – Vistulamündung.

Meissner & Remisiewicz (1998)). The birds were counted at Jastarnia between 1984 and 1989 and at Reda mouth between 1990 and 1997. Only in 1984–86 and 1988 at Jastarnia and in 1990, 1993, 1996–1997 at Reda mouth daily counts were made between mid-July and the end of September. Data from other seasons were omitted, because of gaps in the count-schedule or abnormal situation in the study area met at Jastarnia in 1989, when the meadows were extremely dry. At the Reda mouth birds were counted once a day about midday and in 1990 – three times a day. At Jastarnia counts were conducted three times a day – in the morning at the noon and in the afternoon. In the analysis of migration dynamics, the maximum number of birds recorded during the particular day was used.

In the Redshank, no major peaks in numbers which could influence the drawn pattern of the migration dynamics, occurred outside the studied period.

The fieldwork started in mid-July, when Redshanks had been already present in the study area. There were less than 10 breeding pairs in both sites, but distinguishing migrants from local Redshanks was impossible. The presence of this small local population might have affected the obtained results (especially during the first phase of migration).

At the Reda mouth, at Jastarnia and at Rewa, waders were also caught in the walk-in traps. Trapped birds were aged according to Prater et al. (1977). Data from catching were used to show the age structure of Redshanks migrating in subsequent five-day periods (pentades). The standard pentade scheme was applied (Berthold 1973).

In the Gulf of Gdańsk, 107 direct ringing recoveries were obtained till 1997, including 11 birds ringed as pulli or juveniles northwards from study area and 96 direct recoveries of juvenile birds ringed in the Gulf of Gdańsk. The direct recovery was defined as a recovery obtained during the same autumn migration period in which the bird was ringed, or during the following winter. Each localisation of ringing recovery was allocated

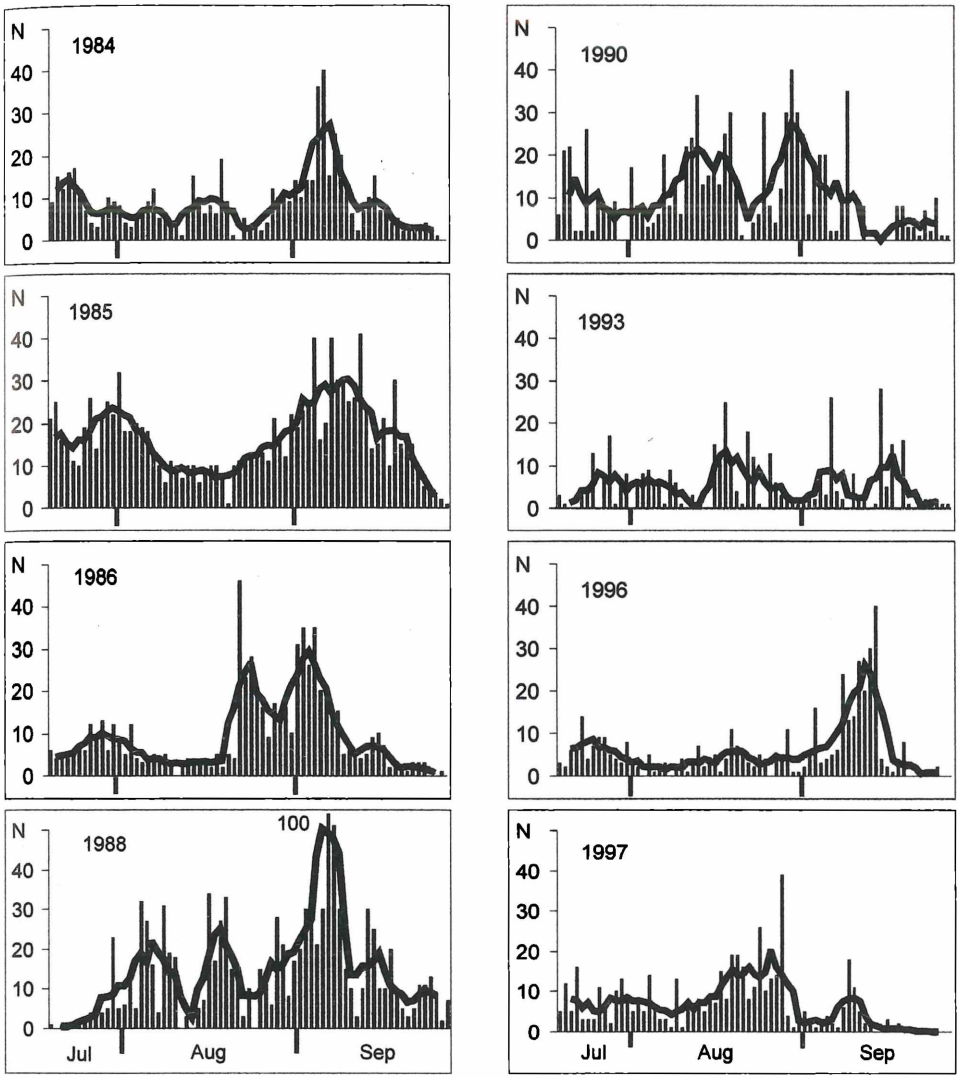

Fig. 2: Phenology of Redshanks autumn migration in different seasons at Jastarnia and at Reda mouth. Columns – number of birds in particular day, line – 5 days running average.

Abb. 2 Phänologie des Rotschenkelwegzuges in verschiedenen Jahren in Jastarnia und an der Redamündung. Säulen – Anzahl Vögel an einzelnen Tagen, durchgezogene Linie – Fünftagesmittelwerte.

to a coastal or an inland area. Coastal area was defined as a 50-km wide zone along the seacoast of Baltic, the North Sea and Atlantic. The inland area includes the interior of the continent east of the German-French border. Birds recovered in the eastern part of the Mediterranean were assumed to fly inland over Central Europe and they were included into the latter group. Recoveries from southern France were treated as "uncertain", because these birds could have followed the seacoast of Spain and Portugal as well as they could have skipped over the French inland.

Acknowledgements: The study was undertaken by the Waterbird Research Group KULING. I am grateful to all colleagues from WRG KULING, who helped in the fieldwork. Volker DIERSHKE and Alexander CZAJKOWSKI kindly relayed their unpublished data about Redshank migration in the wind flat at the island of Hiddensee (Wismar Bay) and in French inland. Frederic CHEVALIER send information about terms of hunting season in France. Jaga GROMADZKA and the staff of the Polish Ringing Centre made available data about Redshanks caught at the Vistula mouth. Magda REMISIEWICZ corrected the English.

3. Results

At the first sight, it seems that among the studiedš season, the dynamic of migration differed markedly (Fig. 2). However, in the majority of years, the pattern showed a clear wave structure, especially when 5-day running average was applied (Fig. 2). The sets of subsequent days with high number of Redshanks present at study area (migration waves) were more or less distinctly separated by days with low numbers of birds. It was especially conspicuous in seasons with high number of migrants. In 1986, 1988 and 1990, three distinct waves appeared while in 1993 – four waves were noted. In 1985, two waves were separated by a long period of low number of birds, and in 1984 a series of short increases and decreases of Redshank number appeared before the September peak. Only in 1996 and 1997 the wave structure was unclear.

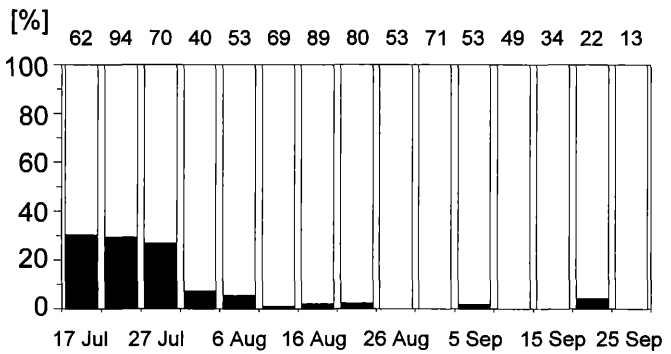

Fig. 3: Age structure of caught Redshanks in subsequent pentades. Black – adults, white – juveniles. The sample sizes were shown above the columns.

Abb. 3 Altersstruktur gefangener Rotschenkel in aufeinanderfolgenden Pentaden. Schwarz – Adulte, weiß – Juvenile. Stichprobengrößen über den Säulen.

It is noteworthy that in the majority of the seasons the main peak of migrants' number appeared in September (1984, 1985, 1986, 1988 and 1996) or at the end of August (1990 and 1997). In the second half of September, often an additional, small increase of Redshank number was noted.

In the second half of July, adults constituted about 30% of caught Redshanks (Fig. 3). In August and September, adults were caught only occasionally. The latest one was noted on 21.09.86 at Jastarnia. Thus, the presented migration pattern concerned almost exclusively juveniles.

The analysis of recoveries showed that birds caught in the Gulf of Gdańsk belong to both "northern" and "southern" populations (Fig. 4). There was a significant correlation between the latitude of ringing place and the time of arrival to the Gulf of Gdańsk ($r = 0.84$, $n = 11$, $t = 4.73$, $p < 0.002$). The more northern the ringing place the later was the arriving date. During migration, the proportion of birds using the inland route decreased in subsequent decades (Fig. 5). In the third decade of August only one ringed Redshank was recovered inland. Thus, for the presentation of the migration direction, all recoveries were divided into two groups – birds ringed in July and in the first two decades of August and individuals ringed in the third decade of August and in September (Fig. 6).

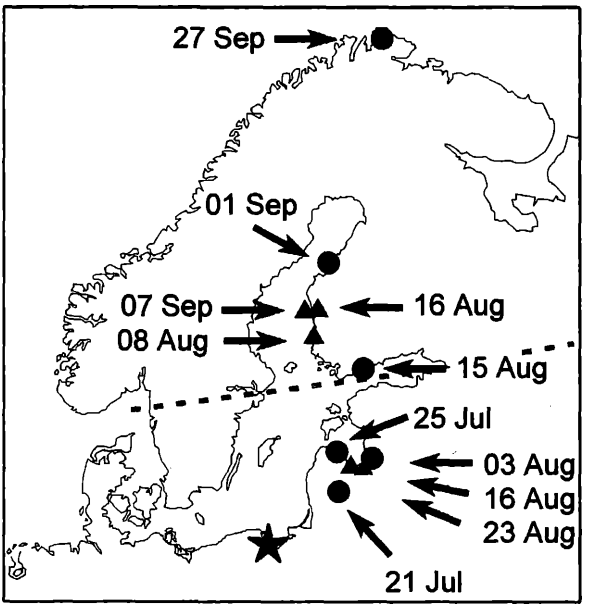

Fig. 4: Ringing places of Redshanks caught in the Gulf of Gdańsk ringed northwards from the Gulf of Gdańsk. Dots – bird ringed as a pullus, triangles – bird ringed as a juvenile. Dates denote date of recovery in the Gulf of Gdańsk. Broken line indicates the approximate border between "northern" and "southern" population (after Meltofte 1993). All birds were recovered within the same autumn season after ringing.

Abb. 4 Beringungsorte von in der Danziger Bucht gefangenen Rotschenkeln, die nördlich der Fangorte beringt wurden. Punkte – Vogel als pullus beringt, Dreiecke – Vogel als Juveniler beringt. Datumsangaben: Tag des Wiederfangs in der Danziger Bucht. Die gestrichelte Linie gibt die ungefähre Grenze zwischen der "nördlichen" und der "südlichen" Population an (nach MELTOFTE 1993). Alle Vögel wurden im selben Herbst des Beringungsjahres wiedergefangen.

Redshanks passing the study area from mid-July to 20 August migrated over inland as well as along the coast, whereas those from the last decade of August and from September flew almost exclusively along the coast. The recovery rate of juvenile birds differed significantly in subsequent half-month periods (Chi-square test, $\chi^2 = 13.3$, df = 4, $p < 0.01$). It reached the highest value in the second half of July (10,7%) and later on decreased to 3.2% in the second part of September (Fig. 7).

3.1. Migration speed

Eleven juvenile Redshanks were recovered within one week after ringing in the Gulf of Gdańsk. Three of them were recorded after one day over 1000 km apart from the place of ringing. The average migration speed of the next six ones exceeded 500 km/day. On the other hand, 23% of juveniles were reported from a distance shorter than 1000 km after 10–31 days.

3.2. Circumstances of recoveries

Among 96 juveniles recovered during their first autumn and first winter 62 were shot, 11 found dead and 23 caught and released (controlled) (Fig. 8). The shot birds were reported only from France, Italy and Greece, but some birds included in the group "found dead" in fact could have been

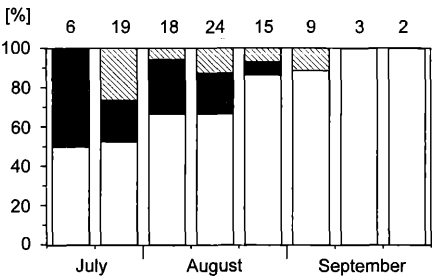

Fig. 5: Distribution of juvenile Redshank recoveries in subsequent decades. White columns – recoveries from coastal zone, black columns – recoveries from inland, hatched columns –"uncertain". X axis refers to the date of ringing at the coast of the Gulf of Gdańsk.

Abb. 5 Verteilung der Wiederfunde iuveniler Rotschenkel in aufeinanderfolgenden Dekaden. Weiße Säulen – Wiederfunde im Küstenbereich, schwarze Säulen – Wiederfunde im Binnenland, schraffierte Säulen – „unbestimmt". X-Achse: Beringungszeitpunkt im Küstenbereich der Danziger Bucht.

shot. In these three countries the proportion of hunted Redshank is very high. All the birds reported from Italy and Greece were shot, as well as 87% of those from France.

4. Discussion

On the Gulf of Gdańsk coast there was not any other area where Redshank appeared in high numbers. Thus, the presented migration pattern is representative for the whole area of the Gulf of Gdańsk.

4.1. The cause of wave migration pattern

The wave-like seasonal migration pattern was described in many species, also in waders (KANIA 1981, MAKSALON 1983, BRENNING 1986, GROMADZKA 1987, TIEDEMANN 1992). It could be caused by different factors (DOLNIK 1975, BUSSE 1996). The regular wave-like changes in number of migrants recurring every year may reflect differences in timing of migration of various population (BUSSE 1996), differences in weather conditions on route, preceding a particular research point (ALERSTAM 1993) or, the most probably, both of them. In many wader species older birds migrate before juveniles and this phenomenon could be also a reason of a wavy-like migration pattern (MEISSNER & SIKORA 1995). Only during the first two weeks of the birds' passage in the study area adults formed less than 30% of the Reshank number. Thus, the observed changes in migrants number concerned juveniles, not the adults. In case of Redshank passing the Gulf of Gdańsk we came across different populations (at least two: "northern" and "southern"), which differ in biometrics and in the migration time (MELTOFTE 1993, MEISSNER 1999). The differences in timing of migration of these groups are probably the main purpose of observed wave structure of Redshank migration. The beginning of egg laying in northern Fennoscandia took place about 3–4 weeks later than in the southern part of this vast area (GLUTZ et al. 1975). The time span between "waves" in the years 1986, 1988 and 1990 (when the "waves" were most distinct) lasted from 12 to 19 days. It coincided well with what was expected from the difference in breeding time. Weather conditions occurring both in breeding areas and on route, probably also determine the observed "wavy" pattern. If deterioration of weather conditions northwards or north-eastwards from study area stopped migration, it could affect time of occurrence of the particular wave in the Gulf of Gdańsk. In some cases the wave may be split and instead of one, two or three smaller "waves" could be observed. The breeding phenology of each of the populations is also caused by weather conditions, which could be different in distant breeding areas.

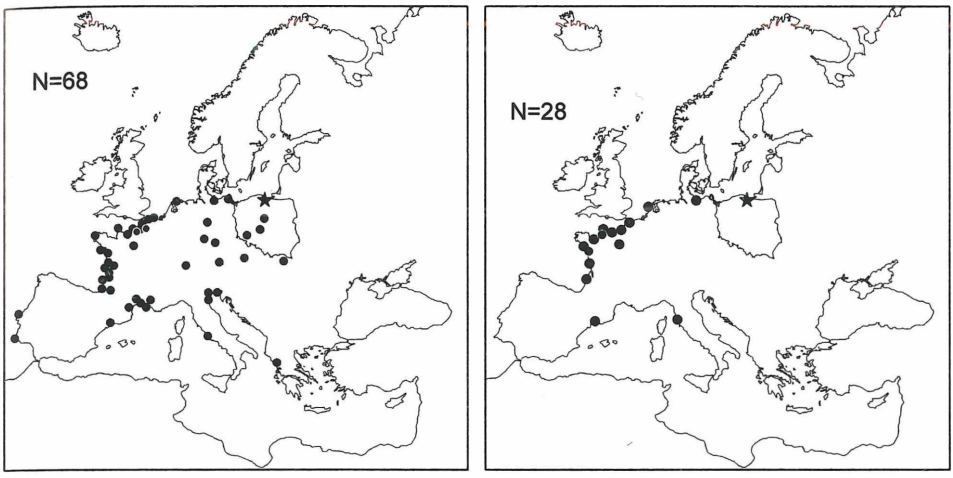

Fig. 6: Localisation of direct recoveries of juvenile Redshanks ringed in the Gulf of Gdańsk between 15 July and 24 August (left panel) and between 25 August and 30 September (right panel). Asterisk – the Gulf of Gdańsk.

Abb. 6: Fundorte „direkter" Wiederfunde juveniler Rotschenkel, die in der Danziger Bucht zwischen dem 15. Juli und 24. Aug. (links) und zwischen 25. Aug. und 30. Sept. beringt wurden. * – Danziger Bucht.

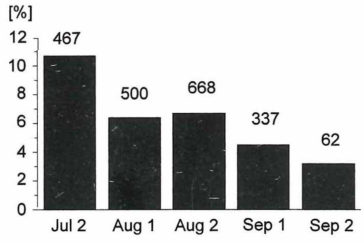

Fig. 7: Recovery rate of Redshanks ringed in the Gulf of Gdańsk in subsequent half-month periods. Numbers above columns denote total of Redshanks ringed in a given period.

Abb. 7: Wiederfundrate von in der Danziger Bucht beringten Rotschenkeln in aufeinanderfolgenden halbmonatlichen Perioden. Gesamtzahl aller in der jeweiligen Periode beringten Rotschenkel über den Säulen.

Moreover, local conditions at the Gulf of Gdańsk may affect the dynamics of migration seriously. There are no tides in the southern Baltic, but direction and strength of the wind often cause rapid changes of water level. When feeding areas remain under high water for many days, birds move elsewhere, like in September 1997 at Reda mouth, such conditions lasted for almost one month. However, such long periods of high water occurred rarely in summer and early autumn and migration patterns do not merely reflect the variability of the habitat at the study site. Variability of phenology and dynamic of autumn migration, similar to those noted in the Gulf of Gdańsk, was described by BRENNING (1986), GIRARD (1989), and DIERSCHKE (in litt.).

4.2. Interseasonal changes in the number of migrants

The number of juvenile Redshanks migrating in particular time in given year reflect the breeding success of certain population and that is why sometimes some of "waves" seem to disappear in the season when the number of fledglings was very low. It is worth noticing that the highest number of juvenile "northern" Redshank was noted in 1988, when also other waders which came from the tundra zone had high breeding success (MEISSNER & SIKORA 1995).

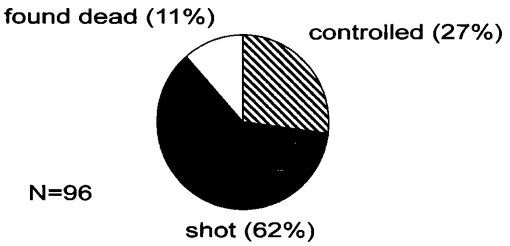

Fig. 8: Circumstances of recoveries of juvenile Redshanks ringed in the Gulf of Gdańsk.

Abb. 8: Fundumstände, die Wiederfunde in der Danziger Bucht beringter juveniler Rotschenkel betreffend.

4.3. Migration dynamics

The highest number of Redshanks in the study area was usually noted in September. However, in other places in Western Europe (where the Icelandic population does not occur) the number of Redshanks rapidly decreases on the turn of August and September or even earlier (BRUCH & LÖSCHAU 1971, GLUTZ et al. 1975, WARTHOLD 1986, GIRARD 1989, SCHIMMELPFENNING 1991, HÖTKER & KÖLSCH 1993, MELTOFTE 1993). It is worth to point out that in Ottenby (southern Sweden), which is localised only about 350 km northwards from the study area, the autumn migration of Redshank finished very early, about the second decade of August (GLUTZ et al. 1975). This suggests that September migrants might not come to the Gulf of Gdańsk directly from the southern Scandinavia, but probably from more north-eastern part of Europe. They continue their migration along the coast of the southern Baltic and southern North Sea. Because huge numbers of Icelandic Redshank T. t. robusta arrive in August and September in the North Sea coast (MELTOFTE et al. 1994), the appearance of birds which constitute the September wave in the Gulf of Gdańsk may be not noticed farther to the west. In eastern and south-eastern Europe, Redshanks reach the maximum of autumn migration in September as well (KOZLOVA 1961, DIMITRIJEVIČ 1976–77). Their origin is unknown, but they probably come from more eastern part of Russia (KOZLOVA 1961, GROMADZKI 1985).

4.4. Ringing recoveries

Recoveries analysed in this study suggest that Redshanks migrating through the Gulf of Gdańsk spend the winter in Western Europe (4 winter recoveries from northern France and southern England and 1 from central France) and in the Mediterranean (3 winter recoveries from southern France, northern Italy and northern Morocco). Many of them have to migrate also to West Africa, where the majority of Fenno-Scandian Redshanks spend the winter (GLUTZ et al. 1975), but a chance to obtain a recovery from that area is lower. Decrease of the recovery rate as season progress suggests that the proportion of Redshanks wintering in Africa increases gradually and the September migrants do not spend winter in Europe at all, which is in agreement with the results of extensive ringing recovery analysis made by SALOMONSEN (1954) and HALE (1973). The proportions of shot birds among recoveries collected in subsequent half-month periods do not differ significantly (G-test, $G = 0.65$, $p > 0.05$). Thus, it could not have serious influence on obtained results.

The obtained results confirmed the fundamental study of SALOMONSEN (1954) about the leapfrog migration of European Redshanks. In July and in the first two decades of August juvenile Redshanks from "southern" population passed through the study area. They migrated both over inland and along the seacoast and the majority of them stayed in Europe for wintering. Late August and September migrants, which constituted main migration peak of juveniles in the Gulf of Gdańsk, followed exclusively the coasts of Baltic and of the North Sea. These birds belong to the "northern" population and they pass Europe finishing the migration in Africa.

It is difficult to explain why late migrants did not stop at inland stop-over places, as earlier ones do. The differences in the hunting season in France cannot explain this as hunting on the coast used to commence earlier (around late July) than in the inland territories (mainly August/September or

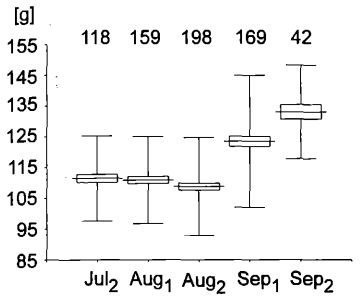

Fig. 9: The average body mass of juvenile Redshanks caught in the Gulf of Gdańsk in subsequent half-month periods. Horizontal line –average, rectangle – standard error, vertical line – standard deviation. Numbers above indicate sample sizes. Birds from the first and the second half of September were significantly heavier than those from the other half month periods (ANOVA, $F_{4,681} = 33.4$, $p < 0.05$ & Tukey's test for unequal N, $p < 0.001$).

Abb: 9 Mittleres Körpergewicht juveniler, in der Danziger Bucht gefangener Rotschenkel in aufeinanderfolgenden Halbmonats-Perioden. Waagerechte Linie – Mittelwert, Rechteck – Standardfehler, senkrechte Linie – Standardabweichung. Obere Zahlen geben Stichprobengröße an. Vögel der ersten und zweiten Septemberhälfte waren signifikant schwerer als solche aus anderen Halbmonatsabschnitten (ANOVA, $F_{4,681} = 33.4$, $p < 0,05$. Turkey's test für ungleiche Stichprobengrößen, $p < 0,001$).

even later) (F. CHEVALIER – in litt.). It is hard to believe that there is some crucial difference in food abundance in European wetlands between August and September. According to A. CZAJKOWSKI (pers. comm.) very few Redshanks cross the French inland during autumn migration when the mass number pass along the coast. Inland stop-over places in autumn probably offer worse conditions comparing to tidal areas of the North Sea and to the east Atlantic. Thus, some of late migrants wintering mainly in Africa follow the coastal route, because they need to forage in rich feeding areas to deposit sufficient fat reserves for the next migration step. Those, which accumulated large amount of fat at the study area, could fly directly to Africa without additional stop inland. The earlier migrating Redshanks finishing their migration in Western Europe or Mediterranean basin do not need to carry large fat reserves.

4.5. Migration speed and theoretical flight range

Several recoveries indicate a very fast migration of juvenile Redshanks (GLUTZ et al. 1975, GROMADZKI 1985, and this study), but it is probably not a general rule. Many birds migrate by short "jumps", while those with large fat reserves are able to reach distant areas in one step. When comparing the average body mass of juvenile Redshanks caught in the study area in subsequent half-month periods, it turned out that later migrants were significantly heavier than earlier ones (ANOVA, $F_{4,681} = 33.4$; $p < 0.05$) (Fig. 9). Moreover, birds recovered after 1–2 days farther than 1000 km from study area had body mass 7–40g above the average. The rough estimation of the flight range (according to PENNYCUICK 1975) of Redshank weighing between 118 and 148 g (±1 standard deviation from the average value for September migrants) resulted with a distance ranging from 550 to 1800 km. It means that the majority of September migrants are able to reach the Wadden Sea region in one step (600–700 km in straight line) and the heaviest birds can fly over the inland directly to northern Africa. A lack of a regular and prominent peak in the Redshank numbers in September in the western Baltic supports this hypothesis (KOWALSKI 1985, BRENNING 1986, v. DIERSCHKE in litt.).

5. Zusammenfassung

An drei Stellen der Danziger Bucht (Polen) wurden über mehrere Jahre täglich Rotschenkel auf dem Wegzug gezählt. Die Durchzugsmuster unterschieden sich in einzelnen Untersuchungsjahren, zeigten jedoch in der Mehrzahl der Jahre einen wellenförmigen Verlauf. Hier dürften in erster Linie die verschiedenen Durchzugszeitpunkte der beiden im Bereich der Danziger Bucht durchziehenden Populationen (eine "nördliche" und eine "südliche") verantwortlich sein, die sich zudem in den Körpermaßen unterscheiden. Auch Wetterbedingungen,

sowohl in den Brutgebieten als auch am Zuge, haben vermutlich einen deutlichen Einfluß auf das beobachtete mehrgipflige Zugmuster.

Wie die Analyse der Wiederfunde beringter Vögel erbrachte, ziehen in den ersten zwei Augustdekaden diesjährige Vögel der "südlichen Population" durch das Untersuchungsgebiet und folgen dabei sowohl der Küstenlinie der Ostsee als auch binnenländischen Zugrouten. Die Mehrheit dieser Vögel überwintert in europäischen Ruhezielen. Ende August und im September erfolgt der Hauptdurchzug diesjähriger Rotschenkel im Bereich der Danziger Bucht. Sie folgen ausschließlich den Küstenlinien von Nord- und Ostsee und gehören offenkundig der "nördlichen" Population an, mit Ruhezielen in Afrika. Mit größeren Fettreserven als die zeitiger durchziehenden ausgestattet, dürfte die Mehrzahl dieser Vögel auf direktem Wege in die Nordsee-Wattenregion oder gar bis in den Mittelmeerraum ziehen. Die schwersten Vögel erreichen die afrikanischen Ruheziele wohl im Nonstopflug.

6. References

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