

AUTUMN MIGRATION OF WADERS (*Charadrii*)
AT THE REDA MOUTH (N POLAND)

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ABSTRACT

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The migration of waders was investigated at the Reda mouth (Polish Baltic coast) between 1996 and 2001. During the study 496 counts were conducted in the period between 5 July and 5 October. The most numerous species observed were: the Lapwing (*Vanellus vanellus*) – 39.5% and Dunlin (*Calidris alpina*) – 29.8% of all waders. Because of a variety of habitats in the Reda mouth region, among the waders staging numerous in the Reda mouth there were species typical both for coastal and inland habitat. It was shown that birds from tundra zone migrated later than those from more southern breeding areas, which was caused by much later beginning of egg laying in northern latitudes. Moreover, in the species from tundra zone, e.g. the Knot (*Calidris canutus*), Little Stint (*C. minuta*), Curlew Sandpiper (*C. ferruginea*), the migration of both age classes were well separated, whereas in those from more southern areas, e.g. the Little Ringed Plover (*Charadrius dubius*), Common Sandpiper (*Actitis hypoleucos*), such difference was less pronounced and the period of common passage of adults and juveniles was much longer. A comparison of the obtained data on migration pattern with some other sites in Poland where regular counts were conducted showed several similarities and some discrepancies, which are discussed in the paper.

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Key words: autumn migration, waders, *Charadrii*, Poland

INTRODUCTION

During autumn migration mouths of rivers Vistula and Reda are two most important stopover sites for waders within the western part of the Gulf of Gdańsk (Gromadzka 1998, Meissner and Remisiewicz 1998). These areas are protected as nature reserves and were included into NATURA 2000 European ecological network with regard to their importance for waterbirds. Studies on wader migration in the Reda mouth region organized by WRG KULING were conducted in 1983-1986 and 1990-2002 (WRG Kuling 1985, Meissner *et al.* 2002). In this period different research projects regarding waders that stopped there for refueling were realized. However, data from regular daily counts have not been published up to now, except for some papers describing migration pattern of particular species (*e.g.* Meissner 1996, 1997a, 2000, 2006; Meissner and Strzałkowska 2006).

This is the first paper showing the species structure and migration phenology of waders in the region of the Reda mouth. Up to now the only published data on migration phenology of waders at the Polish Baltic coast considered the area near Jastarnia on the Hel Peninsula, where field studies were conducted between 1984 and 1989 (Meissner and Sikora 1995). The distance in straight line between the Reda mouth and Jastarnia is about 14 km and the data from this site were used for some comparisons with those obtained in the Reda mouth.

STUDY AREA AND METHODS

Data for this study were collected between 1996 and 2001 in the mouth of the Reda (54°39'N, 18°30'E) in the Puck Bay on the Baltic coast of Poland (Fig. 1). Waders foraged or rest on narrow sandy beaches, temporary emerging sandy islets or at the ash dumping place of the electric power station. Daily counts were conducted about midday in all these places. It was possible to count waders at a close range, so it was easy to determine the exact number of birds as well as their species and age from plumage characteristics. Data on age structure of species with only slight age differences in plumage were taken from trapping results. During the study a set of 30-40 medium-size walk-in traps spread across the foraging area was maintained every day from dawn to dusk and controlled every two hours.

The period covered by counts lasted from 5 July to 5 October. In total 496 counts were done. Counts from all years were combined. For most days six counts were done over the years, but at the beginning and at the end of the studied period the counts were fewer (Fig. 2). For each day the mean and the maximum number of birds of all years were taken to show migration dynamics. To show differences in migration phenology between species, the median day of migration, first and third quartiles as well as 5 and 95 percentiles were calculated. More detailed analyses of migration dynamics and migration phenology were undertaken only for numerous species.

There were a few breeding pairs of the Ringed Plover (*Charadrius hiaticula*), Little Ringed Plover (*Ch. dubius*), Redshank (*Tringa totanus*), Lapwing (*Vanellus vanellus*) and Dunlin (*Calidris alpina*) around the study area. Despite their low number the

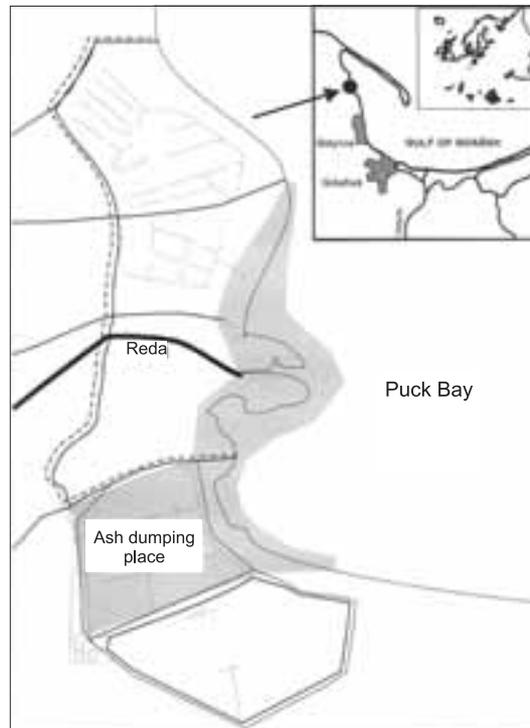


Fig. 1. Location of the study site, area covered by counts shaded grey

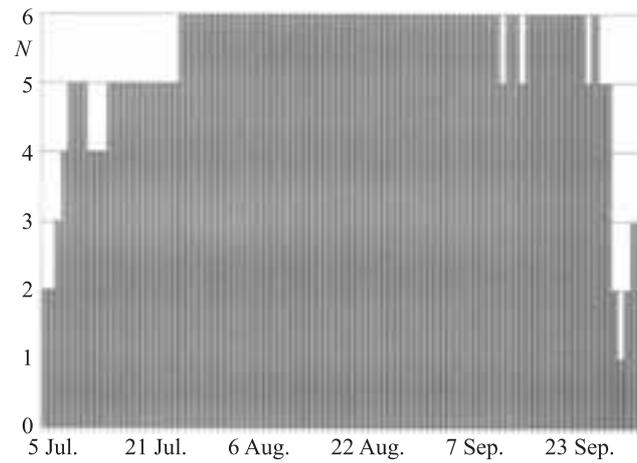


Fig. 2. Total numbers of counts in subsequent days of the studied period

long presence of local birds may have influenced the migration pattern described in this study, especially at initial phase of the passage.

RESULTS

Species composition

During six years of study 28 waders species were noted during regular counts. The apparent dominants were the Lapwing and Dunlin, which comprised respectively almost 40% and 30% of all waders in the study area (Table 1). Among species which exceeded 1% of dominance there were those that migrate mainly through the costal areas, like the Knot (*Calidris canutus*), Grey Plover (*Pluvialis squatarola*), Curlew Sandpiper (*Calidris ferruginea*) and also such waders as the Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), Ruff (*Philomachus pugnax*) and Common Snipe (*Gallinago gallinago*), which are observed during migration mostly in inland habitats.

Table 1

Species structure and numbers of waders. *N* – number of counted individuals in all seasons, *D* - dominance of each species, + - dominance below 0.1%.

	<i>N</i>	<i>D</i> (%)
<i>Vanellus vanellus</i>	56717	39.5
<i>Calidris alpina</i>	42831	29.8
<i>Tringa glareola</i>	5672	4.0
<i>Charadrius hiaticula</i>	5640	3.9
<i>Calidris ferruginea</i>	4603	3.2
<i>Calidris minuta</i>	4144	2.9
<i>Pluvialis apricaria</i>	3767	2.6
<i>Actitis hypoleucos</i>	3211	2.2
<i>Pluvialis squatarola</i>	1984	1.4
<i>Gallinago gallinago</i>	1944	1.4
<i>Philomachus pugnax</i>	1819	1.3
<i>Calidris canutus</i>	1506	1.0
<i>Tringa totanus</i>	1461	1.0
<i>Tringa nebularia</i>	1239	0.9
<i>Limosa lapponica</i>	1139	0.8
<i>Charadrius dubius</i>	1007	0.7
<i>Haematopus ostralegus</i>	864	0.6
<i>Numenius arquata</i>	845	0.6
<i>Calidris temminckii</i>	777	0.5
<i>Calidris alba</i>	615	0.4
<i>Tringa erythropus</i>	591	0.4
<i>Tringa ochropus</i>	373	0.3
<i>Numenius phaeopus</i>	258	0.2
<i>Limicola falcinellus</i>	211	0.1
<i>Arenaria interpres</i>	185	0.1
<i>Phalaropus lobatus</i>	88	0.1
<i>Limosa limosa</i>	23	+
<i>Lymnocyptes minimus</i>	16	+
Total	143530	100.0

Migration dynamics and age structure

Oystercatcher (*Haematopus ostralegus*). Regular migration of this species had not been observed. In most cases only a few birds were seen in the study area. However, on 16 Aug. 1997 a flock of 230 birds was recorded.

Lapwing (*Vanellus vanellus*). This species was present in the Reda mouth from the beginning of the studied period (Fig. 3). The highest daily mean numbers of this species were noted in July and the biggest flock of 1030 individuals was recorded on 20 Aug. 1997. Migration pattern was irregular with rapid changes of bird numbers in subsequent days. Lapwings appeared in the study area about midday and formed typical resting flock. They spent the rest of the day in adjacent meadows and fields.

Golden Plover (*Pluvialis apricaria*). The earliest record took place on 11 Jul. and the median date of first records fell on 15 Jul. Until mid-August only single birds were noted (Fig. 3). In September it was noted irregularly, however sometimes its number exceeded 100 birds. The biggest flock was observed on 24 Aug. 1998 – 317 indiv. Golden Plovers were most often observed in mixed flocks with Lapwings.

Grey Plover (*Pluvialis squatarola*). First bird was noted on 11 Jul. 1998 and the median of first records fell on 16 Jul. Grey Plovers appeared more numerous from the turn of July (Fig. 3). The earliest observation of a juvenile bird took place on 6 Aug. 1996 – 1 indiv. From the first decade of August the proportion of first year birds increased gradually, however, they did not outnumber adults until mid-September (Fig. 5). Migration dynamics showed two waves of migrants. In the first, which lasted until the end of August, adult birds were much more numerous than juveniles, whereas from mid-September almost exclusively juveniles were observed within the second wave. The last record of adult bird took place on 29 Sep. 1998 – 1 indiv. The high mean number of Grey Plovers on 8 Sep. resulted from observation of a single flock of 62 birds in 2000, which was the biggest flock of Grey Plovers noted in the study area. At the end of the studied period the number of Grey Plovers was still high.

Ringed Plover (*Charadrius hiaticula*). The highest numbers of Ringed Plovers were noted in August with the biggest flock of 97 indiv. observed on 18 Aug. 1997. Mean numbers of birds in this month showed two peaks. The first one was formed by adults, whereas the second one – by juveniles (Fig. 3). From mid-September almost exclusively juveniles were observed (Fig. 5).

Little Ringed Plover (*Charadrius dubius*). There were several peaks of number of this species. The autumn passage was the most intensive between the second decade of July and the first decade of August (Fig. 3). Juveniles were observed from the beginning of studied period, but most probably they were individuals from local breeding population. The percentage of juveniles increased gradually and in mid-September no adults were observed (Fig. 5). The last record of an adult bird was on 9 Sep. 1998.

Jack Snipe (*Lymnocyptes minimus*). It was observed rarely. The earliest observation was made on 23 Aug. 1999 – 1 indiv., the latest on 28 Sep. 2000 – 7 indiv.

Common Snipe (*Gallinago gallinago*). Appeared not numerous and irregularly within the whole studied period. Exceptionally high concentration of Common Snipes was observed on 3 Sep. 2000 – 166 indiv. The main feeding area of this species was located outside the study area in wet meadows of the Beka nature reserve.

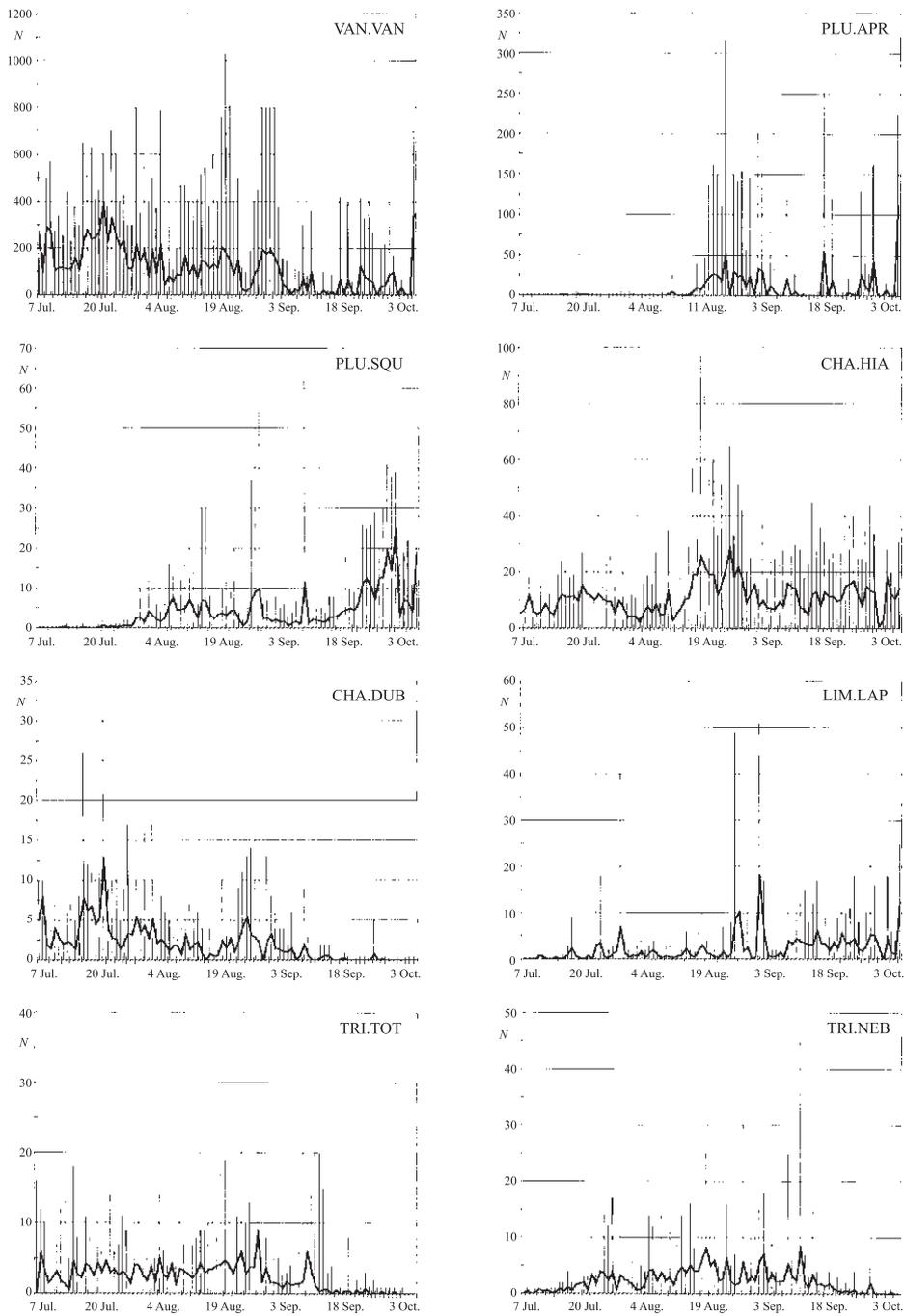


Fig. 3. Migration dynamics of some wader species at the Reda mouth: the Lapwing (VAN.VAN), Golden Plover (PLU.APR), Grey Plover (PLU.SQU), Ringed Plover (CHA.HIA), Little Ringed Plover (CHA.DUB), Bar-tailed Godwit (LIM.LAP), Redshank (TRI.TOT), Greenshank (TRI.NEB). Line – average numbers, bars – maximum numbers of birds on given days.

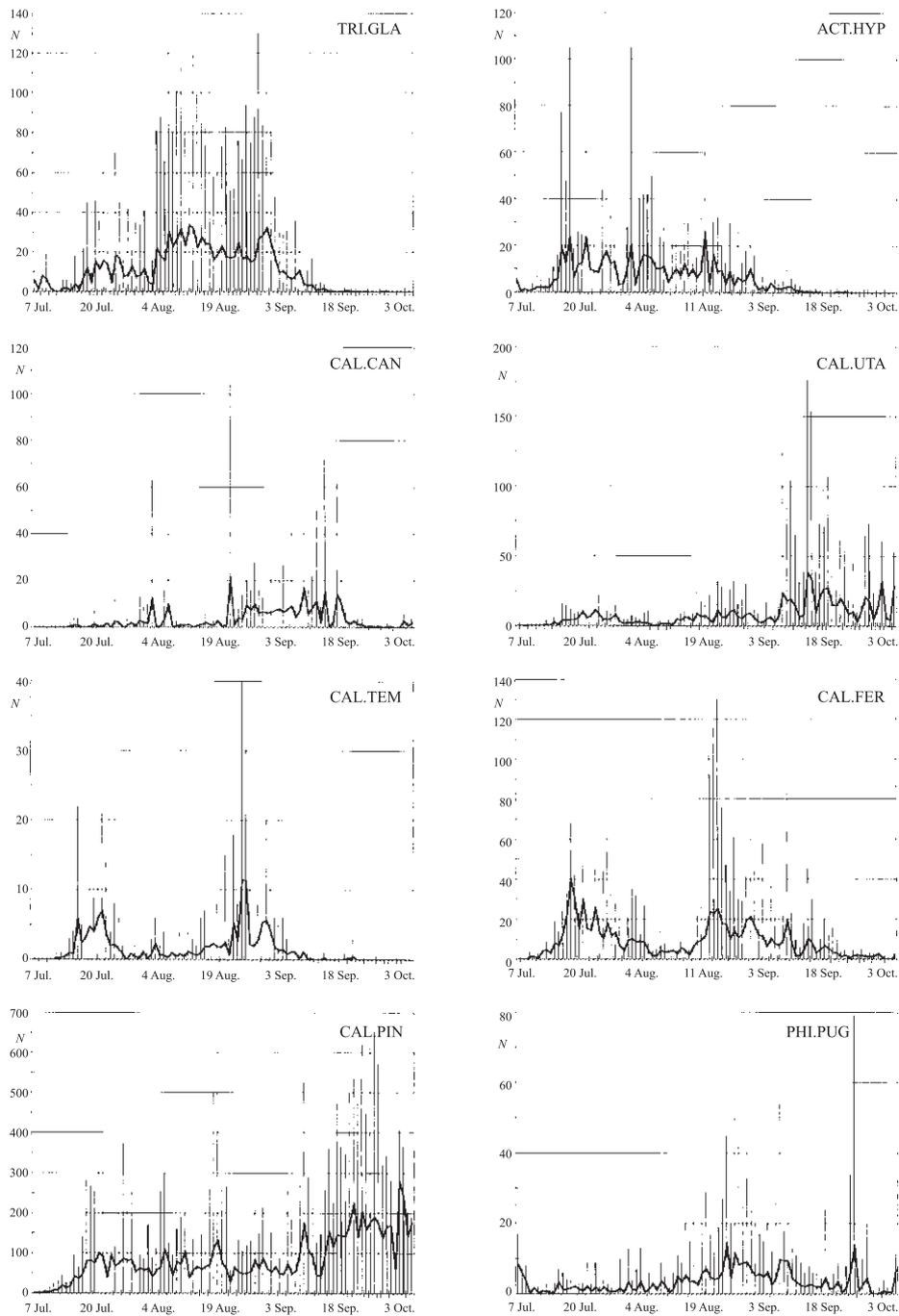


Fig. 4. Migration dynamics of some wader species at the Reda mouth: the Wood Sandpiper (TRI.GLA), Common Sandpiper (ACT.HYP), Knot (CAL.CAN), Little Stint (CAL.UTA), Temminck's Stint (CAL.TEM), Curlew Sandpiper (CAL.FER), Dunlin (CAL.PIN), Ruff (PHI.PUG). Line – average numbers, bars – maximum numbers of birds on given days.

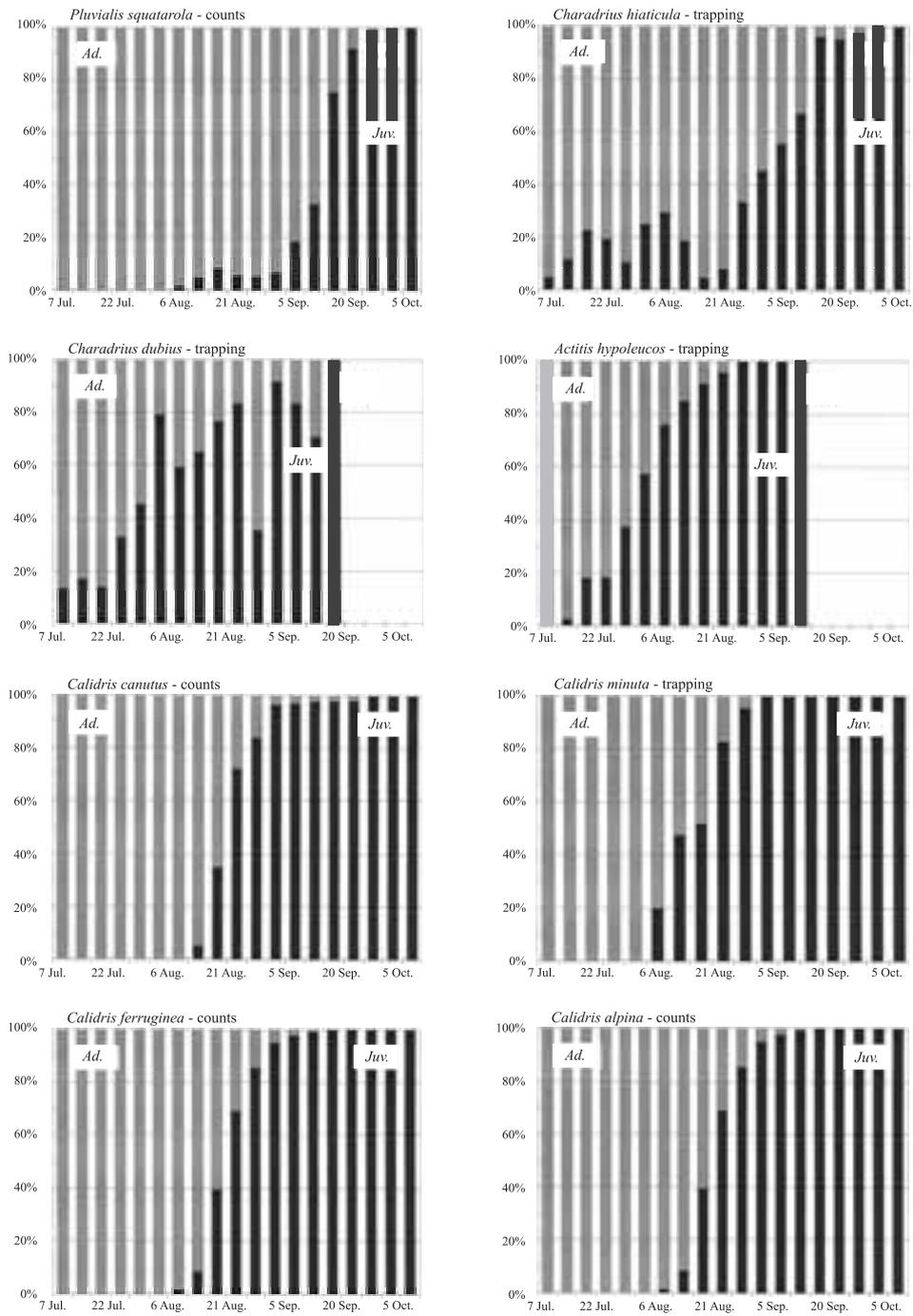


Fig. 5. Percentage of adults and juveniles in subsequent pentades taken from visual counts and trapping

Black-tailed Godwit (*Limosa limosa*). The earliest observation was done on 23 Jul. 1998 – 2 indiv., the latest on 3 Aug. 1999 – 1 indiv. Exceptionally, on 1 Aug. 1999 a flock of 16 birds was observed, which was more than 50% of all the Black-tailed Godwits recorded during the study.

Bar-tailed Godwit (*Limosa lapponica*). The first record of this species took place on 9 Jul. – 3 indiv. in 1997 and 1 indiv. in 1998. The median date of first records fell on 10 Jul. More numerous Bar-tailed Godwits were observed in two periods: in July and from the third decade of August to the end of the studied period (Fig. 3). The biggest flocks were seen on 9 Sep. 2001 (51 birds, mainly juveniles) and 29 Jul. 1996 (40 adults). In July and at the beginning of August only adult birds were recorded. Juveniles started to arrive about mid-August. Last adults were noted on 7 Sep. 2001 – 2 indiv.

Whimbrel (*Numenius phaeopus*). The earliest record of this species took place on 5 Jul. 1999. The median date of first observations fell on 9 Jul. About 80% of Whimbrels noted within the studied period were observed in July. In August the number of Whimbrels decreased and the latest record of this species was on 10 Sep. 1999 – 2 indiv.

Curlew (*Numenius arquata*). It was recorded during the whole studied period. More than a half of birds (52%) were observed in the second and third decade of August. The biggest flock consisting of 55 birds was noted on 20 Aug. 1996.

Spotted Redshank (*Tringa erythropus*). This species was recorded during the whole studied period. The biggest flocks of adults consisting of 30 indiv. was observed on 24 Jul. 2000. The highest numbers of juveniles were noted in the first half of September and the biggest flocks of juveniles were observed on 7 and 14 Sep. 1996 – 22 indiv.

Redshank (*Tringa totanus*). There were no clear peaks in migration pattern of this species (Fig. 3). The highest concentrations of Redshanks were observed in the third decade of August with the biggest flock of 39 birds on 28 Aug. 1997 and in the turn of the first decade of September. From mid-September almost exclusively single birds were noted.

Greenshank (*Tringa nebularia*). This species was noted during the whole studied period. First peak of its number was observed in the second half of July with maximum number of 17 indiv. on 27 Jul. 2001. There was an apparent decrease of the Greenshank numbers in the turn of July followed by an increase in mid-August (Fig. 3). The biggest flock was noted on 11 Sep. 1996 – 45 indiv. In the second half of September the numbers of Greenshanks were very low.

Green Sandpiper (*Tringa ochropus*). The migration of this species started as early as at the beginning of studied period. Up to the end of the second decade of August about 77% of all individuals noted during the study were observed. The last record of the Green Sandpiper took place on 22 Sep. 1996 – 1 indiv.

Wood Sandpiper (*Tringa glareola*). This species was present in the Reda mouth from the beginning of the studied period. Two main waves of migrants were noted – the first in July and the second in August and beginning of September (Fig. 4). Within the second wave two peaks of number were observed: first one in the first half of August and second at the end of August. The percent of adults in catches decreased rapidly from mid-July. Last adults were caught in mid-August. Maximum numbers of Wood Sandpipers observed in the study area exceeded 100 birds, e.g. 130 indiv. on 29

Aug. 1997, 120 indiv. on 7 Aug. 1997. The latest record of this species considered a single bird seen on 29 Sep. 1996.

Common Sandpiper (*Actitis hypoleucos*). In the first decade of July only a few birds were observed. Migration started about mid-July and the number of migrants varied (Fig. 4). Sometimes the numbers of Common Sandpipers exceeded 100 birds, e.g. 105 indiv. on 18 Jul. 1999 and 2 Aug. 1997, while on other days were very low. The percent of adults decreased continuously from the first decade of July, with last adult birds noted at the beginning of the second decade of August. The latest observations of this species were done on 23 Sep. 1999 and 2001 and in both cases considered two individuals.

Turnstone (*Arenaria interpres*). This species appeared in the Reda mouth in small numbers. The earliest observation was of a single bird seen on 24 Jul. 1997, whereas the latest three birds were noted on 25 Sep. 1996. The maximum number of 22 individuals was recorded on 7 Sep. 2001.

Knot (*Calidris canutus*). The first Knots were noted on 14 Jul. 2000 – 2 indiv. In migration pattern of this species two waves can be noted. The first one lasted from mid-July to the end of first decade of August and consisted mainly of adult birds (Fig. 4). The earliest observations of juveniles took place on 12 Aug. 1996 – 1 indiv. Later, the percent of adults declined rapidly, however, single adults were noted up to the end of the second decade of September with the last record on 18 Sep. 1996 and 2000 – 1 indiv. (Fig. 5). The biggest flock of Knots was noted on 22 Aug. 1999, when 104 birds were observed.

Sanderling (*Calidris alba*). This species was noted in low numbers, except for the autumn of 1996, when 83% of all birds noted during this study were recorded. The first Sanderling was observed on 15 Jul. 1999 – 1 indiv. and the biggest flock consisted of 63 birds on 25 Sep. 1996.

Little Stint (*Calidris minuta*). The earliest observation of the Little Stint took place on 8 Jul. 2000 – 1 indiv. The median date of first records fell on 10 Jul. There were three waves in the migration dynamics of this species (Fig. 4). In the first one, between mid-July and the first days of August, only adults were noted. The second wave consisted of adults and juveniles and lasted from the second decade of August to the beginning of September. Juveniles appeared in last days of the first decade of August and their percentage gradually increased (Fig. 5). In September, within the third wave, only juveniles were noted. In this period the migration of Little Stints was the most intensive. The biggest concentration of 196 indiv. was observed on 14 Sep. 1996. Migration of this species lasted also in October, beyond the studied period.

Temminck's Stint (*Calidris temminckii*). The dynamics of this species migration showed two waves (Fig. 4). The first one lasted from the mid to the end of July, whereas the second – from mid-August to mid-September. Outside these periods only single individuals were observed. The earliest and the latest records took place on 12 Jul. 2000 – 1 indiv. and 21 Sep. 1998 – 3 indiv., respectively. The median date of first records fell on 13 Jul. The biggest flock was noted on 25 Aug. 1999 – 40 indiv.

Curlew Sandpiper (*Calidris ferruginea*). The earliest observations of Curlew Sandpipers took place on 8 Jul. 1998 and 2000 – 4 and 1 indiv., respectively. The median day of first records fell on 9 Jul. There were two waves in migration dynamics of

this species. The first one lasted from mid-July to the first decade of August and consisted mainly of adult birds, whereas in the second – between mid-August and the end of September – mostly juveniles migrated (Fig. 4). The earliest observation of a juvenile bird took place on 5 Aug. 2000. The percentage of juveniles increased rapidly and after 10 Sep. no adults were noted (Fig. 5).

Dunlin (*Calidris alpina*). Migration of this species started at the beginning of the second decade of July. Changes in the mean number of birds in subsequent days were small and there was impossible to distinguish clear pattern of waves in migration dynamics (Fig. 4). The highest numbers of Dunlins were noted in September, with maximum of 654 indiv. on 26 Sep. 1999. Juveniles were recorded from the beginning of the studied period except for two last pentades of July. These first-year birds, observed in the beginning of migration period, belonged to local breeding population of *C. a. shinzii* (Meissner and Strzalkowska 2006). From the beginning of August the proportion of juveniles among migrants increased and their percentage exceeded 50% in the last pentade of August (Fig. 5). Adults were recorded up to the end of the studied period. The numbers of Dunlins at the beginning of October were still high (Fig. 4).

Broad-billed Sandpiper (*Limicola falcinellus*). It was observed irregularly and in small numbers, except for 1996, when 56% of all individuals were noted. The earliest and the latest records took place on 13 Jul. 1998 – 3 indiv. and 13 Sep. 2000 – 1 indiv., respectively.

Ruff (*Philomachus pugnax*). This species was observed from the beginning of the studied period, but its numbers remained low until mid-August (Fig. 4). Between mid-August and mid-September Ruffs were more numerous. The biggest flock (54 indiv.) observed in this period was recorded on 7 Sep. 1997. From the mid-September the numbers of Ruffs were low, except for 1996, when in the third decade of September this species arrived in high numbers, with the biggest flock of 79 indiv. noted on 25 Sep. 1996.

Red-necked Phalarope (*Phalaropus lobatus*). This species was recorded irregularly and not numerous. The earliest and the latest observations of single birds were made on 9 Jul. 1999 and 24 Sep. 1996. The biggest flock of 5 indiv. stayed in the study area on 6 and 7 Sep. 1998.

Migration phenology

According to the median dates of migration, the Little Ringed Plover, Lapwing and Common Sandpiper were among the earliest migrants, whereas the Little Stint, Grey Plover and Sanderling had the latest median dates (Fig. 6). There was a clear tendency that species with breeding areas located far in the north within tundra zone migrated later than those breeding more southerly.

DISCUSSION

Twenty eight wader species were noted in the Reda mouth during regular counts. Two other – the Avocett (*Recurvirostra avosetta*) and Semipalmated Sandpiper (*Calidris pusilla*) – recorded in the studied period beyond the count schedule. In other sites

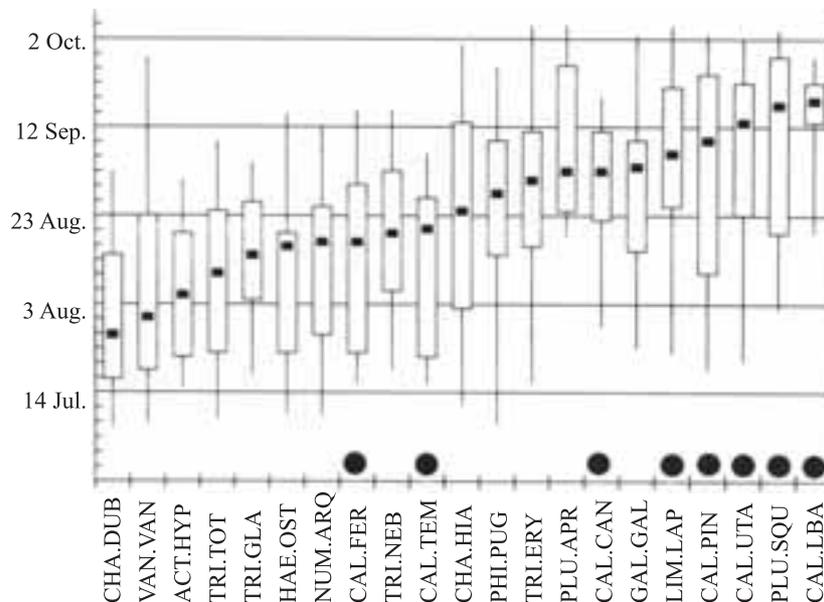


Fig. 6. Phenology of autumn migration of more numerous wader species in the Reda mouth: the Little Ringed Plover (CHA.DUB), Lapwing (VAN.VAN), Common Sandpiper (ACT.HYP), Redshank (TRI.TOT), Wood Sandpiper (TRI.GLA), Oystercatcher (HAE.OST), Curlew (NUM.ARQ), Curlew Sandpiper (CAL.FER), Greenshank (TRI.NEB), Temminck's Stint (CAL.TEM), Ringed Plover (CHA.HIA), Ruff (PHI.PUG), Spotted Redshank (TRI.ERY), Golden Plover (PLU.APR), Knot (CAL.CAN), Common Snipe (GAL.GAL), Bar-tailed Godwit (LIM.LAP), Dunlin (CAL.PIN), Little Stint (CAL.UTA), Grey Plover (PLU.SQU), Sanderling (CAL.LBA). Black Squares – median dates, white bars – interquartile time spans, vertical lines – time when from 5% to 95% migrants passed the study area. Species that breed mainly within tundra zone are marked by black dots.

in Poland, where studies on wader autumn migration were conducted at ash dump for 3 years, similar numbers of species were noted (*e.g.* Lontkowski *et al.* 1988, Kunysz and Hordowski 1992, Zieliński and Studziński 1995). Although the numbers of wader species recorded at stopover sites in different parts of Poland were similar, the proportions of species might be quite different because of their habitat requirements. Among waders staging numerous in the Reda mouth there were species typical both for coastal and inland areas. The Lapwing, Golden Plover, Wood Sandpiper, Common Sandpiper, Common Snipe and Little Ringed Plover migrate across Europe mainly with stop-overs in such habitats as river beds and meadows, arable fields, banks of lakes and different kinds of water reservoirs (Glutz von Blotzheim *et al.* 1975, 1977). Other species like the Knot, Grey Plover and Sanderling are typical for sea coasts, while the Dunlin, Curlew Sandpiper, Little Stint and Ringed Plover migrate mainly along the Baltic coast, but their conspicuous concentrations are known from some inland stopover sites (Stawarczyk *et al.* 1996). The main reason for this high diversity of waders in the study area was the occurrence of various habitats in the Reda mouth region. There were sandy beaches and islets, muddy banks of small bays, wet meadows

and large flat area of the ash dumping place with dry and wet parts. The ash dump was used by waders not only as a foraging place, but also as a roosting area. For example, Lapwings and Golden Plovers foraged outside the study site and their flocks arrived at the ash dumping place about midday for roosting. The numbers of typical coastal species like the Sanderling, Bar-tailed Godwit, Knot and Turnstone, were much higher in another area near village Rewa (only about 2 km from the Reda mouth), where the only habitat was a sandy beach along a narrow peninsula (WRG KULING data).

In many species the sets of subsequent days with high numbers of birds (migration waves) were separated by days with low numbers. The seasonal wave-like migration pattern has already been described in waders (Kube *et al.* 1994, Meissner 2000, Meissner and Strzałkowska 2006). It could be caused by different factors, like different migration timing of various geographical populations, age or sex of birds, differences in weather situation on a route preceding a study site, and local conditions at this site (Alerstam 1993; Meissner 2000, 2007; Meissner and Strzałkowska 2006). In the Wood Sandpiper, Knot, Curlew Sandpiper, and Temminck's Stint, adults migrated much earlier than juveniles, and this resulted in two waves of migrants. In the Dunlin, females migrate ahead of males and adults before juveniles (Zajac 1980, Meissner and Strzałkowska 2006) and as a result many waves of migrants were observed in this species. The Ringed Plover is a good example of migration waves caused by different timing of passage of adults and juveniles and of two subspecies *C. hiaticula hiaticula* and *C. hiaticula tundrae* (Meissner 2007).

There were conspicuous discrepancies between daily mean and maximum numbers in migration dynamics of all species. Differences in migration pattern between studied seasons were the main reason of such a picture, which was noted earlier for some species in detailed studies (Meissner 1996, 2000; Meissner and Strzałkowska 1996; Meissner and Koziróg 2000).

Migration pattern of the Little Ringed Plover in the Reda mouth was similar to those observed at Lake Rakutowskie in central Poland and at the sediment-ponds of coal-mines in Jastrzębie Zdrój in southern Poland (Zieliński and Studziński 1996, Kruszyk and Zbroński 2002). However, at Nyskie Reservoir (southern Poland) the maximum numbers of this species were recorded a little later in July with an additional peak in September (Stawarczyk *et al.* 1996).

Intensive migration of the Ringed Plover through the inland begins much later than in the coastal zone (Kuźniak and Lorek 1993, Stawarczyk *et al.* 1996), because it considers late migrating subspecies *C. hiaticula tundrae* (Meissner 2007). High numbers of birds in July were noted only at Lake Rakutowskie, which is located about 200 km from the coast (Zieliński and Studziński 1996).

In the majority of sites in Poland the migration pattern of the Lapwing is irregular and high numbers of birds are noted between the end of June and October (Kunysz and Hordowski 1992, Stawarczyk *et al.* 1996, Wiehle 1999, Kruszyk and Zbroński 2002, Baran and Gwiazda 2006). Lapwings begin dispersal from breeding grounds in late May and in June and this summer movements merge into autumn migration in September when juveniles leave their natal areas (Cramp and Simmons 1983). In the

Reda mouth Lapwings were counted mainly at roosting places and the observed variation in their number might have resulted from varied access to suitable feeding areas.

In the majority of sites in Poland the beginning of the Ruff autumn migration takes place at the end of June and the migration dynamics reveals two peaks: the first in July and the second in August or September (Kunysz and Hordowski 1992, Kuźniak and Lorek 1993, Stawarczyk *et al.* 1996, Zieliński and Studziński 1996, Kruszyk and Zbroński 2002, Baran and Gwiazda 2006). In the Reda mouth the first peak was very low, however, it might have taken place earlier – in the turn of June, what is supported by the results of observations conducted before the beginning of regular counts, when several birds were recorded, *e.g.* on 1 Jul. 1999 – 16 indiv. (own data).

Autumn migration of the Redshank at inland sites is not numerous (Kunysz and Hordowski 1992, Wiehle 1991, Stawarczyk *et al.* 1996, Zieliński and Studziński 1996, Kruszyk and Zbroński 2002, Baran and Gwiazda 2006). Probably in autumn this species stays in greater numbers only in coastal zone (Meissner and Sikora 1995).

There were conspicuous discrepancies in the Greenshank migration patterns at different sites in Poland. Only one peak of migration was noted in the second half of August at Lake Rakutowskie (Zieliński and Studziński 1996), in the turn of August at Wonieść reservoir (Kuźniak and Lorek 1993), whereas at Nyski reservoir a maximum number of this species was noted in July (Stawarczyk *et al.* 1996). The migration pattern with some peaks of bird numbers similar to the Reda mouth was observed at Dobczycki reservoir in southern Poland (Baran and Gwiazda 2006) and at fish ponds in Górkę in central Poland (Wilniewczyc *et al.* 2001). In many other sites the numbers of Greenshanks were very low (*e.g.* Cieślak *et al.* 1991, Wiehle 1999, Kruszyk and Zbroński 2002) or the migration had irregular pattern (Kunysz and Hordowski 1992).

Migration of the Wood Sandpiper revealed similar pattern at many sites in Poland with two waves of migrants in July and August (Kunysz and Hordowski 1992, Kuźniak and Lorek 1993, Stawarczyk *et al.* 1996, Zieliński and Studziński 1996, Wiehle 1999, Wilniewczyc *et al.* 2001, Kruszyk and Zbroński 2002, Baran and Gwiazda 2006), which suggests that the autumn passage of this species is well synchronized in time.

Many-year migration dynamics of the Common Sandpiper through the Reda mouth showed irregular pattern. Rapid changes in daily numbers of migrants and very low number of retraps among caught birds indicate that in coastal zone the passage of this species is very fast (Meissner 1996). At inland stopover sites where Common Sandpipers appeared numerously, the migration patterns were more regular with peaks of numbers in the turn of July (Kunysz and Hordowski 1992, Stawarczyk *et al.* 1996, Mitrus *et al.* 1998).

In all the *Calidris* species, Bar-tailed Godwits and Grey Plover, the migration periods of adults and juveniles were clearly separated in time. Intensive migration of these species through the Polish inland starts much later than in coastal zone, because it considers mainly juveniles, which migrate later than adults (Kunysz and Hordowski 1992, Kuźniak and Lorek 1993, Stawarczyk *et al.* 1996, Zieliński and Studziński 1996, Wiehle 1999, Wilniewczyc *et al.* 2001, Kruszyk and Zbroński 2002, Baran and Gwiazda 2006). Probably the same phenomenon appears the Golden Plover (Cieślak *et al.* 1991, Kunysz and Hordowski 1992, Kuźniak and Lorek 1993), however, there are no good data on age structure of the migrants.

Comparison of wader migration timing at the Reda mouth and Jastarnia (Meissner and Sikora 1995) revealed that the groups of early and late migrants consisted of the same species with a few exceptions. At both sites the Lapwing, Little Ringed Plover, Oystercatcher and Curlew represented early migrants with their median date of migration within the period between end of July and mid-August, whereas the Knot, Grey Plover, Bar-tailed Godwit, Little Stint and Dunlin migrated later and their median migration dates fell in September. In general, birds from tundra zone migrated later than those from more southern breeding areas, which is caused by much later beginning of egg laying in northern latitudes. High numbers of Lapwings, Little Ringed Plovers, Ruffs, Common and Wood Sandpipers at the beginning of the studied period indicate that migration of these species had been initiated earlier, which was confirmed by observations from other regions of Poland (Kunysz and Hordowski 1992, Kuźniak and Lorek 1993, Stawarczyk *et al.* 1996, Kruszyk and Zbroński 2002).

Migration periods of adults and juveniles revealed also another regularity connected with location of breeding grounds. In the species from tundra zone (*e.g.* the Knot, Little Stint, Curlew Sandpiper) migration of both age classes were well separated, whereas in those from more southern areas (*e.g.* the Little Ringed Plover, Common Sandpiper) such difference was less pronounced and the period of common passage of adults and juveniles was much longer. In the Dunlin and Ringed Plover both age classes migrated together numerously within a long period, because of different timing of migration of geographic populations (Meissner and Strzałkowska 2006, Meissner 2007). In the Wood Sandpiper at the Reda mouth such a period seemed to be short, while in other sites it was much longer (Gromadzka 1987, Włodarczyk *et al.* 2007). This could be caused by a very low sample size of caught birds ($N = 27$).

Results obtained during this study showed that the Reda mouth is an important stopover site for waders. In Poland this is one of scarce stopover sites, which gathers in high numbers both 'inland' and 'coastal' waders, which migrate later in different directions (*e.g.* Meissner 1997a, 1997b, 2000).

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