A survey of spring wader migration on the wetlands of the island of Pag, Croatia (March-May 1990-1991)

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The results of wader counts made during spring 1990/91 (March-May) at wetlands on the island of Pag in Croatia are presented. Estimates of the numbers of waders present at the three largest wetlands on the island (Pag saltpan, Dinjiska saltpan and Lake Velo Blato) in spring were between 4,000 and 11,000 birds. The most numerous species were Little Stint *Calidris minuta* and Ruff *Philomachus pugnax* (1,000-3,000), Redshank *Tringa totanus* (500-1,000), Wood Sandpiper *Tringa glareola* (200-1,000), Curlew Sandpiper *Calidris ferruginea* (200-500). Numbers of other species did not exceed a few hundred.

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INTRODUCTION

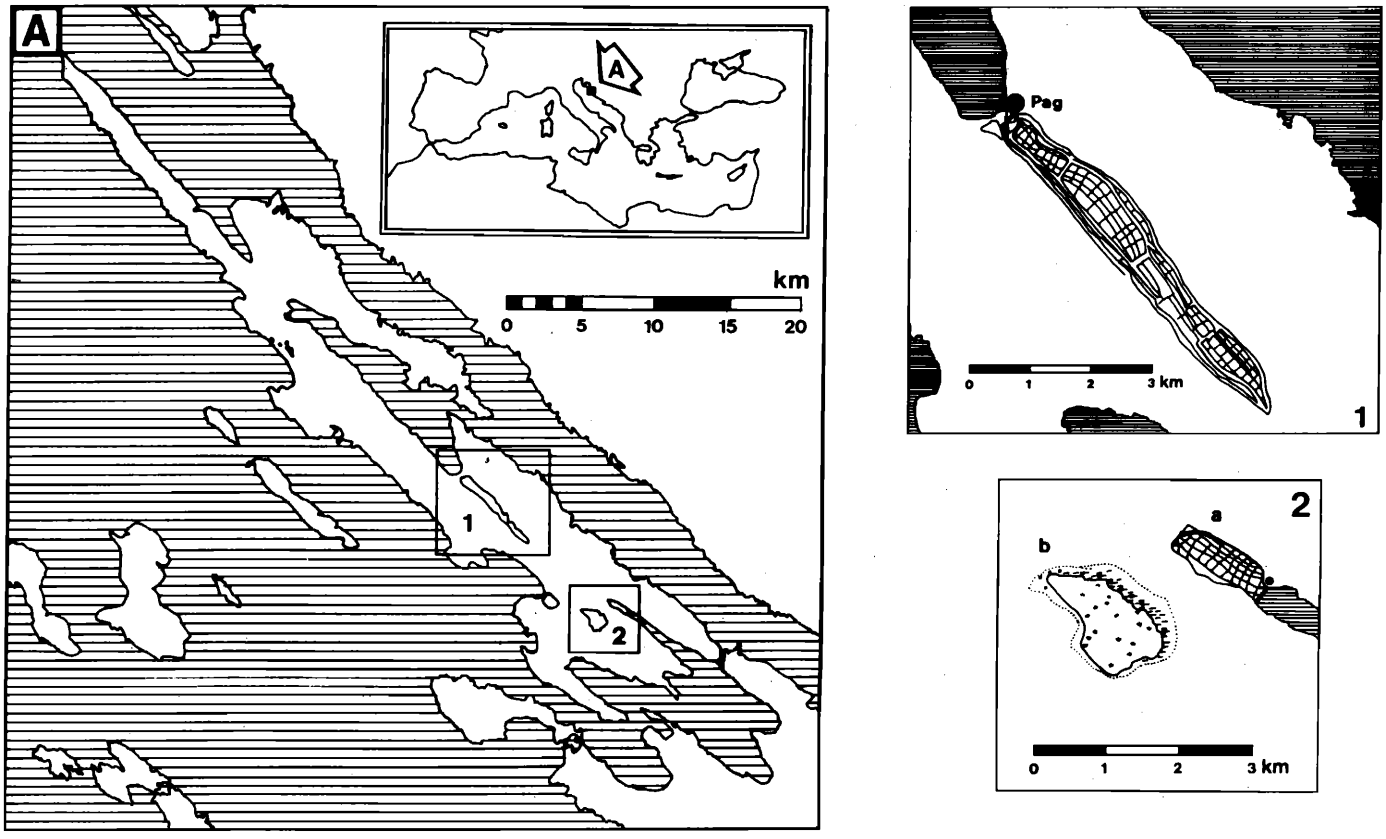
Little is known about non-breeding waders in Croatia, even less than elsewhere in the Mediterranean (Smit 1986b). Up to now, regular counts of migrating waders have not been made on the Adriatic coast, and no important areas for waders have been identified. The Croatian coastline is mostly rocky but includes a few small wetlands. Because of the small tidal amplitude typical of the Mediterranean (Smit 1986a), the coast of Croatia is apparently numerically unimportant for waders. However, it is important to discover the timing of migration and the particular wetlands used by the populations migrating over the eastern Mediterranean (Schekkerman 1989). To further such knowledge, the largest wetland in Croatia, on the island of Pag, was surveyed from March to May in 1990 and 1991.

The island of Pag is situated on the north-eastern Adriatic seaboard between the north Adriatic Italian wetlands of the river Po delta and the flat Albanian coastline in the south. Except for some small wetlands in north Dalmatia, the mainly rocky coastline of Croatia lacks any extensive wetland of greater importance for waders. Hence the migration pattern on the isolated wetlands on the island of Pag should be representative of this part of the eastern Adriatic. Censuses of waders were carried out in order to provide information on the occurrence of species, numbers, migration patterns and the importance of the wetlands on the island of Pag for waders in spring. The data should be directly comparable with other simultaneous counts carried out during "Eastern Mediterranean Wader Project 1990" (Schekkerman 1989), a project which prompted this survey.

METHODS AND STUDY AREAS

Counts were carried out every seven to ten days, on a single day, at the three largest wetlands on the island of Pag (Figure 1). The saltpan at the city of Pag was surveyed from 0600 to 1200 hrs, Lake Velo Blato from 1200 to 1400 hrs, and the small saltpan at the village of Dinjiska from 1400 to 1500 hrs. Lake Velo Blato was not surveyed from March to April 1990. The topography of these wetlands is such that counts are easily made with only a few duplications or omissions. Some birds may have been overlooked in the scattered reedbeds of Lake Velo Blato, especially Snipe *Gallinago gallinago*, but the majority of the waders regularly foraged on the low north and eastern banks. Since roosting sites are unknown, feeding waders were counted. Small numbers of waders also occurred on several minor wetlands (e.g. Kolansko Blato, Malo Blato), at surrounding fields and along rocky beaches, but this did not significantly affect the overall picture, except for Common Sandpipers *Actitis hypoleucos* which were ubiquitous.

Figure 1. Counting sites on the island of Pag, Croatia (A); Pag saltpan (1); Dinjiska saltpan (2a) and Lake Velo Blato (2b).



The saltpan at the city of Pag (44° 26' N; 15° 05' E) is a 6.5 km long and 0.5 - 1 km wide area of rectangular basins surrounded by ditches and dykes. It was constructed by partitioning a deep inlet in a shallow bay and covers 220 ha. The basins are dry during the winter and early spring, and are flooded in late April. The margins of the ditches are overgrown with reed *Phragmites* spp. and rush *Juncus* spp., there are stands of Tamarisk *Tamarix* spp. and some basins containing halophytic vegetation. The large basins and tidal mudflats in the north-western corner are the most important for waders.

The saltpan at the village of Dinjiska (44° 22' N; 15° 11' E) is 1 km long and 0.5 km wide. It is an area of rectangular basins surrounded by dykes and a deep inlet in a shallow bay, and covers 33 ha surface area.

Lake Velo Blato (44° 22' N; 15 10 E) is a shallow fresh-water wetland 2 km long and 1 km wide. This eutrophic lake is very overgrown with clusters of reedbeds. The area surveyed at the north and eastern edges of the lake consists of 10 ha of open wet meadows with scattered clumps of rush and muddy banks used for sheep grazing.

Saltpans are an important breeding habitat for at least half of the Croatian population of Kentish Plover *Charadrius alexandrinus*. Stone-curlew *Burhinus oedicnemus* also breed on the island, exclusively on dry stony semi-desert habitat. Waders wintering on the wetlands and on the sea coast are Kentish Plover *Charadrius alexandrinus*, Grey Plover *Pluvialis squatarola*, Lapwing *Vanellus vanellus*, Dunlin *Calidris alpina*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Redshank *Tringa totanus*.

RESULTS

The counts for each species are shown in Tables 1 and 2. The number of birds which presumably used the wetlands on the island as a staging area (stopover site) in spring was estimated by taking into account the number counted, habitat choice, the completeness of the counts and the presumed turnover.

Black-winged Stilt *Himantopus himantopus*

The migration pattern varied in the two years studied. In 1990, the birds appeared in greater numbers towards the end of April, whilst in 1991 smaller numbers arrived earlier,

in the first ten-day period of April. In 1991, no birds appeared at saltpans. Comparison with Italian data (Serra *et al.* 1992) suggests that the birds arrived in the north Adriatic region in April and departed towards the end of May. This pattern fits well with the fluctuation in numbers in north-east Greece in 1987 (Nobel *et al.* 1987). Approximately 20 to 50 birds were recorded using the wetlands on the island as a stop-over site in spring.

Avocet *Recurvirostra avosetta*

Only one bird appeared at Dinjiska saltpan. Avocet is an irregular migrant and always appears in small numbers.

Collared Pratincole *Glareola pratincola*

This is a regular migrant, with several birds always present. Similar migration patterns were found in both years. Birds arrived at the beginning of May, and apparently left at the end of May. Collared Pratincole appeared only at Lake Velo Blato. Probably not more than ten birds used the wetlands on the island.

Little Ringed Plover *Charadrius dubius*

There was a gradual increase in numbers from the second ten-day period in March to mid April. Birds departed at the end of May. This migration pattern corresponds to that in Italy (Serra *et al.* 1992) and north-east Greece (Nobel *et al.* 1987). The highest count was at Lake Velo Blato in the first half of April 1991. Peak passage in 1991 was earlier and more pronounced than in 1990. Counts suggest that 100-200 birds used the wetlands on the island.

Ringed Plover *Charadrius hiaticula*

In both years, there were two peaks in the numbers recorded, suggesting the migration of two populations, as in Italy (Serra *et al.* 1992). The first small peak was in March, the second larger peak from mid April to the end of May. At Lake Velo Blato, no birds were present during the first peak in March 1991 (in 1990, there were no counts from March to April) but they were recorded there during the second peak in mid April. At Dinjinska saltpan they were recorded at the end of May. The counts suggest that the wetlands on the island were used by 100-200 Ringed Plovers in spring.

Kentish Plover *Charadrius alexandrinus*

This species was present throughout the year but its precise status was unknown. In both years, there was a similar gradual increase in numbers from March to April, but it is unknown whether a migrating population was involved. The increase in numbers may have reflected an influx of resident breeders which had dispersed during the winter at neighbouring coastal beaches of north Dalmatia. Birds were present at both saltpans in similar numbers (less than one hundred) in May. Saltpans on the island are the stronghold of the species in Croatia. About 20-30 pairs breed there.

Grey Plover *Pluvialis squatarola*

Different patterns of migration at Pag saltpan and Lake Velo Blato were found in both years, suggesting two populations were passing through. The birds which passed through first were recorded at Pag saltpan during March and were probably local winterers. A second peak, from mid April to the end of May, suggests the passage of another population, and this is clearly indicated by the influx of birds at Lake Velo Blato in May (no counts were made there in 1990 from March to April). This second peak corresponds well with the departure of Grey Plovers from north-east Greece in mid April 1987 (Nobel *et al.* 1990). About 50-100 birds used the wetlands on the island in spring.

Lapwing *Vanellus vanellus*

A few birds were observed irregularly at wetlands. More birds were probably present in the fields on the island, but no more than 10-20 occured at the wetlands in spring.

Sanderling *Calidris alba*

This is a regular migrant, but always in small numbers. Only one bird was found in mid May 1991 at Pag saltpan. At the same time, a few birds were present in 1990 at Cervia saltpan in Italy (Serra *et al.* 1992) and peak passage occured in north-east Greece in 1987 (Nobel *et al.* 1990). Up to ten birds stayed on the island in spring.

Little Stint *Calidris minuta*

The first birds appeared at the beginning of April. Peak passage occurred in the first two ten-day periods of May with departure at the end of May, as in north-east Greece in 1987 (Nobel *et al.* 1990). In 1990, peak counts were closer to the end of May, but earlier in Italy (Serra *et al.* 1992). There were considerably more birds in 1991 than in 1990 at all wetlands, mainly due to a larger influx in mid-May. Considering the rapid turnover in north-east Greece (Stuart *et al.* 1990) and south Turkey (Cronau 1988), a rough estimate of the total number of Little Stints using all wetlands on the island in spring was between 1,000 and 3,000. Little Stints obviously preferred mudflats on saltpans, and were much less frequent at Lake Velo Blato.

Temminck's Stint *Calidris temminckii*

The first birds appeared in mid April, peak counts were in the first ten-day period of May and departure by the second ten-day period of May. The number of birds and timing of migration was similar in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). Only small numbers were seen, but the species was probably sometimes overlooked due to the very scattered distribution. At least 20-100 birds staged on wetlands on the island. Migration seems to be very rapid.

Curlew Sandpiper *Calidris ferruginea*

The first birds were seen at the end of April. Numbers increased rapidly from the first ten-day period of May to a peak count in the second ten-day period of May before suddenly dropping at the end of May, suggesting a very rapid migration. The pattern of migration is similar to the migration in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992) where migration seems to be more prolonged towards the end of May. Very few birds appeared at the saltpans in 1991 but many more occured at Lake Velo Blato. Approximately several hundred birds used wetlands on the island during spring.

Dunlin *Calidris alpina*

Up to the 400 Dunlins winter, mainly at Pag saltpan. During March 1991, the number of Dunlins at Pag saltpan steadily decreased towards the first ten-day period of April, suggesting departure of wintering birds in March. There is no clear evidence for a passage population at Pag saltpan. Although counts at Lake Velo Blato during March - April 1990 were lacking, an obvious influx during April 1991 suggests the presence of a passage population. A similar influx of passage birds in April occurred in north-east Greece at Porto Lagos (Nobel *et al.* 1990) and in Italy at Cervia saltpans (Serra *et al.* 1992). Excluding wintering birds, 100-200 Dunlins used the wetlands on the island in spring.

Ruff *Philomachus pugnax*

Ruffs arrived in the first ten-day period of March and were present throughout the study period until the end of May. The migration pattern at Pag saltpan suggests rapid turnover with an indication of two migration waves, the first from March to the beginning of April, and the second from April to May. This pattern was probably due to the earlier passage of males in March and the later passage of females in April and May, as indicated by the predominance of females during April in north-east Greece (Nobel *et al.* 1990). This pattern is fairly similar to the migration in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). Most Ruffs were observed on wet pastures on the banks of Lake Velo Blato, where one thousand birds were counted at the beginning of April 1991, but there were no counts there from March to April 1990. Probably several thousand (1,000-3,000) birds staged on the island in spring.

Snipe *Gallinago gallinago*

Since it is difficult to count this species precisely, but the counts suggest departure of wintering birds during March and the passage of migrant birds in May. Although many birds remain uncounted, estimates of 100-300 migrating Snipe during spring are probably reasonable.

Black-tailed Godwit *Limosa limosa*

The main passage occurred in March, with first birds arriving at the beginning of March and numbers rapidly decreasing in April. This pattern is identical to that in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). Approximately 50-200 birds staged on the island in spring.

Whimbrel *Numenius phaeopus*

Only a few birds were present at Pag saltpan in the first half of May. Small numbers (5-10) of Whimbrels staged on the island.

Curlew *Numenius arquata*

Curlews were present on the island throughout the spring in small numbers. Some (10-30) birds staged on the island.

Spotted Redshank *Tringa erythropus*

All counts revealed a very clear migration pattern which were similar in both years. The first birds arrived at beginning of March and the main passage occured in the second half of March and first half of April. This was followed by a rapid decrease in numbers during the second half of April. A distinct peak occurred at the end of March and beginning of April, in contrast to later peaks in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). Probably 50-100 birds staged on island.

Redshank *Tringa totanus*

Although Redshanks appear everywhere in small numbers, but the highest count was at Pag saltpan. The number of wintering birds at Pag saltpan decreased sharply in the second half of March. It is not clear whether only wintering or passage Redshanks were involved, but an almost identical migration pattern in Porto Lagos, north-east Greece (Nobel *et al.* 1990) also indicates an influx of passage birds in March. Approximately 500-1,000 birds appeared on the island in spring.

Greenshank *Tringa nebularia*

First birds were observed in March, but numbers increased steadily from April and peaked in mid April. The numbers then decreased slightly and remained stable before peaking again at the beginning of May (1990) or steadily decreasing in May (1991). The second peak at the beginning of May appeared at the same time as that in north-east Greece (Nobel *et al.* 1990) and in Italy at the Tarquinia saltpans (Serra *et al.* 1992), indicating a bimodal migration pattern. The whole migration pattern coincided closely with counts in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). About 50-150 Greenshanks staged on the island in spring.

Marsh Sandpiper *Tringa stagnatilis*

A few birds appeared at Lake Velo Blato. The first birds were observed at the end of March and the number peaked in mid April. No birds were observed in May (there was no count from March to April 1990 at Lake Velo Blato). The migration pattern is similar to that in north-east Greece

(Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). Some 20-50 birds staged on the island in spring.

Green Sandpiper *Tringa ochropus*

A small number, mainly solitary birds, suggested migration in March and April. The peak count at Pag saltpan in late March (1990) and at beginning of April (1991) resembled migration in north-east Greece (Nobel *et al.* 1990). Probably, 20-50 birds staged on the island in spring.

Wood Sandpiper *Tringa glareola*

First birds were seen in mid March but the number increased dramatically in late April and decreased gradually throughout May. The migration pattern is quite similar to that in north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). More birds were counted at all sites in 1990. This species was easily overlooked because of habitat choice, but up to one thousand (200-1,000) birds staged on the island in spring.

Common Sandpiper *Actitis hypoleucos*

Small numbers were present throughout spring. Although no clear migration pattern emerged, the counts indicated peak passage in late April, as in north-east Greece (Nobel *et al.* 1990). This species was present in small numbers at almost every water pool and everywhere at the coast, and must be more numerous than the counts reveal. At least 50-200 birds staged on the island in spring.

DISCUSSION

In spring much lower numbers of waders migrate through the wetlands on the island Pag than over north-east Greece (Nobel *et al.* 1990) and Italy (Serra *et al.* 1992). However, for most species the timing of migration is similar to that in Greece and Italy, indicating well synchronised migration in the central Mediterranean.

The most numerous species (numbers estimated from several hundreds to several thousands) migrating over the island of Pag are Little Stint, Curlew Sandpiper, Dunlin, Ruff, Redshank and Wood Sandpiper (Table 1). Other species regularly counted in significant number (estimated from several tens to several hundreds) are Black-winged Stilt, Little ringed Plover, Ringed Plover, Kentish Plover, Grey Plover, Temminck's Stint, Snipe, Black-tailed Godwit, Spotted Redshank, Greenshank and Common Sandpiper (Table 1). Regular migrants which appear few in number (estimated several tens or fewer) are Collared Pratincole, Lapwing, Sanderling, Whimbrel, Curlew, Marsh Sandpiper and Green Sandpiper. Avocet is a more irregular migrant and this could also be the case with some other species not observed on the island during the study period.

Table 3. Estimated number of migrating waders using the wetlands on the island of Pag, Croatia in spring (March-May) 1990/91.

Species	Estimated number
Black-winged Stilt	20-50
Collared Pratincole	5-10
Little Ringed Plover	100-200
Ringed Plover	100-200
Kentish Plover (resident)	60-80
Grey Plover	50-100
Lapwing	10-20
Sanderling	1-10
Little Stint	1000-3000
Temminck's Stint	20-100
Curlew Sandpiper	200-500
Dunlin (excluding local wintering birds)	100-200
Ruff	1000-3000
Snipe	100-300
Black-tailed Godwit	50-200
Whimbrel	5-10
Curlew	10-30
Spotted Redshank	50-150
Redshank	500-1000
Greenshank	50-150
Marsh Sandpiper	20-50
Green Sandpiper	20-50
Wood Sandpiper	200-1000
Common Sandpiper	50-200
TOTAL	3721-10610

An approximate estimate of waders actually using wetlands on the island in spring, taking into account the censuses and presumed turn-over rate, is between 4,000 and 11,000 birds. The most abundant species were Little Stint and Ruff (1,000 - 3,000 of each species passing through), followed by Redshank (500 - 1,000), Wood Sandpiper (200 - 1,000), and Curlew Sandpiper (200 - 500). Other wader numbers were much lower.

Typically maritime species are almost absent during spring, but there are greater numbers of freshwater species (Ruff, Wood Sandpiper) or species of both types of habitat (Little Stint, Curlew Sandpiper, Redshank). The estimated number of Little Stints (1,000-3,000) could represent 1% of the East Atlantic Flyway population (1% threshold=2000 birds; Smit & Piersma 1989), making the island of Pag internationally important for this species.

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Table 1. Results of the 1990 spring counts of waders at the three largest wetlands on the island of Pag (Pag saltpan, Dinjiska saltpan, Lake Velo Blato).

1990	MARCH				APRIL				MAY			
Species	7	12	19	28	2	14	23	30	7	14	21	28
Himantopus himantopus								3	5	8	16	15
Glareola pratincola									1		2	1
Charadrius dubius			1	1	7	7	11	7	1	2	3	2
Charadrius hiaticula	3	1				3			6	12	20	
Charadrius alexandrinus	33	29	41	26	58	38	45	42	45	71	56	61
Pluvialis squatarola	8	8	8		6	8	3	8	8	14	6	
Vanellus vanellus				2								
Calidris minuta							10	7	85	77	134	158
Calidris temminckii									6			
Calidris ferruginea							1		17	63	79	3
Calidris alpina	80	60	68	7	71	4	4				1	
Philomachus pugnax	10	9	31	29	42		28	44	476	102	95	13
Gallinago gallinago	15	9		4	3					2	1	
Limosa limosa	23	8	2	15	11			2				
Numenius arquata	2	3	2	1		1		3			1	1
Tringa erythropus				8	17	3	2	4		1		
Tringa totanus	170	143	67	41	24	8	4		1			
Tringa nebularia		1		1	2	14	10	10	14	1	2	
Tringa ochropus		1	7		5	5	3					
Tringa glareola		1			13	1	113	78	98	42	28	7
Actitis hypoleucos		2				2	11	1				
TOTAL	344	275	227	135	259	94	245	209	763	395	444	261

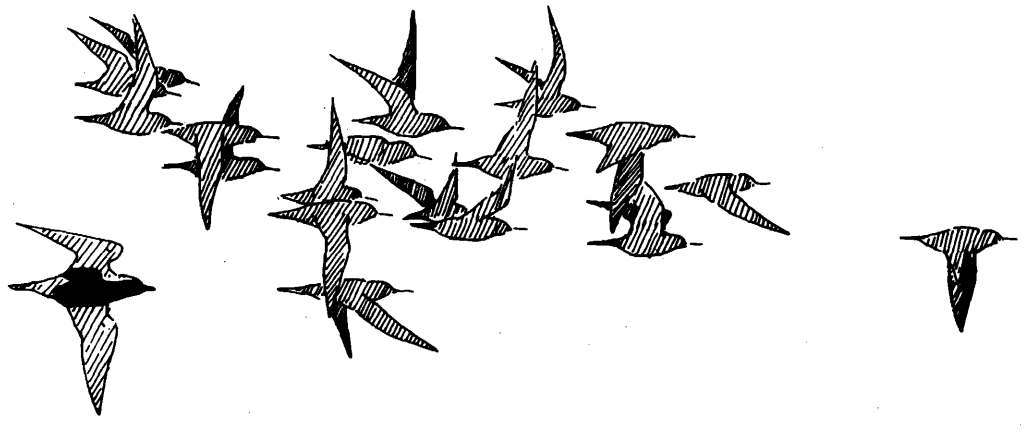

Table 2. Results of the 1991 spring counts of waders at three largest wetlands on island Pag (Pag saltpan, Dinjiska saltpan, Lake Velo Blato).

1991	FEB.	MARCH			APRIL			MAY			
Species	18	4	13	21	2	9	16	2/4	13	21	28
Himantopus himantopus						1	6		5		
Recurvirostra avosetta										1	1
Glareola pratincola								2	2	1	
Charadrius dubius			12	6	10	34	15	4	4	1	
Charadrius hiaticula			8	2			1	13	44	28	30
Charadrius alexandrinus	10	24	29	22	44	48	54	52	58	57	50
Pluvialis squatarola	9	16	17	18	11	9	12	17	23	13	5
Vanellus vanellus							3				
Calidris alba									1	1	
Calidris minuta					2	2	4	40	499	44	50
Calidris temminckii							1	6			
Calidris ferruginea								2	100		
Calidris alpina	359	300	251	217	25		48	4	2	3	
Philomachus pugnax		4	72	170	1000	785	456	71	53	55	22
Gallinago gallinago	3	5	3	7	2			1	3		
Limosa limosa		3	28	16	40	10	11				
Numenius phaeopus								3	1		
Numenius arquata	2	1	2	2	2	2	1		1	1	3
Tringa erythropus		1	9	30	13	16	13	1			
Tringa totanus	86	219	170	76	56	7	3	2	4	2	1
Tringa stagnatilis				1	4		7				
Tringa nebularia					2	3	34	4	7	4	
Tringa ochropus			1	3	2	7					
Tringa glareola						6	46	24	25	7	8
Actitis hypoleucos	2						2	1	1	1	
Numenius sp.					8						
TOTAL	471	573	602	570	1221	930	717	247	833	219	170