Bios (Macedonia, Greece), 1(2): 69 - 98 (1992)

SHOREBIRD POPULATIONS IN THE EVROS DELTA, GREECE

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Abstract.- The distribution and population trends of 32 species of shorebirds from October 1987 to June 1988 in the Evros Delta are described. The population trends and distribution patterns observed in the Delta zones (coastal region, lower delta, upper delta) are described for most species. Shorebird populations changed through the study period. Lowest numbers were generally counted in winter; numbers were similar in autumn and early spring but increased dramatically during the second fortnight of April and in May. Thereafter, only colonially breeding species occurred in important numbers. Species richness was correlated with population size. The relative numerical dominance of particular species changed through time. Of autumn migrants, Redshanks were the most abundant. In winter, Dunlins occurred in the highest numbers, except in late February, when successively Avocets and Curlews were dominant. During spring migration, Ruffs were generally by far the most abundant species but others, such as Dunlins, Little Stints, Spotted Redshanks and Curlew Sandpipers were periodically most numerous.

The Evros Delta supports many species of shorebirds in significant numbers compared to other Mediterranean wetlands. Many of these species are protected by the E. C. Directive 79/409-85/411. Their presence in the Delta depends on a combination of factors, of both natural and human origin. Conservation and management measures for shorebirds and their habitats in the Delta are proposed.

Introduction

Shorebirds (or waders) are a group of many species that use wetlands as their main habitat. Greece has over 130 wetlands (Heliotis, 1988) and, as a consequence, supports a considerable number and variety of shorebirds. Both unpublished and published information supports this view (Bauer *et al.*, 1969). The considerable use made of the main Greek wetlands has been documented as part of the studies of ten of the eleven Greek Ramsar Wetland sites (except

for the Prespa Lake for which see Katsadorakis, 1986) carried out in 1984 and co-ordinated by the Ministry of the Environment, Physical Planning and Public works.

With the exception of the Evros Delta, recent published information on shorebirds in Greece comes from a variety of sources and deals both with the mid-winter period (Smit, 1986) and other seasons (Englemoer & Bloksma, 1982, Jerrentrup, 1982, Sjizz, 1982, Joensen & Jerrentrup, 1988, Philippona, 1985, Van Vestrienen, 1988, Meininger, 1990). However, most of the information was collected during relatively short visits and some seasons were often not studied.

In the Evros Delta general information on the status of shorebirds was published some time ago (Bauer & Muller, 1969, Britton & Hafner, 1978). Recent studies heve provided more information on the occurrence, numbers and distribution of shorebirds and have examined specific aspects of the biology of particular species, though most of them dealt mainly with the breeding season (Goutner, 1983 a, b, 1985, 1986, Goutner & Goutner, 1988, van Vestrienen, 1988, Goutner & Handrinos, 1990, Meininger, 1990).

This paper describes the seasonal trends in numbers and the distribution of all shorebird species during a nine month period in the Delta. We analyze the composition and trends in the population and comment on their conservation in the particular area, based on the results of this project and on other available data. Our purpose is to provide basic knowledge on shorebirds of the Evros Delta to help conservationists and responsible Services protect this group and its habitats.

Study area and methods

The Evros Delta it the easternmost Greeke wetland and is ranked third in terms of its importance, especially for waterfowl populations, among the 11 Greek Ramsar wetlands. The Greece part of the Delta extends over 15000 ha. However this figure refers to the original undisturbed wetland of some 50 years ago. Nowadays less than one third of this area is important for wildlife because of heavy human interference. Our study area covered the whole Greek part of the Delta (Fig. 1) that consists of a variety of habitats which have been described in detail elsewhere (Babalonas, 1979, 1980, 1981, Britton & Hafner, 1978, Goutner, 1983 a, b, 1986). During this project, rainfall was much greater than in previous years (Goutner & Kazantzidis, 1989), and this affected the availability of freshwater and temporary feeding habitats for shorebirds and other waterbirds. Thus, the study period was a "good" one for shorebirds. This helped us to make useful comparisons with other years and to evaluate better the conservation needs of the birds.

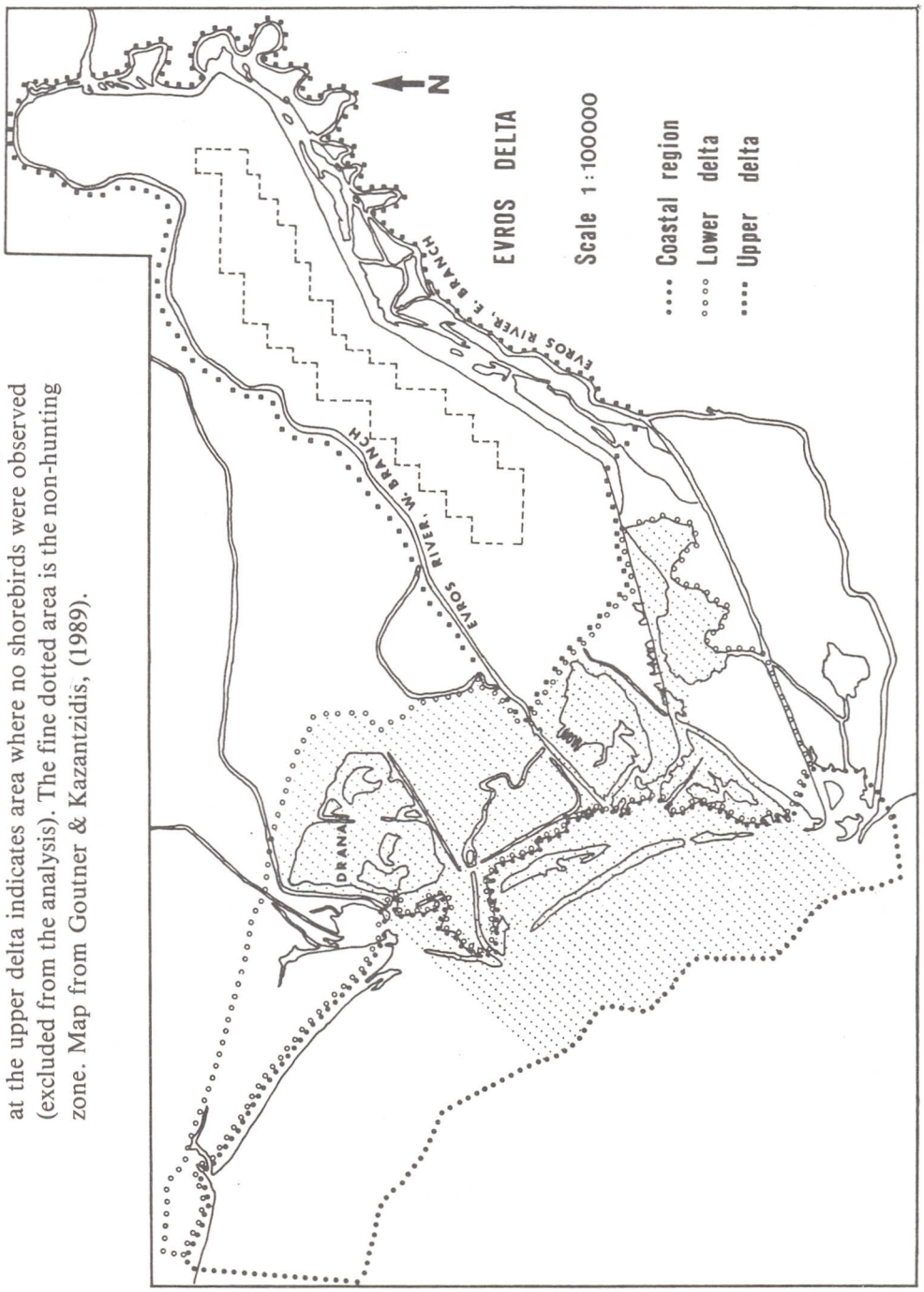

Fig. 1. Map of the study area with zones considered. Stippled lined quadrat at the upper delta indicates area where no shorebirds were observed (excluded from the analysis). The fine dotted area is the non-hunting zone. Map from Goutner & Kazantzidis, (1989).

The Delta was divided into three parts, the coastal region, lower delta and upper delta (Fig. 1). Each was 4875 ha in area and comprised a major biotope. This separation was to some extent artificial as some habitats occurred in more than one zone and their limits were not always clear. More detailed description of each zone is given in Goutner & Kazantzidis, (1989).

Twenty field visits were made between 10 October 1987 to 15 June 1988. Due to logistical and weather problems, full cover of the area was obtained on only 15 visits (see in Tab. 3). The remaining five were thus excluded from the analysis so, unfortunately, data for December 1987 are lacking. Two complete censuses were carried out by other observers during the mid-winter period though without the data being separated into zones. Nonetheless these data were also used. The area was censused by car and boat; the same routes were followed in each visit. Shorebirds were counted by binoculars and telescopes and records were kept on habitat use, distribution and movements.

In the following presentation distributions are only mapped for some of the shorebirds protected by the E. C. Directive 79/409-85/411.

Results

1. *Population changes and distribution of shorebirds by species*

Haematopus ostralegus (Oystercatcher, Fig. 2)

Oystercatchers were seen throughout the study but in generally low numbers (11-108 birds). Maximum numbers occurred in November and April, probably due to migrating birds. In most months, there were rapid changes in numbers between visits which are not easy to explain. Such rapid changes had also been observed during the breeding season (Goutner 1983 a). They may be caused by movements into and out of the area from the Turkish part of the Delta. The sand- and mudflats of the coastal region was the most important biotope used (Tab. 1). The saltmarshes of the lower delta were used mainly in spring when breeding territories were established (Goutner 1983 a).

Charadrius hiaticula and *C. dubius* (Ringed and Little Ringed Plovers, Fig. 3C)

Very small numbers of both species were seen in the Delta during this study. Most (89%) of Ringed Plovers were observed in October, while a few were seen in April.

Little Ringed Rlovers only occurred in March and April on spring migration, mostly at the end of March.

Both species used mainly the sandy beaches and sand-mud flats of the coastal region, though a few were scattered elsewhere.

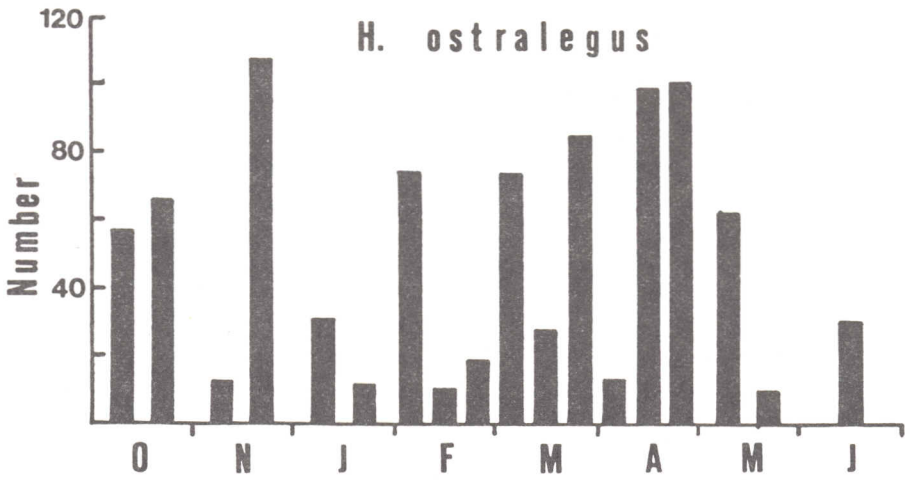

Fig. 2. Population trends of Oystercatchers, from October 1987 to June 1988.

Charadrius alexandrinus (Kentish Plover, Fig 3B)

Only small numbers of Kentish Plovers were observed. Maximum numbers were counted during the migration periods in October and mid-April. These birds mostly used the coastal habitat and, to a lesser extent, the flats of the lower delta (Tab. 1). Kentish Plovers do breed in the Delta (Bauer & Müller, 1969, Goutner, 1983 b).

Pluvialis squatarola (Grey Plover, Fig. 4)

Grey Plovers were observed during all visits. Their numbers were generally low, with a maximum of about 260 birds counted at the beginning of November. Their numbers dropped considerably in late January and in February but another peak appeared again at the end of March during spring migration. Thereafter, numbers decreased to almost zero in June. Grey Plovers were mainly seen in the coastal region and secondarily on the mudflats of the lower delta (Tab. 1).

Vanellus vanellus (Lapwing, Fig. 5)

The highest numbers of Lapwings were seen in winter with a peak at the beginning of February. Thereafter negligible numbers were observed. Lapwings are game birds and their wintering population was disturbed by hunters and consequently moved continuously. When not disturbed, Lapwings spent

Tab. 1. Frequency of occurence of 19 shorebird species observed in the three Delta zones, based on 15 visits where such data are available. Species seen occasionally and/or in low numbers (< 50) were not included in this table. Species are ranked by overall totals.

SPECIES	Coastal region		Lower delta		Upper delta		Totals
	%	n	%	n	%	n	counted
P. pugnax	7.5	8	72.6	6	19.9	6	11677
C. alpina	79.2	13	20.8	11	0.0	1	11587
T. totanus	65.9	13	31.2	14	2.9	10	5161
N. arquata	82.8	14	16.8	15	0.4	1	4937
C. minuta	54.5	6	45.5	7	0.0	0	4272
C. ferruginea	3.8	1	93.6	2	2.5	2	3391
T. erythropus	40.9	6	37.8	7	21.3	4	3207
R. avosetta	71.1	11	28.9	10	0.0	1	2789
P. squatarola	88.4	14	11.6	10	0.0	0	1580
H. ostralegus	86.3	15	13.2	9	0.5	2	791
C. alba	95.5	10	4.5	3	0.0	0	730
T. glareola	0.0	0	80.1	3	19.9	4	719
Ch. alexandrinus	77.6	10	21.7	9	0.7	1	428
T. stagnatilis	63.9	2	26.9	3	9.2	2	371
H. himantopus	2.0	1	97.4	5	0.6	1	349
T. nebularia	29.7	8	32.2	8	38.0	4	326
L. limosa	32.9	7	40.1	5	27.0	2	307
T. ochropus	0.9	2	50.6	6	48.5	5	229
V. vanellus	0.5	1	15.6	6	83.9	4	204

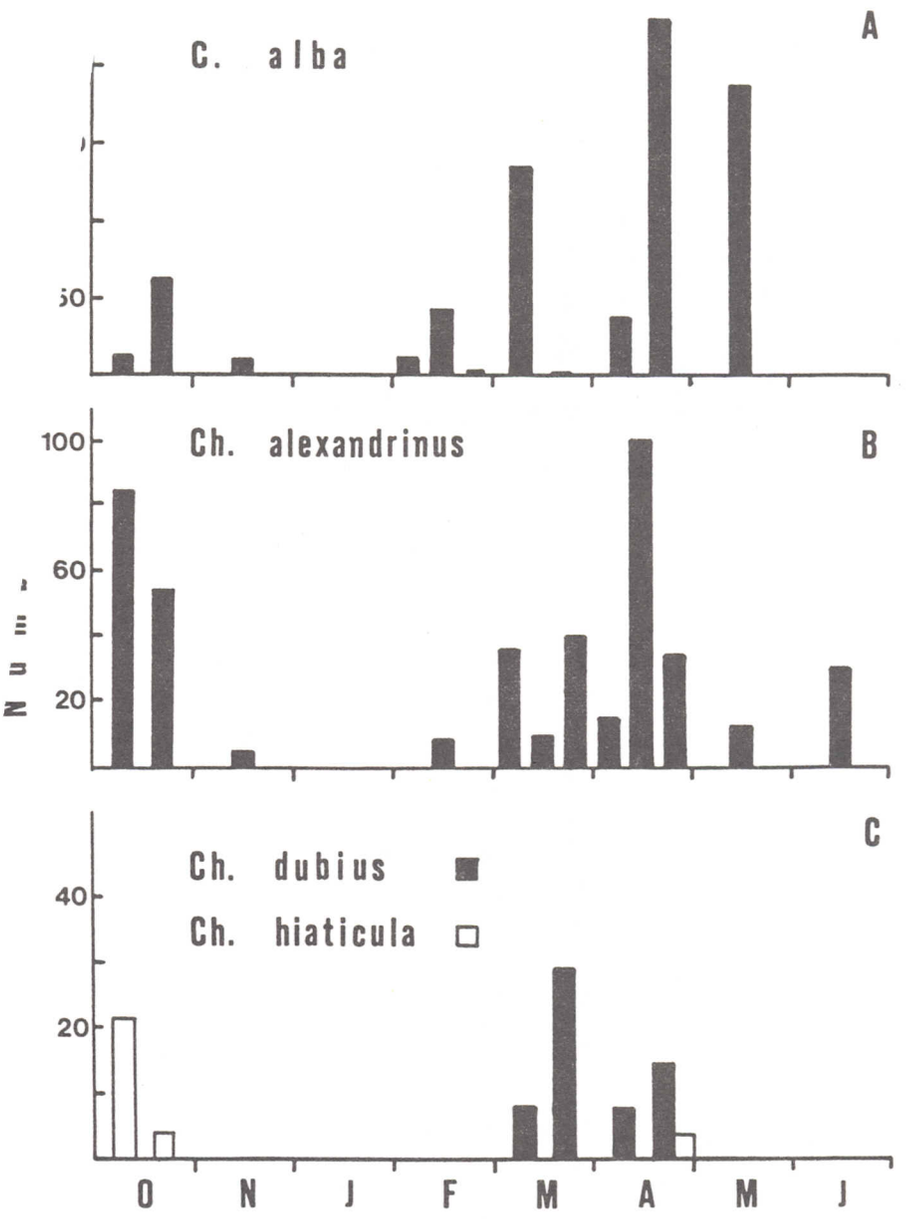

Fig. 3. Population trends of Sanderlings, Kentish Plovers, Little Ringed Plovers and Ringed Plovers from October 1987 to June 1988.

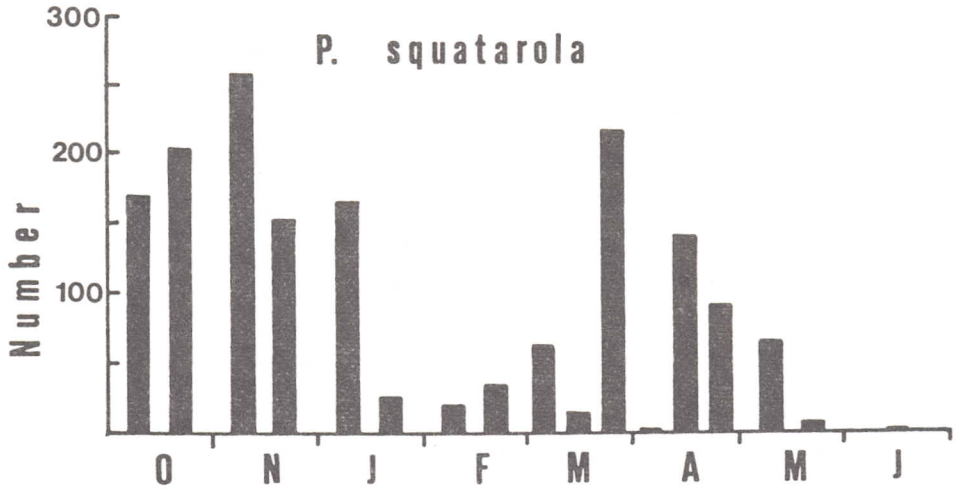

Fig. 4. Population trends of Grey Plovers from October 1987 to June 1988.

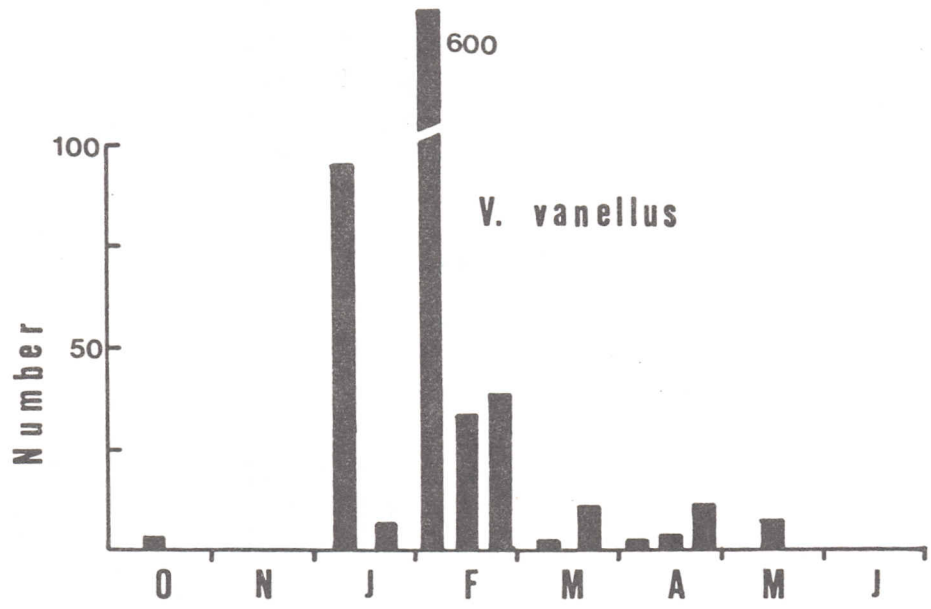

Fig. 5. Population trends of Lapwings from October 1987 to June 1988.

most of their time feeding in the fields of the upper delta (Tab. 1). Lapwings breed in the Delta (Goutner, 1983 b).

Hoplopterus spinosus (Spur-winged Plover), *Burhinus oedicnemus* (Stone Curlew) and *Glareola pratincola* (Collared Pratincole)

These shorebirds are regular breeders in the Delta (Bauer & Müller, 1969, Goutner, 1983 b). With the exception of Stone Curlew, which was also seen during the autumn migration (Tab. 2), they were observed in spring and summer and then only in low numbers. All three species suffered from habitat destruction and from disturbance due to grazing on their breeding sites. Their populations have declined dramatically in recent years. For Spur-winged Plovers, the Deltas of the rivers Nestos, situated about 200 km to the west, and Evros itself are the strongholds of the European breeding population (Jerrentrup, 1982, Jerrentrup, *et al.*, 1989). In the past, the Drana lagoon alone supported more than half of the breeding population of Collared Pratincoles in the Delta (Goutner, 1983 b).

Arenaria interpres (Turnstone)

Only very few birds were seen at occasional intervals during the study: two on 28 February, two on 4 April, 12 on 7 May and 17 on 8 May. They were mainly seen in the coastal region.

Tab. 2. Numbers and distribution of Stone Curlews, Spur-winged Plovers and Collared Pratincoles in the Evros Delta. C.L: coastal region, L.D: lower delta, U.D: upper delta.

	B. oedicnemus			*H. spinosus*			*G. pratincola*		
	C.R.	L.D.	U.D.	C.R.	L.D.	U.D.	C.R.	L.D.	U.D.
10-11 Oct.	—	7	—	—	—	—	—	—	—
25-27 Mar.	—	—	—	1	1	2	—	—	—
3 - 4 Apr.	—	1	—	—	—	6	—	—	—
12-15 Apr.	1	4	—	4	1	8	—	—	—
28-30 Apr.	—	1	—	1	—	2	6	57	23
7 - 9 May	—	1	—	4	—	6	2	22	4
5 - 7 June	—	—	—	—	—	2	60	2	20

Calidris minuta (Little Stint, Fig. 6C)

Low numbers of Little Stints were observed in the autumn and in winter. A sudden increase took place throughout April due to spring migration, though all the birds had again disappeared by mid-May. They occurred mostly in the coastal region of the Delta but also fed on the mudflats in the lower delta (Tab. 1), mainly in the regions of Drana and Palukia.

Calidris alpina (Dunlin, Fig. 6A)

This species was the mostly numerous shorebird in the Delta. They were observed in varying numbers regularly from October to May with peak numbers occurring at the beginning of February (see also Tab. 3). Two more peaks appeared in March and April during spring migration. Dunlins mainly occurred in the coastal region on the muddy-sand flats though they were seen almost as frequently, though in lower numbers, in the lower delta (Tab. 1).

Calidris ferruginea (Curlew Sandpiper, Fig. 6B)

Curlew Sandpiper only occurred in April and May for about three weeks when they were on sping migration. They showed a characteristic peak during the first week of May. Curlew Sandpipers mainly used saltmarshes and temporary brackish water marshes in the lower delta (Tab. 1).

Calidris canutus (Knot)

Knots were seen only once: 41 birds on 25 March. They occurred in the coastal region on sand bars in mixed shorebirds flocks.

Calidris alba (Sanderling, Fig. 3A)

Generally only small numbers of Sanderlings were observed in the Delta. The greatest numbers occurred in spring with a maximum of 230 birds at the end of April. None occurred after May. This species mostly used the sandy beaches and bars of the coastal region and occasionally the lower delta (Tab. 1).

Philomachus pugnax (Ruff, Fig. 7)

Migrating Ruffs appeared at the beginning of March in limited numbers: the first four birds were found in a hunter's bag on 6 March. At the end of that same month, their population increased considerably and peaked in mid-April, when about 4500 birds were counted in one day. Their main migration movements stopped around mid-May and the last ten birds were seen on 6 June. Ruffs fed in any available mudflat area with shallow, temporary stands of either fresh or brackish water. They also used saltmarshes, especially in the lower, but also in the upper delta (Tab. 1, Fig. 8). Flocks of 500-1000 birds were seen frequently, and flocks of 100-300 were common.

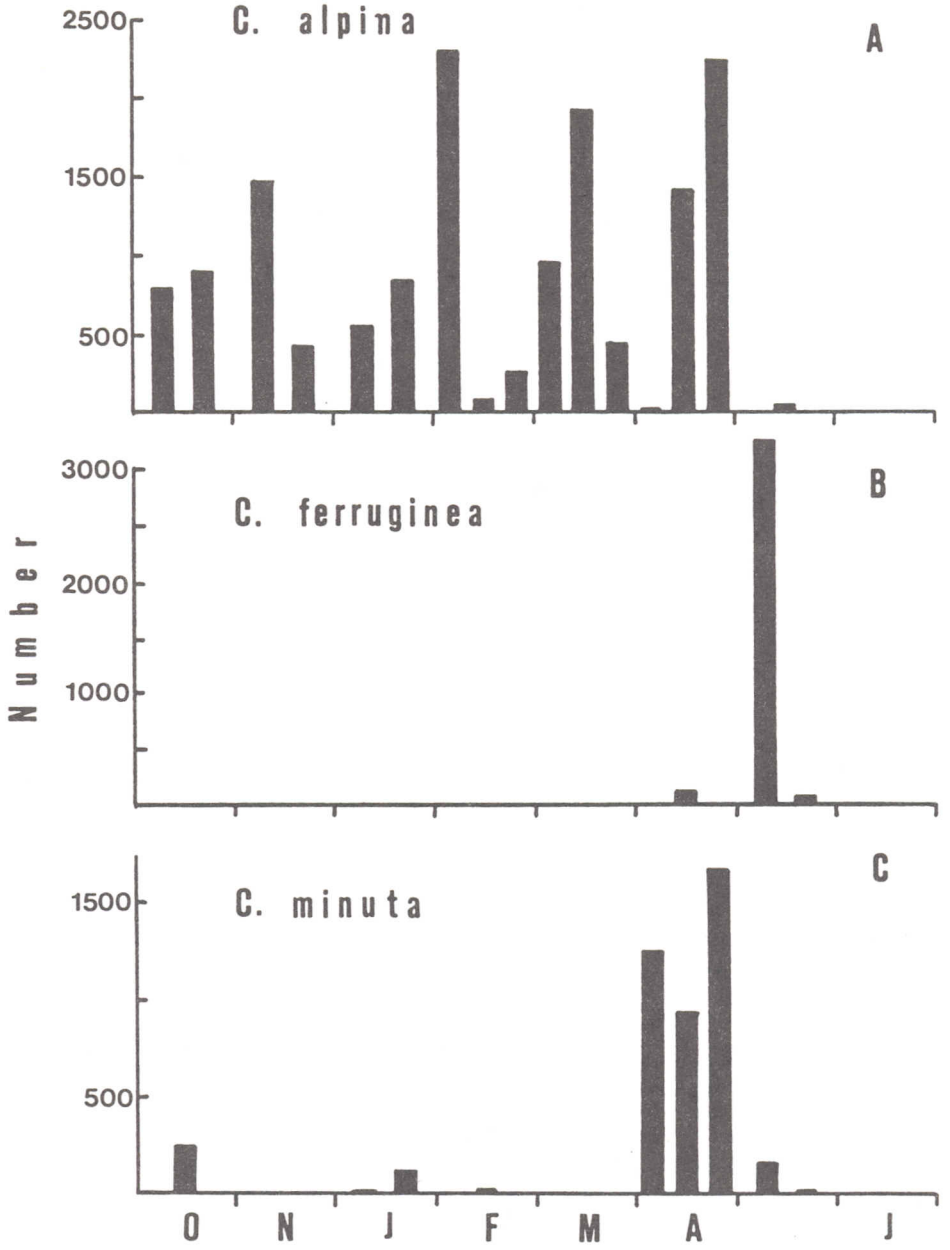

Fig. 6. Population trends of Dunlins, Curlew Sandpipers and Little Stints from October 1987 to June 1988.

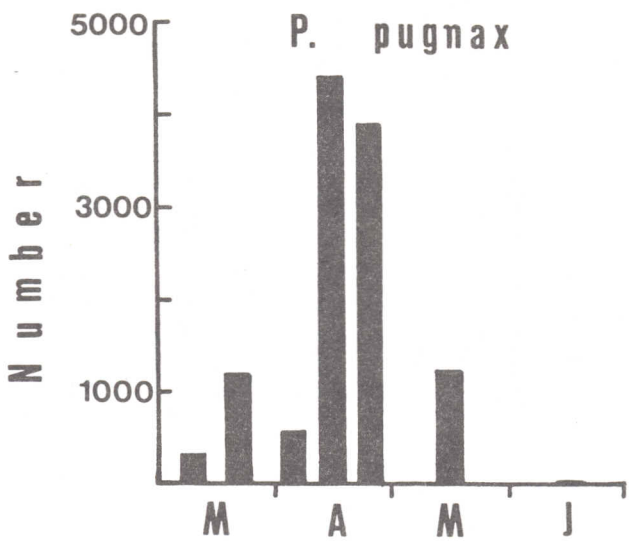

Fig. 7. Population trends of Ruffs from March to June 1988. The period from October 1987 to February 1988 was excluded from the histogram because no Ruffs were observed during these months.

Tringa erythropus (Spotted Redshank, Fig. 9C)

Spotted Redshanks occurred on migration, especially in spring, when numbers increased from March to the end of April, the peak numbers being 1372 birds. All birds disappeared around mid-May. Overall, the estuarine mudflats of the coastal habitat and the saltmarshes of the lower delta were of almost of equal importance, while the mudflats of the upper delta were less important (Tab. 1).

Tringa totanus (Redshank, Fig. 10)

Redshanks occurred in the Delta throughout the study period but their numbers were by far the greatest in autumn, especially in October. A second peak took place in March but it was only half to two-thirds of the autumn peak. A small number of pairs bred. Redshanks were observed in all Delta zones. The largest proportion occurred on the coastal flats and the smallest in the lower and upper delta regions (Tab. 1).

Fig. 8. Distribution of Ruffs ih the Evros Delta during the study.

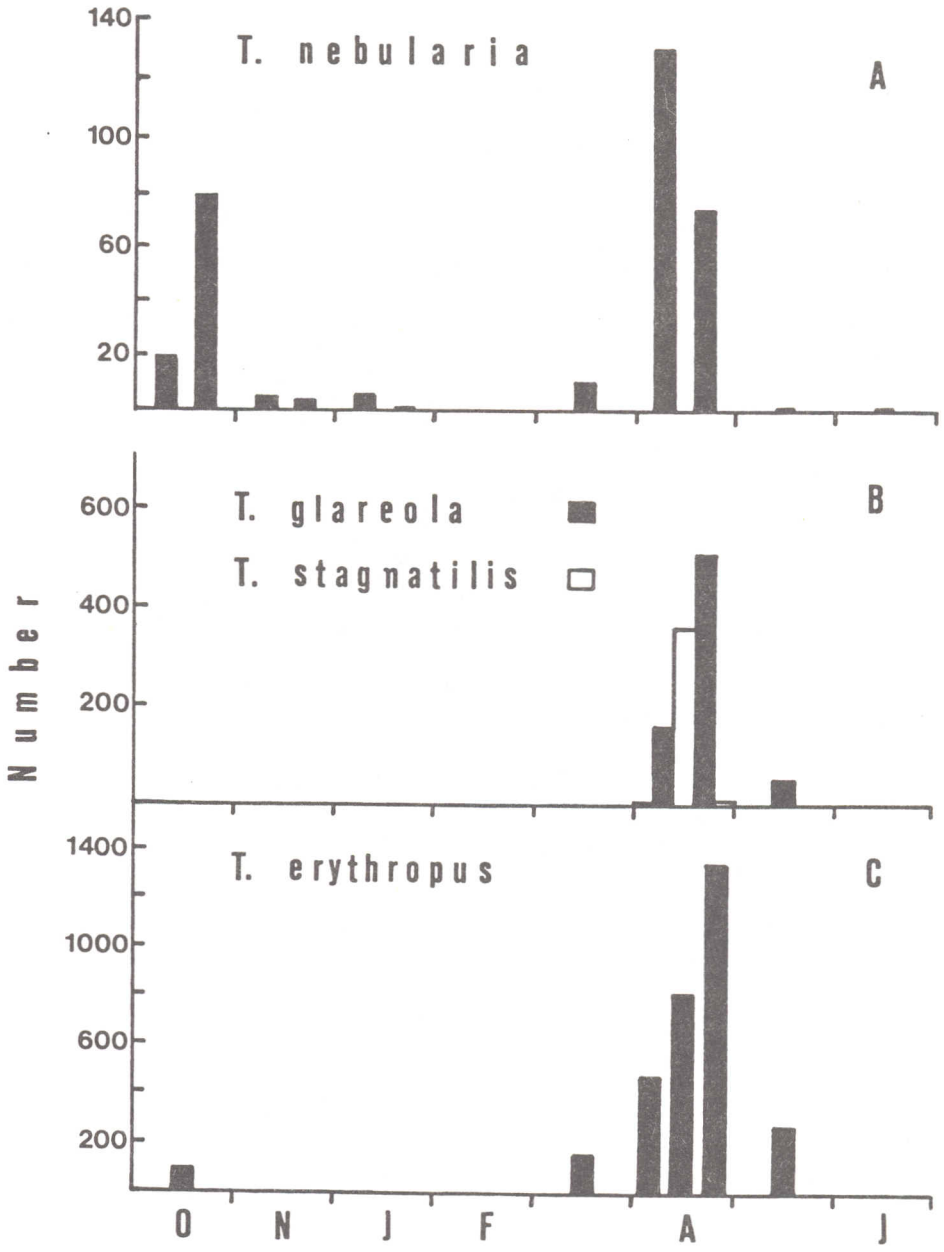

Fig. 9. Population trends of Greenshanks, Wood Sandpipers, Marsh Sandpipers and Spotted Redshanks from October 1987 to June 1988.

Tringa stagnatilis (Marsh Sandpiper, Fig. 9B)

Clearly spring migrants, Marsh Sandripers peaked sharply in numbers in mid-April, then decreased rapidly up to the end of the month so that no birds were seen by the beginning of May. They mainly used the estuarine flats of the coastal region. They also used the lower delta but hardly occurred in the upper delta (Tab. 1). They fed in temporary brackish marshes, often with Wood Sandpipers and Ruffs.

Tringa nebularia (Greenshank, Fig. 9A)

Only low numbers were generally seen during the study. Although observed on most visits, the highest numbers of Greenshanks occurred during the autumn and, especially, the spring migration. Greenshanks used all Delta zones but the estuary in the coastal region was more important than the other two (Tab. 1).

Tringa glareola (Wood Sandpiper, Fig. 9B)

Wood Sandpipers appeared at the beginning of April on migration with a peak in the second fortnight of the month. Movements stopped at the beginning of May. The numbers observed in 1988 were much higher than in 1987 (max 23, van Vestrienen 1988), due to the greater availability of feeding habitats. Wood Sandpipers occurred mainly on the temporary brackish water marshes of the lower delta but also on the temporary frech water marshes of the upper delta (Fig. 11, Tab. 1).

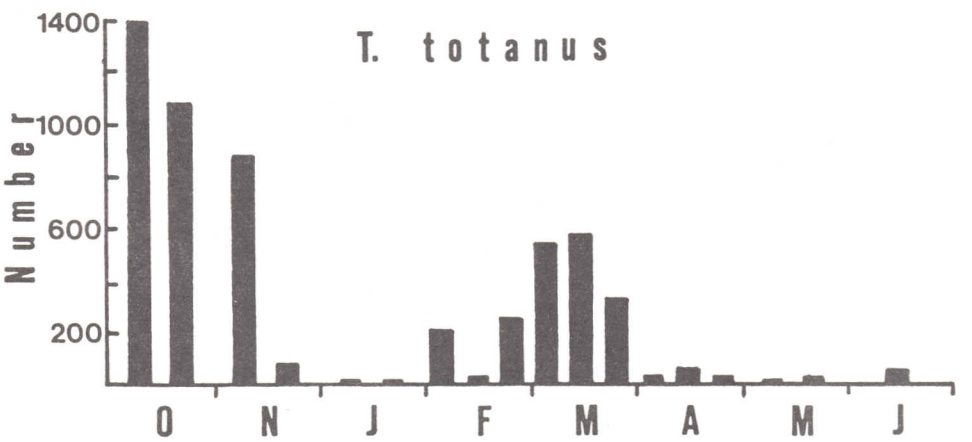

Fig. 10. Population trends of Redshanks from October 1987 to June 1988.

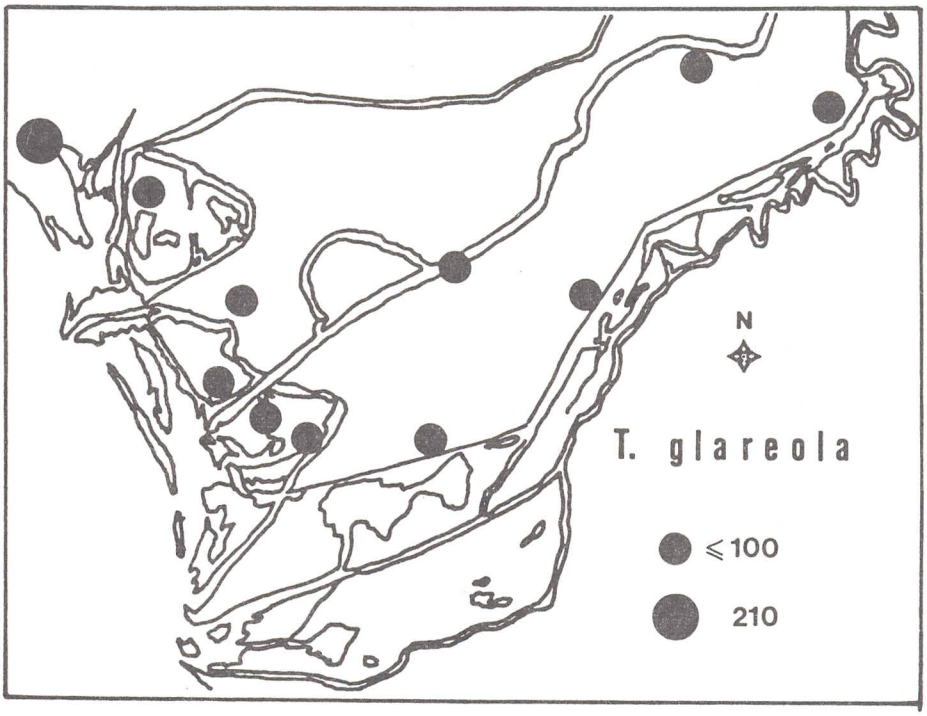

Fig. 11. Distribution of Wood Sandpipers in the Evros Delta during the study.

Tringa ochropus (Green Sandpiper, Fig. 12)

Only a few occasional birds were seen before the third part of March. Thereafter, until almost mid-May, they were seen regularly on spring migration, the peak being at the end of March. However their numbers were generally low. Green Sandpipers were mainly seen at temporary brackish marshes in the lower delta and freshwater riverine mudflats of the upper delta (Tab. 1).

Tringa hypoleucos (Common Sandpiper)

There are only a few records of this species, all occurring in the lower delta: one bird on 12 April, 7 on 29 April, 12 on 30 April and 2 on 1 May (spring migration).

Limosa limosa (Black-tailed Godwit, Fig. 13C)

A few Black-tailed Godwits were seen between October and March, the maximum numbers being counted on migration during the last ten days of March.

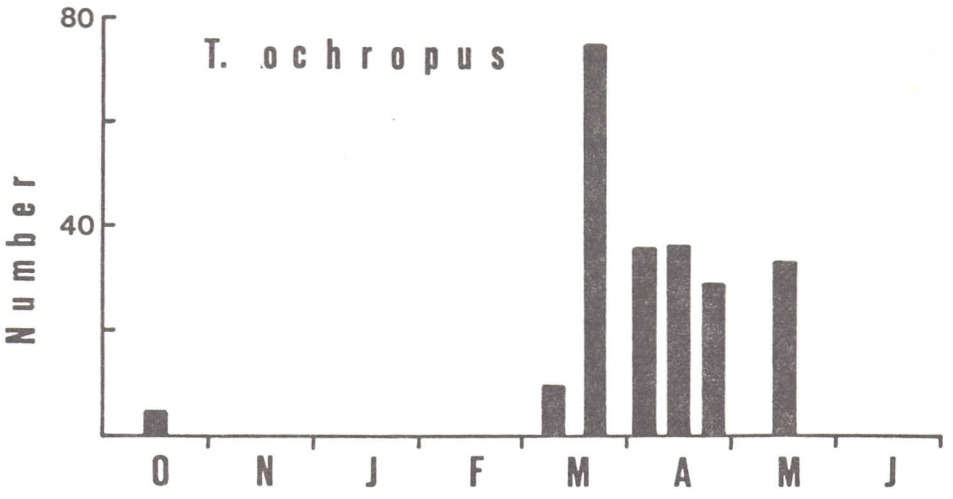

Fig. 12. Population trends of Green Sandpipers from October 1987 to June 1988.

Very few were present in April and there were none thereafter. These shorebirds used all the zones, of the delta. They especially used the lower delta (Tab. 1). Temporary fresh and brackish water marshes were used in the upper and west delta regions while sandflats were used in the coastal region.

Limosa lapponica (Bar-tailed Godwit)

Bar-tailed Godwits were observed only twice during the study: one bird on 8 January and four on 25 March. All of them were seen resting on sand-bars of the west coastal region.

Numenius arquata (Curlew, Fig. 13A)

Curlew occurred commonly during the study. Their population consisted primarily of migrating and wintering birds. Large numbers occurred in October and early November on autumn migration. They decreased in numbers in winter but increased rapidly from the end of February to the beginning of March during spring migration. After mid-April, only small numbers were seen, but their origin is unknown. Curlews fed mainly on muddy-sand coastal flats (Tab. 1). When these were covered with sea water, they used mainly tidal salt-marshes in the lower delta.

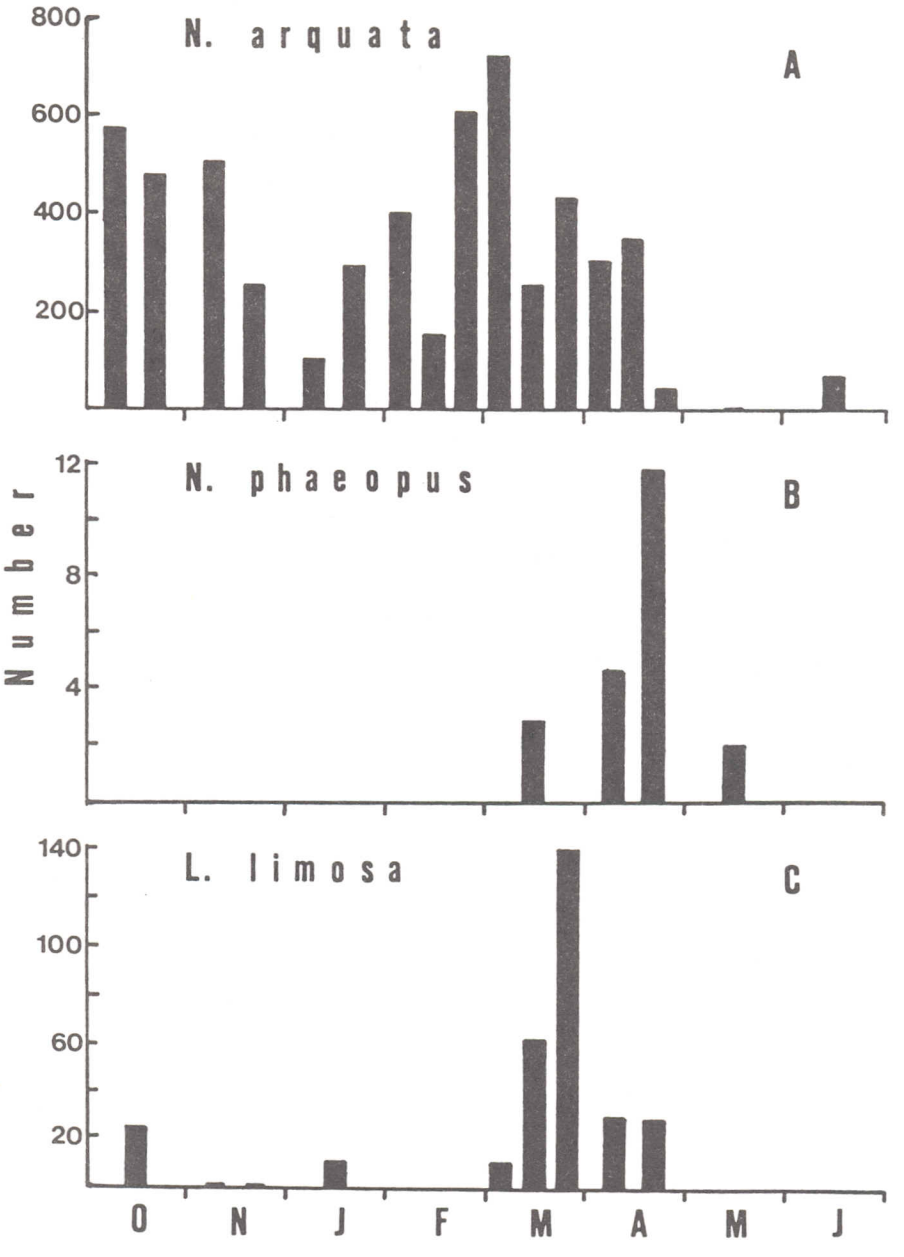

Fig. 13. Population trends of Curlews, Whimbrels and Black-tailed Godwits from October 1987 to June 1988.

Numenius phaeopus (Whimbrel, Fig. 13B) and *N. tenuirostris* (Slender-billed Curlew)

Whimbrels occurred mainly on migration between the end of March and the beginning of May, with a maximum of 12 birds being seen on 30 April. They mostly used the tidal saltmarshes of the lower delta and the sandy flats and beaches of the west coastal region.

Slender-billed Curlews were extremely rare during the study. They were seen only twice by our working group (nine on 6 March, seven on 4 April) and once by other observers (one or two on 15 April). All these records were in the lower delta. Slender-billed Curlews have been observed repeatedly in the Delta in the past. The area is the most important staging wetland for these birds in the whole western Palearctic (Goutner & Handrinos, 1990).

Gallinago gallinago (Snipe)

Snipes were occasionally seen in the upper and lower delta: two on 24 October, two on 6 February, four on 20 March, three on 27 March and four on 15 April.

Gallinago media (Great Snipe)

Great Sniper were occasionally seen in the upper and lower delta: two on 24 October, two on 6 February, four on 20 March and four on 15 April.

Himantopus himantopus (Black-winged Stilt, Fig. 14)

A few birds were observed on autumn migration, but the largest numbers were seen in April on spring migration, with a peak occuring in the middle of the month. After population had declined, a very small number of pairs (< 10) bred. The breeding population declined dramatically at the beginning of the 1980s due to drainage and general habitat destruction (Goutner, 1983 b). During this study, the Black-winged Stilts used the lower delta (Tab. 1, Fig. 15). They used temporary fresh and brackish water marshes in the western delta region and rain-water-flooded mudflats elsewhere.

Recurvirostra avosetta (Avocet, Fig. 16, Fig. 17)

Avocets were present during the whole study period, their numbers varying with the season. The highest population was counted during winter, with a peak on 6 February 1988. The 1100 birds counted on that occasion was the highest number seen during the last ten years in the Delta. About 3100 Avocets were observed in the same month in 1965 (Bauer & Müller, 1969). The increase in the Avocet population in the winter of 1988 may have been related to the outflow of large amounts of freshwater into the estuary following a period of high rainfall, thus producing the brackish environement favoured by Avocets (Wolff,

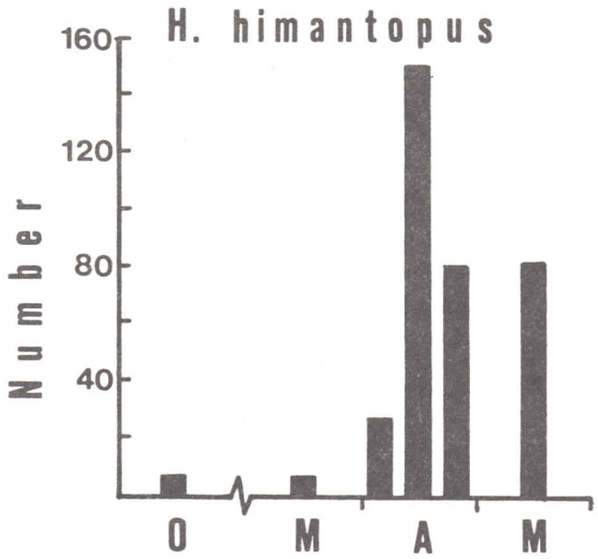

Fig. 14. Population trends of Black-winged Stilts from October 1987 to June 1988.

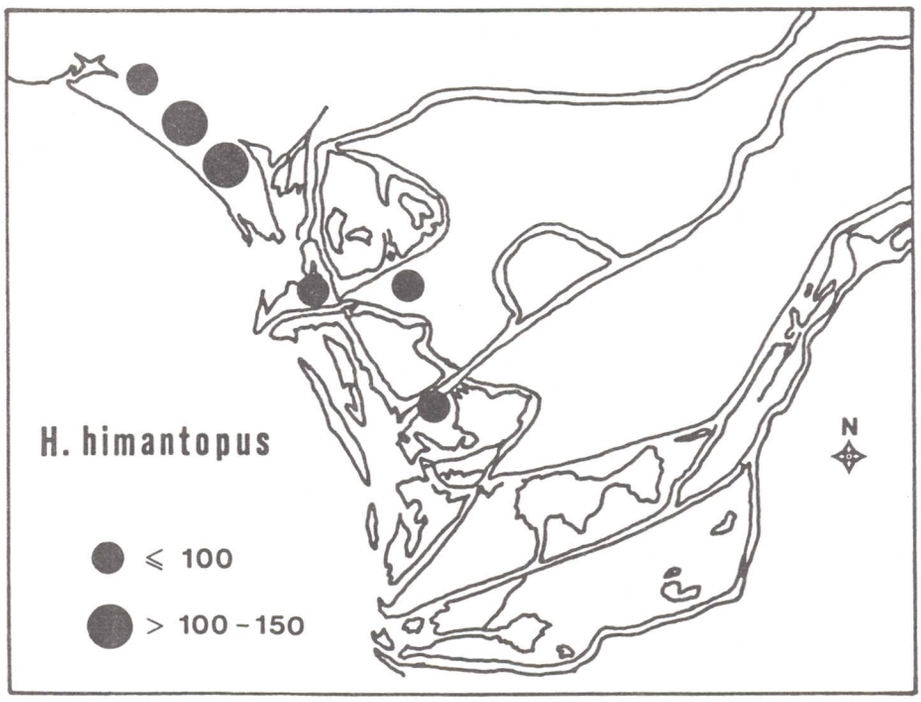

Fig. 15. Distribution of Black-winged Stilts in the Evros Delta Stilts during the study.

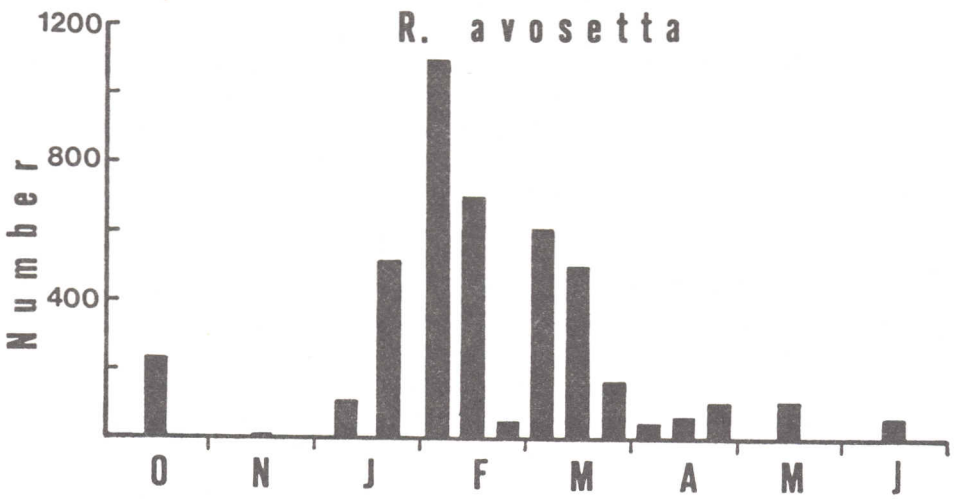

Fig. 16. Population trends of Avocets from October 1987 to June 1988.

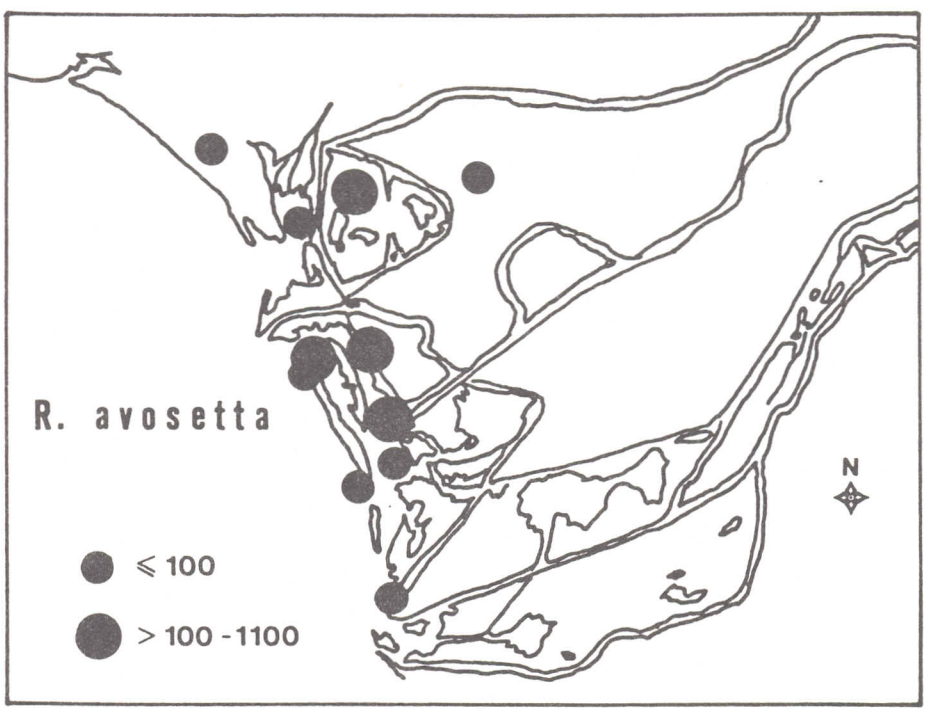

Fig. 17. Distribution of Avocets in the Evros Delta during the study.

1969, Goutner, 1983 a, b). Their most important sites were the river estuary in the coastal region, the Drana lagoon and the temporary brackish water marshes in the west region of the Delta (Tab. 1). After mid-March, the population remaining was low and only a few pairs bred. Their breeding population declined greatly after 1983 because of disturbance caused by grazing over the breeding areas in the Drana islets (Goutner, 1985 and unpublished data). After 1987, the Avocet was practically exterminated as a breeding species when the Drana lagoon, their stronghold in the Delta, was destroyed (Goutner & Jerrentrup, 1987).

2. *Seasonal changes in shorebird populations.*

By combining the numbers of all species of shorebirds counted on each visit, we described the seasonal changes in their overall numbers (Fig. 18). The total numbers were similar in autumn (October) and early spring (March) but increased dramatically during the second half of April. Thereafter they declined rapidly to reach a minimum in June. The population levels in winter were lower than in either autumn or spring except at the beginning of February.

The species richness also showed seasonal changes with minimum values generally being obtained in late autumn and winter (Fig. 18). A rapid increase occurred in spring when the maximum values were observed. In summer, breeding species were mainly present (nine out of 11 present, see also Goutner, 1983 b).

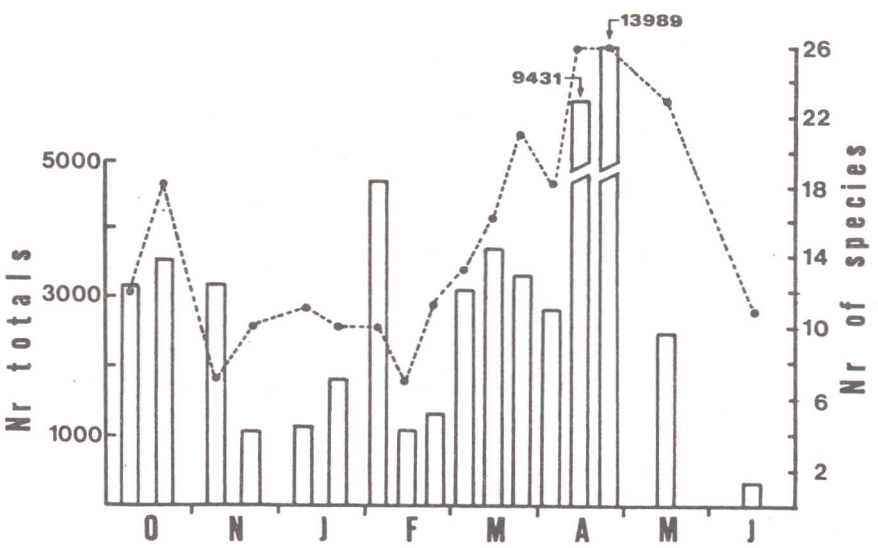

Fig. 18. Trends of overall numbers and species richness of shorebirds in the Evros Delta from October 1987 to June 1988.

Population size was positively correlated with species richness ($r = 0.569$, $P < 0.01$, $df = 16$. Spearman Rank Correlation Coefficient, two-tailed test). But despite this, it was the high numbers of just a few species that dominated all of others. This relative dominance changed over the seasons and sudden changes sometimes occurred between successive visits (Tab. 3). For example, in October, the most abundant shorebird was Redshank. From the beginning of November to the end of March, Dunlins were dominant, except for two occasions in February when Avocets and Curlews were numerically dominant because of their early peaks in migration. A noticeable change in species composition took place at the end of March with the appearance of the spring migrants. During this period, Ruff was by far the most dominant species, apart from the beginning of April when Little Stints peaked during their spring migration. Simultaneously, other species, such as Spotted Redshank and Curlew Sandpiper, were present in occasionally high numbers (Tab. 3). Finally, by June, the dominant species was the Collared Pratincole, a colonially breeding species.

3. *Conservation*

Shorebirds are an important bird group in Mediterranean wetlands and the numbers recorded in Greece make the area very important within the whole Basin (Smit, 1986). Furthermore, several species occur there that are quite rare, taking the Western Palearctic as a whole. The Evros Delta provides a good example of the importance of Greece. Of 12 shorebird species protected by the European Community Directive 79/409 - 85/411, 11 have been recorded in the Delta.

The knowledge needed for the conservation of all the species, including unprotected ones, and their habitats is increasing. The factors affecting the presence, distribution and numbers of shorebirds in the Delta are summarized in Tab. 4. For the purposes of conservation, we separated them into habitats of "natural" and "of human origin". But in reality, human and natural factors are interrelated. Of the "natural" factors, seasonal cycles, habitat preferences, rainfall and tides are not directly influenced by Man in the region. Rainfall is particularly important being a prime factor which regulates the occurrence of feeding habitats for many shorebirds: due to annual variations in rainfall, the distribution of habitats in the Delta, particularly during migration, varies greatly from year to year (Goutner, 1983 a,b, Goutner, & Kazantzidis, 1989, this study, van Vestrienen, 1988, Meininger, 1990). The tides of the region, being of the low amplitude, Mediterranean type, are greatly affected by wind direction and strength (Variagin, 1975). The significance of the tidal cycle to shorebirds, especially those related to foraging rhythms, is therefore not comparable to their significance in intertidal areas bordering

Tab. 3. Relative proportions of shorebird populations in the Evros Delta during the study. Underlined numbers are these of the dominant species in each visit. Proportions of less than 5% were combined in one category.

	1987				1988												
	OCT.		NOV.		JAN.		FEB.		MAR.				APR.			MAY	JUNE
	10-11	24-28	7-8	19-20	8-10	20-21	5-6	20-21	26-28	4-6	19-20	25-27	3-4	12-15	28-30	7-9	5-7
T. totanus	44.5	30.6	29.2	7.8	—	—	—	—	18.3	17.2	15.5	9.8	—	—	—	—	10.8
C. alpina	24.9	25.5	46.1	40.2	49.9	43.7	48.6	9.4	20.1	29.8	51.4	13.6	—	15.1	16.0	—	—
N. arquata	18.8	13.5	16.0	23.7	9.1	16.3	8.4	14.1	47.4	23.0	7.1	13.6	10.5	—	—	—	24.4
P. squatarola	5.4	5.7	8.2	14.5	15.0	—	—	—	—	—	—	6.4	—	—	—	—	—
C. minuta	—	6.9	—	—	—	7.2	—	—	—	—	—	—	44.2	9.3	12.0	6.0	—
R. avosetta	—	6.6	—	—	9.9	28.8	23.2	64.9	—	19.6	13.6	5.0	—	—	—	—	11.5
P. pugnax	—	—	—	—	—	—	—	—	—	—	8.4	34.3	20.7	47.1	28.0	49.0	—
V. vanellus	—	—	—	—	8.4	—	12.7	—	—	—	—	—	—	—	—	—	—
T. erythropus	—	—	—	—	—	—	—	—	—	—	—	—	16.7	8.9	9.8	11.0	—
C. ferruginea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23.5	—	—
C. alba	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7.5	—
C. alexandrinus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9.8
H. ostralegus	—	—	—	10.2	—	—	—	—	—	—	—	—	—	—	—	—	10.2
G. pratincola	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	27.8
Others (combined	6.8	11.2	0.6	3.4	7.5	4.0	7.0	11.5	14.1	10.4	3.9	17.3	7.8	19.5	10.8	26.5	5.4
and Nr of spp.)	8	12	3	5	6	6	6	4	8	9	11	15	14	22	21	19	5

the open oceans (Goss-Custard, 1969, Heppleston, 1971, Goss-Custard *et al.*, 1977 a, b, Kersten *et al.*, 1983, Englemoer *et al.*, 1984, Leewis *et al.*, 1984, and others). The role of the tidal cycle, and the additional influence of the wind upon the life cycles of shorebirds in the Delta has not yet been adequately studied, although there are indications that they affect their distribution (Goutner, 1983 b) and the timing of laying (Goutner, 1986) of some species.

The Delta has long been subjected to human influence and, consequently, shorebirds have also been affected. Habitat destruction, especially of breeding areas, has continued until the present times (see Tab. 4 for references). Just after the end of this study, valuable feeding habitats in the lower delta, situated at the west region of the Delta, were drained for reclamation. Another recent destruction of breeding, feeding and resting habitats of shorebirds, and other rare waterbirds, was the draining of the Drana lagoon in May 1987 (Goutner & Jerrentrup, 1987). In the past, the reproduction of rare shorebirds, like Black-

Tab. 4. References for factors affecting presence, distribution and numbers of shorebirds in the Evros Delta.

A. NATURAL FACTORS
1. **Seasonal Cycles:** Britton & Hafner, 1978, Goutner, 1983 a, Goutner & Kazanzidis, 1989, Goutner & Handrinos, 1990, this study.
2. **Habitat (feeding, resting, breeding) preferences and availadility:** Goutner, 1983 a, b, 1985, Goutner & Goutner, 1987, this study.
3. **Rainfall:** Goutner, 1983 a, b, Goutner & Kazantzidis, 1989, this study.
4. **Water salinity:** Goutner, 1983 a.
5. **Tides:** Goutner, 1983 b, 1986.
6. **Predation (of eggs and chicks in the breeding season):** Goutner, 1983 a, b, 1985.
B. FACTORS OF HUMAN ORIGIN
1. **Habitat destruction:** Goutner, 1983 a, b, 1985, Goutner & Jerrentrup, 1987, this study.
2. **Regulation of water regime:** Britton & Hafner, 1978, Goutner, 1983 a, b, 1985, Goutner & Jerrentrup, 1987, Goutner & Kazantzidis, 1989.
3. **Grazing over breeding grounds:** Goutner, 1983 a, b, 1985.
4. **Hunting:** Goutner & Kazantzidis, 1989, this study.

winged Stilts, Avocets and Spur-winged Plovers, have frequently been destroyed by cattle grazing on breeding grounds (Goutner 1983 a, b, 1985).

The regulation of the water regime has proved to be a valuable tool in the conservation and management of shorebirds and other waterbirds (Scott, 1982, Beintema, 1986, Clay & Nelson, 1986, Davidson & Evans, 1986, Britton & Johnson, 1987, and others). In the Delta, water regulation can be an extremely important technique in dry seasons and in late summer, when rain-water evaporates from temporary mudflats. In 1980, the inflow of freshwater into particular areas of the Delta encouraged reproduction of the Black-winged Stilts and Avocets in sites that had not been used before, and also attracted large numbers of moulting shorebirds (Goutner, 1983 b). A major problem with this practice, however, is the adequate availability of freshwater. This is much used by the farmers for irrigation, especially in years of drought. A further difficulty is the poor management of freshwater resources in the Delta. This can mean that even when water is available for conservation purposes, it is lost either by draining or mismanagement.

Hunting presents a problem for all birds wintering in the Delta. Protected species of shorebirds are killed whenever possible, mainly in the estuarine and eastern border regions. As the hunting season is quite long (15 September - 10 March), protected migrant species are killed in unknown numbers. Illegal shooting, in combination with habitat destruction may have severe destructive effects on extremely rare migrants such as the Slender-billed Curlews, for which many aspects of the biology are still unknown (Cramp & Simmons, 1983, Goutner & Handrinos, 1990).

In general, the lower delta and coastal region were more important zones for shorebirds than the upper delta (Goutner & Kazantzidis, 1989, Tab. 1). For some species however (*T. nebularia, V. vanellus*), the upper delta was more significant than any of the others; for some other species (*P. pugnax, T. glareola, T. ochropus*), the upper delta was used more than the coastal region. For some species (*T. totanus, T. erythropus, L. limosa)*, the upper delta was an area of noticeable significanse (Tab. 1). Although the shorebird distribution over these three zones is related to their seasonal appearance, habitat, and food preferences and to other factors like tides, weather and rainfall (Tab. 4), it is clear that all of the zones are required as minimum protection for this group.

This paper has discussed the conservation of a particular group of birds. But the problem is that in the Delta, and in Greece in general, it is quite difficult to promote the protection of a single bird species or of a group of related species. It follows that the first step must be to preserve the remaining natural habitats that are important for wildlife in general and which have shrunk dramatically in recent times. Sadly, the responsible Ministries,

Authorities and local people have exhibited a disappointing indifference towards conservation of the Delta. Indeed, quite frequently they acted directly against any concrete protection measures.

The following measures should urgently be taken for the conservation of the Delta habitats in general, and of shorebirds in particular:

1) The adoption and law enforcement of the limits of the Delta proposed in 1984 (MEPPW project mentioned).

2) The stopping of any drainage scheme.

3) The control and better management of freshwater resources over the whole of the Delta region.

4) The strict control of hunting and a shortening of the hunting season (1 November to 28 February).

5) The restoration of degraded habitats which have been invaluable for shorebirds in the past. Such habitats are the Drana lagoon and its surrounding mudflats and the marshes and mudflats of the west delta region and upper delta.

6) The control of grazing, especially on the Drana islets. Grazing should only be allowed between 1 August and 15 March to control the vegetation.

7) If such measures were taken, it would be possible to apply some more specific management schemes in particular areas for attracting particular shorebirds. Such schemes could be based on existing information though specialized aspects could be the object of total specific studies.

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Acknowledgments

This paper was written within the framework of a project jointly scheduled by the Royal Society for the Protection of Birds and the Hellenic Ornithological Society, aiming in conservation of Slender-billed Curlews and Lesser White-fronted Geese in the Evros delta. We especially thank Mr Alistair Gammell for encouragement and all colleagues, especially George Handrinos for fieldwork participation and Christos Goutner for various help. The project was supported by an E. C., D. G. XI grant. Dr J. D. Goss-Custard made useful comments and a linguistic correction of the manuscript.

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