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# **TOWARDS A MANAGEMENT PLAN FOR COLONIAL WATERBIRDS NESTING AT THE DRANA LAGOON, EVROS DELTA, GREECE**

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## **INTRODUCTION**

In our increasingly changing world natural ecosystems cannot be left to their own fate. Mediterranean wetlands are widely diverse systems with a variety of habitats and the kind of ecosystems that traditionally attracted the attention of man. They have been drained and altered to such a degree that their very existence is threatened. The reasons for this have been widely considered during recent decades (the Mediterranean lagoons and saltmarshes are summarised by Goutner

1994). Each habitat should be managed in a manner fitting to its structure and function as well as its unique characteristics. In the Mediterranean, integrated management of lagoons and saltmarshes and consideration for the welfare of waterbirds is uncommon. The most important managing procedures are probably those that have been applied in the Camargue, southern France, through a long-term programme of habitat monitoring (Bassett 1980). Mediterranean lagoons are important for wintering waterfowl (Tamisier 1979, Verhoeven 1980, Ferrer 1982, Allouche & Tamisier 1984, Joensen & Madsen 1985). Lagoon islands and their saltmarsh vegetation constitute important breeding habitat for a variety of waterbirds (Blondel & Isenmann 1981, Goutner 1983b, 1985, Atta 1986, Fasola et al. 1993, Walmsley & Duncan 1993, Walmsley 1994). Use of such islands is encouraged by their isolation and avoidance of ground predators (Buckley & Buckley 1978).

The Drana Lagoon, in the Evros Delta and a wetland of international importance, was drained by the local inhabitants in 1987 (Goutner & Jerrentrup 1987) and has not been restored since. The purpose of this paper is to indicate the significance of the Drana Lagoon islands for breeding colonial waterbirds contributing to their conservation by a suitable restoration of the lagoon.

## STUDY AREA

The Drana Lagoon is an area of about 400 ha situated in the north-western part of the Evros Delta (Figure 1, see also Goutner & Kazantzidis 1989). This natural lagoon area was surrounded by dykes in 1975. Formerly the lagoon had a maximum depth of about 1.20 m and communicated with the sea through a 4 m wide channel. The salinity varied seasonally from 37.5 g/l to 55g/l (Britton & Hafner 1978) and was used for fish farming until it was drained. On 11 May 1987, people from the community of Loutros blocked the single 4 m wide connection of the lagoon to the sea. They also broke parts of eastern dykes draining water away from the lagoon.

During the course of ornithological studies the vegetation has been described in some detail for a number of these islands (Goutner 1985, 1987a, 1987b, 1990). Islands were covered by saltmarsh vegetation where dominating species were *halocnemum strobilaceum*, *Halimione portulacoides*, *Arthrocnemum fruticosum* and *Artemisia monogyne* and included low-level plains adjacent to open water. These plants have the form of low bushes leaving almost no unvegetated gaps except *H. strobilaceum*. Most of the islands (between them two breeding 1 and 3) were irregularly grazed by 30-40 cows.

The Drana Lagoon was rich in *Ruppia cirrhosa* beds (Britton & Hafner 1978) and was declared a non-hunting area by the local authorities thus attracting many waterfowl in winter (Goutner & Jerrentrup 1987). The area was also protected by the Ramsar Convention, the EC

Bird Directive 79/409 and by a Ministerial Decree (N° 3130/3.5.1980). The surrounding dykes were used by thousands pairs of Sand Martins *Riparia riparia* and a number of Bee Eaters *Merops apiaster*.

The coastal part of the Evros Delta includes some sandy islands and sandbars which were also used by some of the study species (for maps see Goutner 1990, Fasola et al. 1993). These habitats are within 2-5 km far from the Drana Lagoon. They comprise mainly of sand dunes and are partly covered by ammophile and halophytic vegetation. Species such as *Elymus giganteus*, *Phragmites australis*, *Xanthium strumarium*, *Halimione portulacoides* and *Tamarix smyrnensis* are common on these islands (Babalonas 1979, Goutner 1986a). Some huts have been built by local fishermen and tourists guided by local people visit the islands occasionally in spring and summer.

## MATERIALS AND METHODS

From 1980 to 1989 the populations of colonial waterbirds nesting on the islands of the Drana Lagoon and on those of the coastal region of the Evros Delta were monitored. The species studied were the Avocet *Recurvirostra avocetta*, Collared Pratincole *Glareola pratincola*, Common Tern *Sterna hirundo*, Little Tern *Sterna albifrons*, Gull-billed Tern *Sterna nilotica* and Mediterranean Gull *Larus melanocephalus*. Their distribution was mapped and nest counts made during the breeding season (late April to late July). Data on the

structure of the Drana islands were measured both in the field and also on official maps based on aerial photographs.

## RESULTS

### **Use of the Drana Lagoon by breeding colonial waterbirds**

#### \* Avocet *Recurvirostra avocetta*

The Drana Lagoon supported the highest numbers of breeding Avocets in the Evros Delta in all the study years. Maximum populations were 133 and 120 pairs in 1981 and 1982 respectively falling greatly thereafter to only 26 pairs in 1986 (Figure 2) and practically disappearing in 1987 (our unpubl. data). The preference of Avocets for particular islands and consequently the population distribution on the Drana Lagoon islands changed over the years (Goutner 1985, 1987b). In total, from 1981 to 1986, two of the islands (2 and 3, Figure 1) had most of the population, but a few other sites were also used (Table 1). Islands close to the periphery of the lagoon were only used occasionally (Goutner 1985, 1987b). A part of the population (probably failed early breeders) used dykes elsewhere in the Delta in 1980 (Goutner 1985), but this case is not considered here.

\* Collared Pratincole *Glareola pratincola*

Since 1981, the Collared Pratincole showed a clear preference for the Drana Lagoon (Figure 2), and partly preferred a coastal sandy island during all study years. The maximum Drana Lagoon populations were 110 pairs in 1981 and 100 in 1982, constituting more than 55% of the Evros Delta population, falling to 54 pairs in 1986, constituting 84% of the total (Figure 2). In total, from 1981 to 1986 two of the Drana islands (2 and 3) held the highest proportion of the Pratincole population in the Delta whereas another (1) was used by a much lower number of pairs (Table 1). Peripheral islands were never used by this species.

\* Common Tern *Sterna hirundo*

The breeding population of the Evros Delta did not show considerable variations in size except for the peak of in 1985 (Figure 2). However, there was a progressive and prominent preference for the Drana Lagoon by the Common Tern where the population increased from only 5 pairs in 1981 (c. 4% of the total) to a maximum of 366 in 1985 (c. 90% of the total). Island 2 was by far the most important breeding site for the Common Tern followed by island 1 and island 5 (Table 1). A few pairs only used island 3.

\* Little Tern *Sterna albifrons*

Although the population in the Delta varied from a minimum of 80 pairs in 1981 to a maximum of 459 in 1985, the respective population proportions using the



Drana islands were 0% and 27% (Figure 2). The number of breeding pairs in the Drana Lagoon correlated to the total population of Little Terns in the Delta =W (Goutner 1990), suggesting that a population increase rather than a habitat preference of Little Terns forced them use the Drana Lagoon islands. The most preferred site was island 3, then 2,1 and 4 (Table 1).

\* Gull-billed Tern *Sterna nilotica*

Since 1982 the Gull-billed Tern breeding population in the Evros Delta preferred the Drana Lagoon islands (Figure 2) but up to 1984 a number of pairs used a coastal island. From 1982 to 1985-86 the proportions of the Delta Gull-billed Tern breeding population on the Drana Lagoon islands increased from 56.5% to 100%. Nevertheless, on the whole, the population in the Delta gradually declined from a maximum of 115 pairs in 1982 to only 20 pairs in 1986 (Figure 2). Only island 2 of the Drana Lagoon was preferred (Table 1) and in 1985 and 1986 it was the only site used by this species for breeding in the Evros Delta (our unpubl. data).

\* Mediterranean Gull *Larus melanocephalus*

Mediterranean Gulls bred for the first time in the Evros Delta in 1981 (Goutner, 1986a). Their population showed considerable fluctuations through the years, from a minimum of 170 pairs in 1983 to c. 990 pairs in 1985, and from 1983 to 1986 preferred to breed exclusively the Drana Lagoon (Figure 2). In 1982, 300 Mediterranean Gulls assembled on island 2 but did not breed (Goutner

1986a). Only island 2 in the Drana Lagoon was used by breeding Mediterranean Gulls (Table 1).

In total, 3,883 nests of six species of colonial waterbirds were recorded on the Drana Lagoon islands from 1981 to 1986. Of these the highest numbers belonged to the Mediterranean Gull (1568 pairs) followed by the Common Tern (941), Avocet and Collared Pratincole in similar numbers (374 vs 399) and by the Little and Gull-billed Tern (339 and 262 respectively) (Table 1).

Of the six islands preferred by the bird species studied, island 2 was by far the most important. In total, from 1981 to 1986 it attracted about 80% of the breeding populations and was used for 29 (out of 31 available) bird-seasons (Table 1). Island 3 followed in importance, attracting 13% of the populations in 16 bird-seasons. Island 1 attracted about 3% of the populations in five bird-seasons while two sites were only used occasionally. Island 6 was used by nine pairs of Avocets in 1980 (Goutner 1985), but islands 7-12 (Figure 1) were not used by the birds during the study period.

In 1987 and 1988 the former Drana Lagoon area was dry and no islands were available to colonial waterbirds. In these years the total breeding populations used the islands of the coastal area of the Delta (Table 2).

## **AN ENVIRONMENTAL EXPERIMENT**

In 1988 the local inhabitants, in agreement with the Ministry of the Environment Housing and Public Works constructed sluices on the north and eastern dykes of the

Drana Lagoon. The aim was to allow freshwater from a nearby torrent and channel associated to the Evros river to flow into the area to reduce the salinity risk to surrounding cultivations. It is noteworthy that this management action was not directed towards the restoration of wildlife values of the Drana Lagoon. From December 1988 to June 1989 great amounts of fresh water from abundant winter and spring rainfall of that year (Goutner & Kazantzidis 1989) were allowed to flow into the former lagoon area. At the beginning of June 1989, the area had the appearance of a freshwater lake (salinity averaged 6‰ which is a brackish environment). In the same year, a good number of breeding colonial waterbirds were found again on the islands 2 and 3 of the Drana area (Table 2).

The whole Evros Delta population of Avocets, Gull-billed Terns and Mediterranean Gulls bred on the Drana area islands. Most Collared Pratincoles and Common Terns (95% and 80% respectively) also bred on the Drana area islands but only 25% of the Little Tern population. This was the first time that the Mediterranean Gull and Gull-billed Tern have bred on island 3. That same year, breeding Mediterranean Gull numbers increased to 1,040 pairs, the highest ever recorded in the Evros Delta. The Drana area again attracted the majority of the Evros Delta population of breeding Laridae. From 1989 to 1994 there were very small amounts of water remaining in the former lagoon during the breeding season. Thus the islands in the Drana area have not been used by breeding colonial waterbirds.

## DISCUSSION

Nest site selection in Gulls and Terns is frequently a compromise between avoidance of predators and disturbance, flooding and vegetation increase (Burger & Lesser 1978, Kotliar & Burger 1986, Storey 1986). The absence of breeding birds on the former Drana islands in 1987 and 1988, and their recolonization in 1989, suggests that the presence of water was very important for isolation from terrestrial predators and in encouraging birds to breed on the islands. The average distance of the most populated islands 1, 2 and 3 to the mainland was 360 m, significantly greater to that of the other islands (4-12) with an average distance of 76 m ( $U=24$ ,  $P=0.01$ , Mann-Whitney U-Test). Thus, the distance of Drana islands from the mainland could also be an important habitat selection factor for breeding populations. Apart from isolation, there are a number of factors such as island surface area, vegetation structure, grazing intensity and others, that may have influenced the use of the Drana Lagoon islands by breeding colonial waterbirds, but detailed analysis will be published elsewhere.

The overall decline of bird populations in the Evros Delta over the years may be due to the gradual worsening of breeding conditions generally. Even in the late seventies, Britton & Hafner (1978) reported that the Drana Lagoon and the coastal islands were the only remaining important breeding areas for the study species in the Delta, but,

except for Avocets, other species preferred the coastal islands. The increased interest of Pratincoles, Gulls and Terns in the Drana Lagoon islands in the eighties seems to be due to a number of reasons. For example, although Mediterranean Gulls bred on a coastal island in 1981, they then shifted to the Drana Lagoon because of the encroachment of Reeds *Phragmites australis* over their breeding grounds (Goutner 1986a). Predation increased on Little Terns in the coastal habitat over the years, but was much less on the Drana islands (Goutner 1990). In addition, disturbance on the coastal islands increased due to activities such as fishing, digging for bait and bivalves, and visits by tourists. Avocets, Mediterranean Gulls and Gull-billed Terns were not dependent on the Drana Lagoon for foraging (Goutner 1985, 1986b, 1991). Consequently, the Drana islands probably became relatively more attractive due to increasing habitat alteration, predation and disturbance in the coastal habitat, In 1989, because no appropriate management plan was enforced to improve conditions elsewhere in the Delta, the birds returned to the islands in the Drana area.

## **TOWARDS THE RESTORATION OF THE DRANA LAGOON**

In 1994, the local community responsible for the drainage of the Drana Lagoon, were probably convinced of the multiple values of the area and proposed a restoration study for the lagoon. More recently, the local community,

fishermen, co-operatives, authorities, WWF Greece, the Greek Biotope and Wetland Center and scientists, have been engaged in the study and conservation of the area to prepare a restoration plan for the Drana Lagoon. There are still financial difficulties which hopefully will be resolved by EC funding.

## SALT WATER MANAGEMENT

If the Drana Lagoon can be restored to its former status by letting in sea water, it is possible that it will continue to be important for waterbirds. The sea water entrance should be widened and made deep. The peripheral canal should be made deeper and wider to provide isolation of the islands and regeneration of the vegetation. Vegetation can be managed to attract birds, and grazing by animals used as a tool to control vegetation on some islands. The latter should be between September and March to avoid disturbance of breeding populations. Over the years it is expected that the population of the bivalve *Cerastoderma glaucum*, which disappeared after draining, will recover in the lagoon. Shells deposited by wave action on the shores of some islands will be available as a breeding habitat for Terns. Flooding of nests in May and June during strong S-SW winds could be avoided by closing sluices in connection to the sea. It is also likely that an increase of suitable habitat may attract higher breeding populations. The size and vegetation on some of the peripheral islands can also be managed to attract Avocets. Some sites may be modified to form low dykes surrounded

by water and this would improve their breeding success (Goutner 1985). Artificial islands with adequate sparse vegetation surrounded by relatively deep water are attractive to most waterbirds (Walmsley 1994) and for American Avocets (Giroux 1985). Such management may be useful to encourage a breeding population increase in the area and minimise the disadvantages and losses due to flooding. Small Avocet colonies may be subjected to greater predation pressure by corvids (Goutner 1983a) and experimental control of corvid nests resulted in a higher breeding success of Avocets (Goutner 1985). In Great Britain there was no clear positive effects of culling to Avocet reproductive success (Hill 1988). Thus culling is not recommended, but a method should be found to reduce heavy losses due to predation. The large isolated islands of the Drana Lagoon were most important for colonial waterbirds, therefore the islands 1, 2 and 3 (Figure 1) must remain intact.

Avocets depend on mudflats rich in macrofauna for food. In 1980-1981 these sites surrounded the Drana Lagoon, especially in the north and south (Goutner 1983a). In 1980, due to a different water management in spring (Goutner 1983b) and abundant rainfall in 1988 (Goutner & Kazantzidis 1989), there were extensive areas of mudflats in the Delta, thus encouraging migrating waders to stay in the area. Management of the Drana islands, and especially for Avocets, should inevitably include the management of the surrounding salt steppe as feeding areas by flooding, using water from the river. Management of food resources is recognised as a basic

means for the success of Avocets in a managed area (Adret & Bouche 1986, Hill 1989). Availability of water for this type of management is a problem in the Evros Delta (see further).

## **FRESH WATER MANAGEMENT**

Since 1987, there has been only one year of abundant rainfall (winter 1988- spring 1989) when the Drana lagoon was flooded and water remained until June. In other years, up to 1994, the lagoon dried up in late spring. The demands for water for the surrounding agricultural land are high which meant that sluices were closed early in spring. The amount of water needed to cover the Drana Lagoon to a depth between 0.5 cm-1 m is between 666,500 m<sup>3</sup> and 1,333,000 m<sup>3</sup>, because almost one third of the Drana area is covered by islands. In shallow areas evaporation is very high, so these amounts should be multiplied by a factor of 3 if the water depth is to be preserved until late summer, when reproduction ceases. This amount is not available on a regular yearly basis under the conditions which prevail in the area. In 1989, impressive bird numbers used the islands under this type of management. One could not expect a rapid modification of the island habitats (especially vegetation) in a so short a period of flooding by fresh water. Thus, provided that food is not a limiting factor in the Delta, the Drana area could support bird populations. However expected changes on a long term basis of flooding the Drana area with fresh water may have serious consequences:



- A) Low water salinity may modify the island vegetation towards less salt tolerant species. Encroachment of bushy vegetation will make former breeding sites unsuitable for colonial waterbirds.
- B) Suspended material will continue to be deposited in the area causing sedimentation. Silting up of lagoons threaten their existence (Hervé & Bruslé 1981). Shallowness and low salinity may well encourage the development of Reeds Phragmites. This has occurred along the western branch of the Evros as well as in the canal north of Drana, both of which are now isolated from the sea by small dams. Reeds could alter the physiognomy of the area from an open lake to a closed reedbed. The latter habitat is not preferred by colonial waterbirds (except by some Heron species). Reedbeds are generally unwanted in open wetland areas and the control of Reeds is difficult and costly (Axel 1982, Thomas 1982).
- C) Species such as Pratincoles, Mediterranean Gulls and Gull-billed Terns did not depend on the lagoon for food but the Terns and Avocets did. The substrate and macrofauna may well change and become more euryhaline. This, in combination with habitat changes, might negatively affect the presence of some waterbird species in the area.
- D) The quality of water flowing into the Drana Lagoon may be very important. Fresh-water from the river Evros contains large amounts of nitrates and phosphates (Angelidis & Athanasiadis 1995). In a closed area where there is no recycling of water

eutrophication and biological degradation is a consequence.

In conclusion, the most appropriate long term solution to the restoration of the Drana Lagoon is the reflooding by sea water after repairing the lagoon dykes. Improvements could be made to increase fish production and the preservation of colonial waterbirds.

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## SUMMARY

The use of islands of the Drana Lagoon, in the Evros Delta, is described from 1980 to 1987, for six species of breeding colonial waterbirds: Avocet *Recurvirostra avocetta*, Collared Pratincole *Glareola pratincola*, Common Tern *Sterna hirundo*, Little Tern *Sterna albifrons*, Gull-billed Tern *Sterna nilotica* and Mediterranean Gull *Larus melanocephalus*. The

preference of the Drana Lagoon by most species and the overall decline of bird populations in the Evros Delta was due to the gradual scarcity of suitable breeding habitats and especially habitat changes, predation and disturbance on the coastal breeding islands, which were shared with the Drana Lagoon. Measures are proposed for the restoration and rehabilitation of the Drana Lagoon for nesting colonial waterbirds. It is proposed that sea-water and not freshwater management be used if the lagoon is to be restored to its former condition.

## REFERENCES

- Adret, P. & S. Bouche. 1986. Evolution d'une colonie d'Avocettes dans une réserve aménagée: Territorialité et ressources trophiques. Action concepte de recherche sur les Marais de l'Ouest. Mus. Nat. Hist. Nat. - Univ. Rennes, Pp. 1-137.
- Allouche, L. & A. Tamisier. 1984. Feeding convergence of Gadwall, Coot and the other herbivorous waterfowl species wintering in the Camargue: a preliminary approach. *Wildfowl* 35: 135-42.
- Angelidis, M. O., & A. I. Athanasiadis. 1995. Pollution mechanisms in a Ramsar wetland: Delta of the River Evros, Greece. *Aquatic Sci.* 57: 161-171.
- Atta, G. A. M. 1986. Status of the breeding population of Little Tern *Sterna albifrons* in the Bardawil nature Reserve (Egypt). MSc Thesis, University of Aberdeen, U. K., 45
- Axel, H. E. 1982. Control of Reeds *Phragmites communis* at Minsmere, England. In: D. A. Scott (Ed) *Managing wetlands and their birds*. IWRB, England, Pp. 44-50.
- Babalonas, D. 1979. Plant sociological study of the vegetation of the river Evros (Aenission Delta). Doctoral Dissertation, Univ. of Thessaloniki (in Greek).
- Basset, P. A. 1980. Some effects of grazing on vegetation dynamics in the Camargue, France. *Vegetatio* 43:173-84.
- Blondel, J. & P. Isenmann. 1981. *Guide des Oiseaux de Camargue*. Delachaux & Niestlé, Neuchâtel, Paris, France.
- Britton, R. H. & H. Hafner. 1978. Proposals for nature conservation in the Evros Delta. Unpublished official report, Station Biologique de la Tour du Valat (France) and Ministry of Coordination (Greece), 66 pp.
- Buckley, P. A. & F. G. Buckley. 1978. Guidelines for the protection and management of colonially nesting waterbirds. U. S. National Park Service Cooperative Research Unit, Center for Coastal and Environmental Studies, 52 pp.
- Burger, J. & F. Lesser. 1978. Selection of colony sites and nest sites by Common Terns *Sterna hirundo* in Ocean County, New Jersey. *Ibis* 120: 433-49.

- Fasola, M., V. Goutner & J. G. Walmsley. 1993. Comparative breeding biology of the Gulls and Terns in the four main deltas of North Mediterranean. In: J. S. Aguilar, X. Monbailliu & A. Paterson (Eds) Status and Conservation of Seabirds-Ecogeography and Mediterranean Action Plan. MEDMARAVIS, Madrid.
- Ferrer, X. 1982. Anátidas invernantes en el Delta del Ebro. Doctoral Dissertation, Univ. of Barcelona.
- Giroux, J-F. 1985. Nest sites and superclutches of American Avocets on artificial islands. *Can. J. Zool.* 63: 1302-5.
- Goutner, V. 1983a. Breeding ecology of the Avocet *Recurvirostra avocetta* L. and Oystercatcher *haematopus ostralegus* L. in the Delta of the river Evros. Doctoral Dissertation, Univ. of Thessaloniki (in Greek).
- Goutner, V. 1983b. The distribution of the Waders *Charadrii* in the Evros Delta (Greece) during the breeding season. *Sci. Annals, Fac. Sciences, Univ. Thessaloniki* 23: 37-78.
- Goutner, V. 1985. Breeding ecology of the Avocet *Recurvirostra avocetta* L. in the Evros Delta (Greece). *Bonn. zool. Beitr.* 36: 37-50.
- Goutner, V. 1986a. The ecology of the first breeding of the Mediterranean Gull *Larus melanocephalus* Temminck 1820 in the Evros Delta, Greece. *Ecol. Birds* 8: 189-97.
- Goutner, V. 1986b. Distribution, status and conservation of the Mediterranean Gull *Larus melanocephalus* in Greece. Pp. 431-447 In: MEDMARAVIS & X. Monbailliu (Eds) Mediterranean Marine Avifauna - Population Studies and Conservation. NATO ASI Series Vol. 12., Springer-Verlag, Berlin Heidelberg, Germany.
- Goutner, V. 1987a. Vegetation preferences by colonies of Mediterranean Gulls *Larus melanocephalus* and Gull-billed Terns *Gelochelidon nilotica* in the Evros Delta. *Seevögel* 8: 29-31.
- Goutner, V. 1987b. The nesting habits of Avocets in the Evros Delta, Greece. *W. S. G. Bull.* 48: 12-13.
- Goutner, V. 1990. Habitat selection of Little Terns in the Evros Delta, Greece. *Colonial Waterbirds* 13: 108-14.
- Goutner, V. 1991. Food and feeding ecology of Gull-billed Terns *Gelochelidon nilotica* in Greece. *Rev. Ecol. (Terre Vie)* 46: 373-84.

- Goutner, V. 1994. Importanza e gestione di lagune e stagni salmastri. In: Monbailliu & A. Torre (Eds). La gestione degli ambienti costieri e insulari del Mediterraneo. MEDMARAVIS, Alghero, pp. 169-198.
- Goutner, V. & H. Jerrentrup. 1987. The destruction of the Drana Lagoon in the Evros Delta Ramsar wetland, and its consequences for waterfowl. W. S. G. Bull. 50: 18-19.
- Goutner, V. & S. Kazantzisis. 1989. Evaluation of the relative importance of the zoning of the Evros Delta wetland (Greece) for bird groups of special conservation interest. Acta Oecologica- Oecol. Applic. 10: 365-78.
- Hervé, P. & J. Bruslé. 1981. L'étang de Canet-Saint-Nazaire (P.O.). Ecologie générale et ichthyofaune. Vie et Milieu 31:7 25.
- Hill, D. 1988. Population dynamics of the Avocet *Recurvirostra avocetta* breeding in Britain. J. Anim. Ecol. 57: 669-83.
- Joensen A. H. & J. Madsen. 1985. Waterfowl and raptors wintering in wetlands of western Greece. Nat. Jutl. 21: 169-200.
- Kotliar, N. B. & J. Burger. 1986. Colony site selection and abandonment by Least Terns *Sterna antillarum*, in New Jersey, USA. Biol. Conserv. 37: 1-21.
- Storey, A. E. 1986. Adaptations for marsh nesting in Common and Foster's Terns. Can. J. Zool. 65: 1417-20.
- Tamisier, A. 1979. The functional units of wintering Ducks: A spatial integration of their comfort and feeding requirements. Verh. orn. Ges. Bayern 23: 229-38.
- Thomas, G. J. 1982. Management of vegetation at wetlands. In: D. A. Scott (Ed) Managing wetlands and their birds. IWRB, England, Pp. 21-37.
- Verhoeven, J. T. A. 1980. The ecology of *Ruppia* dominated communities in western Europe. III. Aspects of production, consumption and decomposition. Aquatic Botany 8: 209-53.
- Walmsley, J. G. 1994. Un approccio pratico alla gestione ambientale nelle saline del Mediterraneo. In: Monbailliu & A. Torre (gds). La gestione degli ambienti costieri e insulari del Mediterraneo. MEDMARAVIS, Alghero, pp. 147-168.
- Walmsley, J. G. & P. Duncan. 1993. Industrial salinas in the Camargue and the conservation of breeding seabird

populations. In: J. S. Aguilar, X. Monbailliu & A. Paterson (Eds) Status and Conservation of Seabirds-  
Ecogeography and Mediterranean Action Plan. MEDMARAVIS, Madrid, pp. 285-293.

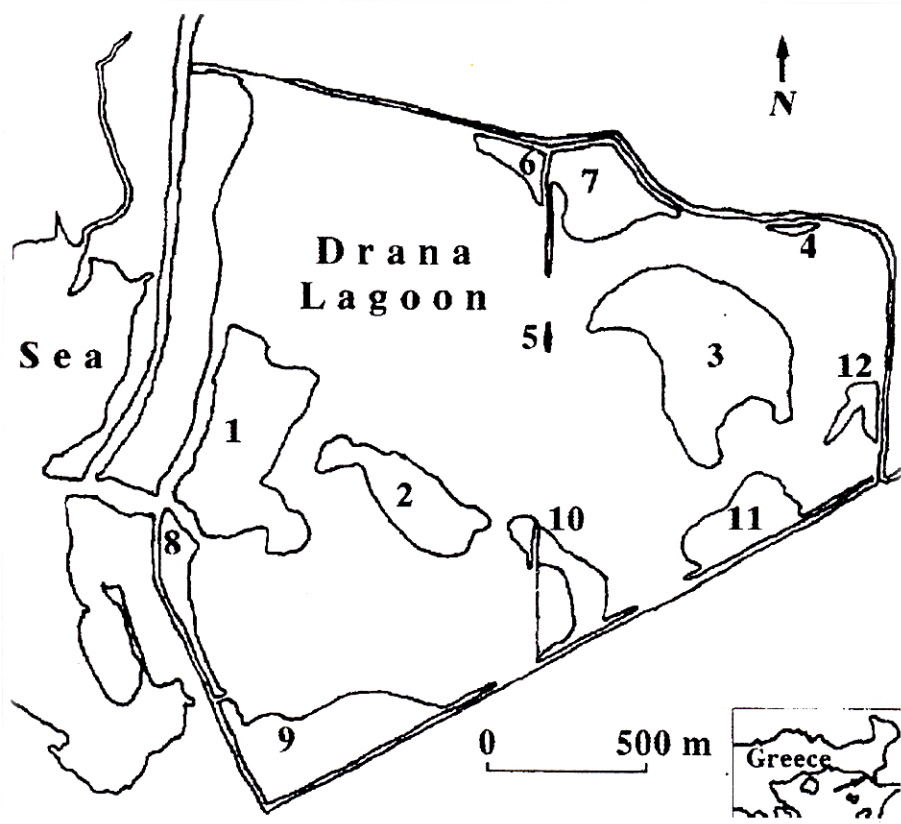


Figure 1: Map of the study area, the Drana Lagoon in the Evros Delta and its location in north-eastern Greece



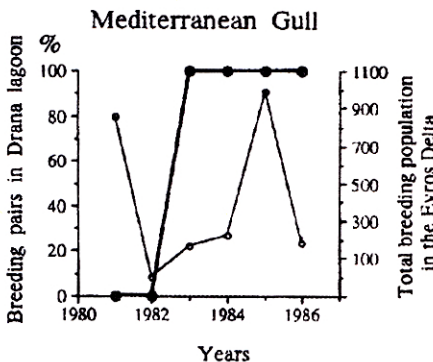
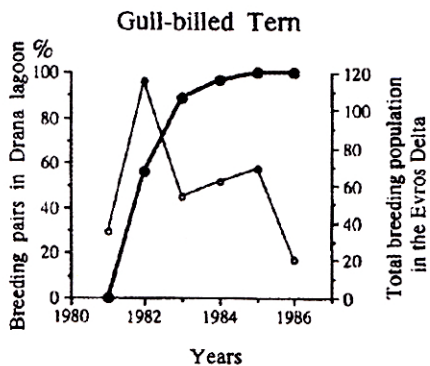
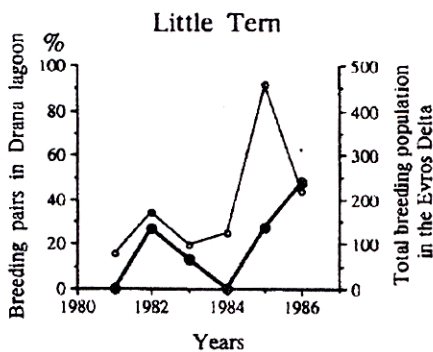
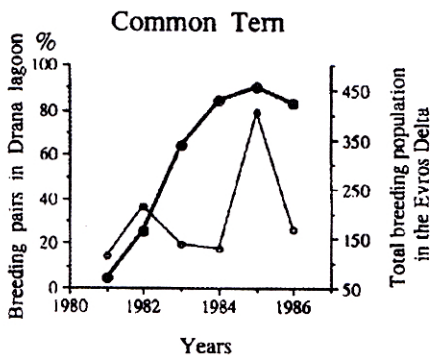
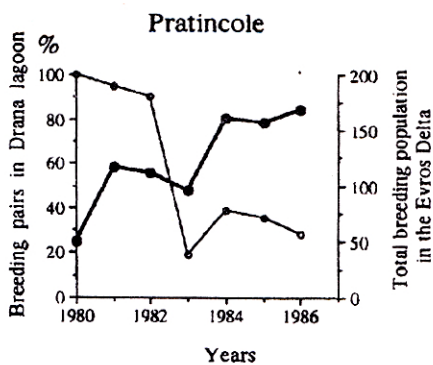
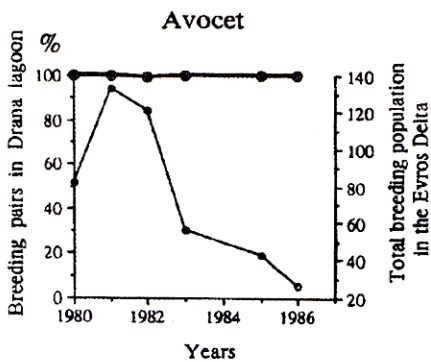


Figure 2 : Percentages of the breeding population of waterbirds studied in the Drana Lagoon (left y axes, thick line, closed dots) in relation to the total breeding population in the Evros Delta (right y axes, thin line, open dots) from 1980 to 1986.

| Species                    | Island number (Figure 1) |       |      |     |     | Coast | Totals | % on Drana islands |
|----------------------------|--------------------------|-------|------|-----|-----|-------|--------|--------------------|
|                            | 1                        | 2     | 3    | 4   | 5   |       |        |                    |
| Avocet                     | 2                        | 184   | 172  | 15  | 1   | 1     | 375    | 99.7               |
| Collared Pratincole        | 18                       | 292   | 89   | 0   | 0   | 370   | 769    | 92.7               |
| Common Tern                | 92                       | 768   | 5    | 0   | 76  | 409   | 1,350  | 69.7               |
| Little Tern                | 12                       | 91    | 227  | 9   | 0   | 811   | 1,150  | 29.5               |
| Gull-billed Tern           | 0                        | 262   | 0    | 0   | 0   | 93    | 355    | 73.8               |
| Mediterranean Gull         | 0                        | 1,568 | 0    | 0   | 0   | 906   | 2,474  | 63.4               |
| Totals                     | 124                      | 3,165 | 493  | 24  | 77  | 2,590 | 6,473  | 60.0               |
| % of Drana totals          | 3.2                      | 81.5  | 12.7 | 0.6 | 1.2 |       |        |                    |
| Total N' of bird-seasons * | 5                        | 29    | 16   | 2   | 2   |       |        |                    |

\* Produced by adding the number of breeding seasons each island was used by each species on each island.

**Table 1: Numbers of breeding pairs of birds using islands in the Drana Lagoon and coast from 1981 to 1986.**

| Species             | Coastal island |      |      | Drana islands (1989) |     | % of Delta population |
|---------------------|----------------|------|------|----------------------|-----|-----------------------|
|                     | 1987           | 1988 | 1989 | 2                    | 3   |                       |
| Avocet              | 5              | 3    | 0    | 0                    | 12  | 100                   |
| Collared Pratincole | 21             | 27   | 3    | 0                    | 60  | 95                    |
| Common Tern         | 153            | 195  | 68   | 200                  | 71  | 80                    |
| Little Tern         | 161            | 194  | 204  | 0                    | 68  | 25                    |
| Gull-billed Tern    | 58             | 5    | 0    | 10                   | 19  | 100                   |
| Mediterranean Gull  | 17             | 85   | 0    | 1,040                | 170 | 100                   |

**Table 2: Numbers of pairs of colonially nesting birds from 1987 to 1989 in the available Evros Delta breeding grounds.**