WETLANDS, Vol. 16, No. 4, December 1996, pp. 548–556

INVENTORY OF GREEK WETLANDS AS NATURAL RESOURCES

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Abstract: This effort is the first approximation for an inventory of Greek wetlands that will be used to create a national archives of wetland information. The objectives of this study were to a) collect data on characteristics, functions, threats, and positive actions related to the use of wetlands, b) design and develop a data base with the above information, and c) depict part of these data on a digitized thematic map. The project consisted of a) design of a questionnaire that would be easy to understand and fill out, comprehensive, and compatible with data formats of other international data bases (Ramsar Bureau, CORINE Biotopes), b) distribution of the questionnaire, c) data quality control, d) design and development of the data base, and e) depiction of the location of the types of Greek wetlands proportional to their size on a scale of 1:1,000,000. The results included the publication of the compiled information sheets for 378 Greek wetlands. These data sheets contain information on the location, the area, the most important biotic and abiotic characteristics, the values, the uses, the pressures threatening the wetlands, the legal status, and the positive actions. Additional results included the number and the location of drained wetlands, the preliminary results on the wetland flora of Greece, and a digitized map of Greek wetlands.

Key Words: inventory, wetlands, national archives, wetland archives

INTRODUCTION

The inventory of a country's natural resources is a prerequisite for policy-making, conservation, utilization, and planning. The importance of the inventory is evident by the fact that most countries have such projects in progress. International organizations such as the Food and Agriculture Organization (FAO) and the World Bank have funded resource inventories in developing countries.

The value of an inventory of the world's wetlands as distinct natural resources (i.e., distinct from soil and water resources) has been recognized recently. However, inventories by themselves cannot save wetlands. National governments and international bodies seem to agree that a wetland inventory is necessary for several reasons.

a. A wetland cannot be protected if no one is sure it exists, or if it exists, where it is found.
b. Many wetlands have international importance as habitats for migratory birds, while others are shared by two or more countries. Hence, the inventory presents an opportunity for international cooperation, including information exchange and methods of gathering, processing, and communicating such information.
c. The maps created from an inventory frequently are useful in general physical planning studies. They can help the delineation of conservation areas and administrative units.
d. An inventory shows knowledge gaps; it can therefore help identify research priorities.
e. Designing an inventory project and subsequent data processing encourages interdisciplinary cooperation and sharing of modern information technology across disciplines.
f. An inventory is a rich and valuable source of data for public awareness programs. A map of Greek wetlands or derivative thematic maps or maps appropriately simplified and printed as posters can be distributed to thousand of recipients.
g. The data from regularly repeated inventories, together with appropriate monitoring programs, (which are conceptually subactions of long-term inventory actions) render time-series studies possible.
h. The appropriate processing of the inventory data,

which is possible with a carefully designed program, is useful for the identification of trends, the comparison between national and international wetlands, and the identification of priority conservation actions.

A complete and uniform inventory system for Greek wetlands does not exist. Earlier surveys by the Army Geographical Service resulted in the publication of a list of principal Greek rivers and lakes by the Greek National Statistics Service (1987).

Efforts to register some important Greek wetlands have been published in several international directories and inventories (Olney 1964, Luther and Rzüska 1971, Carp 1980, Scott 1980, Rose and Taylor 1993, Grimmett and Jones 1989, UNEP/IUCN 1989, Jones 1993). With the exception of the 11 Ramsar sites (Jones 1993), plus a few other large wetlands, there is little information on the characteristics, functions, and values of wetland sites and associated threats.

The first inventory of Greek wetlands (Dorikos 1981) documented 115 wetlands throughout the country. However, this inventory contained data gathered by the Prefectures and is of uncertain quality. Other significant studies that provided inventory data for many Greek wetlands are Economidou 1981, Hallmann 1982, CEC CORINE Biotopes Program 1988, Heliotis 1988, Malakou et al. 1988, Kourteli and Economou 1990, Papayannis 1990, Psilovikos 1990 and Pyrovetsi 1990. The most extensive compilation of Greek wetlands to date was that of Tsiouris and Gerakis (1991). This list contained no data on the characteristics of individual wetlands. None of the above studies meets all the quality criteria of an inventory as defined in Zalidis (1993).

The lack of an integrated data base hinders wetland management because a) quantitative data and information about the wetlands are not available, b) processing of data is difficult due to its complexity and varying methods of collection, c) the integration of the various studies (characteristics, functions, threats, etc.) is impossible.

The proposed data base can provide technical support to scientists and administrators responsible for the natural, biological, and economic wealth of wetlands and their catchment areas (Zalidis et al. 1993).

The wetlands inventory project aims to create a national data base of all wetlands that will include descriptive and geographical information, the principal structural and functional characteristics, threats, and all relevant activities (positive and negative) that are taking place or being planned (Zalidis 1993). Data will be stored in a way that is easily accessible at both the national and community level. An archive with multiple information layers will be created.

The specific aims of the project are a) collection of the above data, b) design and development of a data base to store descriptive and geographical information, c) preparation of a digitized thematic map showing the location and extent of Greek wetlands, and d) publication of the reports on all the inventoried wetlands.

Table 1. Wetland classification system.

Marine and coastal wetlands	Estuaries[1]
	Deltas[2]
	Salt marshes
	Brackish/saline lagoons
Inland wetlands	Permanent rivers and streams
	Seasonal/intermittent rivers and streams
	Permanent freshwater lakes[3] and marshes
	Seasonal/intermittent freshwater lakes and marshes
	Peatlands
	Seasonal brackish, saline or alkaline flats marshes
	Seasonal and permanent brackish, saline lakes
	Springs

[1] Including shallow marine waters.
[2] Including shallow marine waters.
[3] Including deepwater habitats.

MATERIALS AND METHODS

The Greek wetlands inventory project included a number of tasks: a) design of the questionnaire, b) distribution and completion of the questionnaire, c) checking of completed questionnaires by a team of experts, d) design and development of a data base, and e) presentation of the results.

The questionnaire was designed to be completed by non-experts (Appendix). Thus, it had to be easily understood and answered and short. For these reasons, a simple classification system (Table 1) of wetland types was adopted based on the one used by the Ramsar Bureau (1990).

The questionnaire was designed to be compatible with data entry forms of other data bases, such as the Ramsar Data base. The Ramsar Wetlands Information Sheet was modified and improved as a basis for the construction of an inventory data sheet that could be easily answered, processed, and digitized.

The next task in the inventory project was to distribute the questionnaire. Through the valuable assistance of the Ministries of Environment and Agriculture, the questionnaire was distributed to many environmental organizations, as well as individuals and groups concerned with wetland conservation.

To facilitate completion, the questionnaire was ac-

companied by a) a list of known wetlands located in each Prefecture, as well as in the neighbouring Prefectures based on the "Inventory of basic Greek wetlands" (Dorikos 1981), and that compiled by Tsiouris and Gerakis (1991), and b) a sample of a completed questionnaire. At this stage, the project team was in contact with the recipients to expedite completion and return of the questionnaires.

The completion of the questionnaires was followed by an initial assessment and screening of the answers by a project team whose aim was a) to identify possible weaknesses or omissions in the answers and b) to group additional data and information given in the answer sheets. This work resulted in the completion of a standard data form, which was the first step towards the construction of a data-base. The completed standard data form, along with the completed questionnaires, was sent to wetland experts who cross-checked the information. The final data-base format was the objective of a workshop in which a team of experts examined the quality and reliability of the data.

The design and development of the data base were the next task. The GRIN (GReek INventory) data base was designed to meet the following objectives: a) to be compatible with similar data bases of international or European inventories, b) to be user-friendly, c) to be easily processed, and d) to be easily transferable to other programs for statistical processing or processing with GIS. The files were constructed with DBase III Plus so that the updating of various fields would be possible and data would be easily processed. Each file consists of a number of fields (numeric, alpha-numeric, logic) depending on the type and number of the inventory data sheet parameters. The size and contents of these fields is determined by the inventory data sheets. The GRIN base consists of 22 fields (Table 2).

A digitized thematic map of Greek wetlands (scale 1:1,000,000) was produced using data from the above descriptive data base, in which are entered a) the type of wetland (delta, estuary, lake, lagoon, river, etc.), b) the name, c) the prefecture in which it is located, d) the coordinates of its centre, and e) the area of 387 wetlands. The base map used was the existing AGS (Army Geographical Service) topographic map with a scale of 1:1,000,000.

Table 2. The fields of the GRIN data base.

1. Date of the completion of the questionnaire
2. Information on the recipients who completed the questionnaire
3. Wetland name(s)
4. Wetland code which includes the code of the administrative region to which the wetland belongs according to the NUTS classification system
5. Name(s) of the wetland components
6. Geographical co-ordinates of the wetland centre defined from the digitized map of the Army Geographical Service, (projection system EGSA '87)
7. Name of the administrative region to which the wetland belongs
8. Name of the prefecture
9. Location of the nearest inhabited area
10. Altitude above sea level
11. Area or length of wetland
12. Ramsar class
13. Abiotic characteristics
14. Biotic characteristics (flora and fauna)
15. Significant present values
16. Uses
17. Cause of changes
18. Sources of pollution
19. Existing conservation legislation
20. Significant positive actions for the preservation of wetlands
21. Drained wetlands (name, year of drainage, reason for drainage and possibility for restoration)
22. Principal bibliography used

RESULTS AND DISCUSSION

The Greek wetlands inventory project created a national data base (GRIN) that provides descriptive and geographical information for the Greek wetlands. The data collected far exceeded expectations thanks to an enthusiastic response by civil servants, members of environmental organizations, and scientists. The materials and methods used are subject to the usual limitations of questionnaires. Therefore, the reliability of the results is expected to vary from wetland to wetland and, within the same wetland, from subject to subject. The data quality control carried out by experts improved the reliability of the method. Further work to acquire more detailed and quantitative information can be planned that could improve data reliability.

The digitized map scale 1:1,000,000 is the first attempt to create an archive with multiple information layers for biotic and abiotic features in Greek ecosystems. Such an effort is an essential tool because a) it connects the spatial with the descriptive information, b) it facilitates presentation, enhancement, and comparison of the data, and c) it provides input data for simulation.

Using the results of the digitized map of Greece and the processing of the data base using GIS, information about the number of wetlands and the wetland area of each wetland type (deltas, marshes, lakes, etc.) was summarized. Greece has 378 wetlands with a total area of about 200,000 hectares. If complex wetlands (e.g., deltas made up of smaller wetlands) are counted separately the total number of Greek wetlands rises to 408. The identified wetland area comprises 1.5% of

Table 3. Type, number and area of the wetlands in the three geographical regions of Greece.

		Northern Greece	Central Greece and Attiki	Islands and Crete
Deltas	Number of wetlands	5	7	—
	Area (ha)	31800	36230	—
Marshes	Number of wetlands	22	22	31
	Area (ha)	1246.9	2172.1	2413.6
Lakes	Number of wetlands	17	32	7
	Area (ha)	37001.4	22648.5	117.4
Lagoons	Number of wetlands	11	23	26
	Area (ha)	6378.5	18287.5	4100.5
Springs	Number of wetlands	9	7	1
	Area (ha)	72.6	52.5	8
Estuaries	Number of wetlands	9	13	20
	Area (ha)	3049.6	577.5	637.5
Reservoirs	Number of wetlands	8	11	6
	Area (ha)	17930	17640	253.5
Rivers	Number of wetlands	37	36	18
	Length (km)	23896	1588	294
	Number of wetlands	118	151	109
	% of the total number	31%	40%	29%
Total	Area (ha)	97479	97608.1	7530.5
	% of the total Area	48%	48%	4%
	Length (km)	2386	1588	294
	% of the total Length	56%	37%	7%

the total area of Greece. The Greek wetlands inventory project identified 12 deltas, 56 lakes, 25 reservoirs, and 60 lagoons that comprise 95% of the total wetland area and 17 springs, 42 estuaries, and 75 marshes that comprise the remaining 5%. In addition, 91 rivers with a total length of more than 4000 km were recorded.

Dorikos (1981) identified 115 Greek wetland sites and provided limited information on the characteristics of each wetland. Heliotis (1988) identified and classified 124 sites that comprise an area of 91,454 ha. The most extensive list provided by Tsiouris and Gerakis (1991) does not contain data on the characteristics of each site. The total number of wetland sites recorded by the present project far exceeds any other number recorded by previous inventory projects for Greece. Additionally, information on the characteristics (abiotic and biotic) of each wetland site is included.

The distribution of the identified 378 wetlands among the three geographical regions of the country (Northern Greece, Central Greece and Attiki, Islands, and Crete) has been examined (Table 3). Northern Greece (Anatoliki Makedonia-Thraki, Kentriki and Dytiki Makedonia, and Thessalia) and Central Greece and Attiki (Ipeiros, Dytiki Ellada, Sterea Ellada, Peloponnisos, and Attiki) have 96% of the total wetland area and 93% of the total length of linear wetland (e.g., rivers). Northern Greece has most of the major river systems and most of the biggest lakes and estuaries of the country, while some of the biggest marshes and lagoons occur in Central Greece and Attiki. A significant number of small sized wetlands occur in Islands and on Crete.

The spatial distribution of the wetlands is an important element to be taken into account in policy-making and conservation of wetland resources. Information about drained wetlands is provided, including the name, the year of drainage, the reason, and the possibility of restoring the wetland (Table 4). The majority of the wetland sites were drained between 1930s and 1980s. The most important reason for their drainage was the acquisition of new agricultural land. Partial restoration could require interest in wetland conservation and guarding against further loss.

Other information provided in the data base includes biotic and abiotic characteristics (with preliminary results on the wetland flora), the present values, the uses, the pressures threatening the wetlands, the legal status, and the significant positive actions for the preservation of wetlands. As a result, the data-base can provide the baseline information required for the planning of a monitoring program.

The project has produced additional benefits, which may be summarized as follows.

a. Development of a wetlands information network. The contribution of the Ministry of Environment,

Table 4. Drained wetlands of Greece.

Administrative Region	Name	Prefecture	Date of Drainage	Reason of Drainage	Possibility for Restoration
Anatoliki Makedonia-Thraki	Lekanis Marsh	Kavala–Xanthi	1960	Expansion of agriculture	Unknown
	Tenagi Filippon	Kavala–Drama	1935	Expansion of agriculture	Unknown
Kentriki Makedonia	Kleidi Lagoon	Imathia	1974	Expansion of agriculture	No
	Giannitson Lake	Pella–Imathia–Thessaloniki	1935	Expansion of agriculture	No
	Lantza Lake	Thessaloniki	1960	Expansion of agriculture	Unknown
	Mavrouda Lake	Thessaloniki	1960	Expansion of agriculture	Yes
	Artzan Lake	Kilkis	1935	Expansion of agriculture	Unknown
	Amatovou Lake	Kilkis	1935	Expansion of agriculture	Unknown
	Azapiko Marsh	Chalkidiki	in the late eighties	Expansion of agriculture–Establishment of new housing facilities	Unknown
	Neos Marmaras Marsh	Chalkidiki	in the late eighties	Expansion of agriculture–Establishment of new housing facilities	Unknown
	Sozopoli Marsh	Chalkidiki	1977	Establishment of new housing facilities–Land filling	Unknown
	Achinou Lake	Serres	Thirties	Expansion of agriculture	Unknown
	Armyres Marsh	Serres	Eighties	—	Unknown
Dytiki Makedonia	Sari Giol Marsh	Kozani	1951	Expansion of agriculture	Unknown
Thessalia	Kallipefkis Lake	Larisa	1907	Expansion of agriculture	Yes
	Karla Lake	Magnisia–Larisa	1962	Expansion of agriculture	Yes
	Skopelos Marsh	Magnisia	1965	Establishment of new housing facilities	Unknown
Ipeiros	Lapsista Marsh	Ioannina	1959	Expansion of agriculture	Unknown
	Kastritsa Marsh	Ioannina	1970	Expansion of agriculture	Unknown
	Amfithea (Strounio)	Ioannina	1973	Expansion of agriculture	Unknown
	Koutselio Marsh	Ioannina	1950	Expansion of agriculture	Unknown
	Lagatsa Marsh	Ioannina	1959	Expansion of agriculture–Establishment of new housing facilities	No
Ionia Nisia	Ropas	Kerkyra	1905	—	Yes
Dytiki Ellada	Meso Tholo Lagoon	Aitoloakarnania	1969–70	Expansion of agriculture	Unknown
	Pritsala Marsh	Aitoloakarnania	1969–70	Expansion of agriculture	Unknown
	Agoulinitsa Lake	Ileia	1969	Expansion of agriculture	Yes
	Mouria Lake	Ileia	1969	Expansion of agriculture	Yes
	Kasta Lagoon	Achaia	1969	Expansion of agriculture	Unknown
	Akosi Marsh	Achaia	—	—	Unknown
Sterea Ellada	Kopaida Lake	Viotia	1886	Expansion of agriculture	Unknown
	Xyniada Lake	Fthiotida	1950	Expansion of agriculture	Yes
Peloponnisos	Kandilas Lake	Arkadia	1985–86	Expansion of agriculture	No
Nisia-Notio Aigaio	Koulouki Estuary (Leros)	Dodecanisos	1970	Land filling–Establishment of recreational facilities	No
	Laki Marsh (Leros)	Dodecanisos	1970	Establishment of new housing facilities	No
	Lampi Marsh (Kos)	Dodecanisos	—	Establishment of new housing facilities	No

Table 4. Continued.

Administrative Region	Name	Prefecture	Date of Drainage	Reason of Drainage	Possibility for Restoration
	Gavrio Marsh (Andros)	Kyklades	1977–78	Establishment of new housing facilities	No
	Achladi Varis Estuary (Syros)	Kyklades	1977–80	Establishment of new tourist facilities	No
	Galissas Marsh (Syros)	Kyklades	1970–72	Establishment of new tourist facilities	No
	Foinikas Marsh (Syros)	Kyklades	1967–70	Establishment of new tourist facilities	No
	Ftelia Estuary (Mykonos)	Kyklades	1970–80	Establishment of new tourist facilities	No
	Kalafatis Estuary (Mykonos)	Kyklades	1970–80	Establishment of recreational facilities	Unknown

Physical Planning, and Public Works and the Ministry of Agriculture in making this inventory possible laid the groundwork for the development of an invaluable network of contacts and cooperation with the civil service. This network may contribute to the development and coordination of a wetland conservation program and wise wetland management. An equally positive response came from environmental organizations, groups, and individuals concerned with the preservation of wetlands, to whom completing the questionnaire gave the chance to examine more closely the existing situation in the wetlands and the problems they face.

b. Creating a Greek wetland data base. A comprehensive library of studies and projects on Greek wetlands was created, and the GRIN data base provides rapid, user-friendly access to the inventory data.
c. Specialist participation. The project provided the opportunity for specialists in various disciplines to work together in evaluating the data and to better evaluate quantitative information on wetlands.
d. Dissemination of information. While data collection was still in progress, some data were used in reports to the Greek and European Union authorities.

This project is a first approximation towards the countrywide inventory of wetlands as natural resources. A detailed inventory of the particular habitats of the recorded wetland sites, which provides information about their position, size, present status, and characteristics, has been initiated. This work will involve a) identification and classification of the wetland habitats according to the classification system proposed by the Mediterranean Wetlands project, which is an adaptation to the Mediterranean conditions of the system developed by Cowardin et al. (1979), b) mapping of wetland habitats, and c) creation of a geographical data base using GIS.

ACKNOWLEDGMENTS

The project was funded by the European Commission (75%) and by the Ministry of Environment and WWF (25%) in the context of the establishment and first phase of operation of the Greek Biotope/Wetland Centre (EKBY), Contract Number B91/91/sin/8192 signed by the Commission of European Communities (DG XI) and the Goulandris Natural History Museum. The authors express deep appreciation to DG XI of the European Commission, the Greek Ministry of Environment, and the world-wide Fund for Nature for funding, to the central and regional services of the Greek Ministries of Environment and Agriculture and to the Environmental NGOs for assisting in the completion of the data forms, to all the experts who provided suggestions for raising the reliability of the information, to Mrs. Hrisoula Kourteli and Nikolaos Lampropoulos for their valuable assistance in the processing of data, and to Mrs. Dimitra Spala for her assistance in selecting information through the network of civil servants. Appreciation is extended to Dr. Argyris Gerakis for his valuable assistance in preparing an early draft of this article, to Mrs. Eleni Gourvelou for her assistance in preparing the final manuscript, and to Louisa Nikolaou and Maria-Dafni Tsitsi for their technical assistance.

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Manuscript received 1 December 1995; revisions received 22 March 1996 and 1 August 1996; accepted 3 September 1996.

Appendix. INVENTORY OF GREEK WETLANDS: Questionnaire of wetland site

1. Date:

2. Name, address and phone number of compiler:

3. Name(s) of wetland:

(If known give the geographical co-ordinates of the centre of the designated site)

4. Wetland type. (*Mark with X's*)

Delta	_____	Spring	_____
Estuary	_____	Marsh	_____
Lagoon	_____	Reservoir	_____
Lake	_____	Other	_____
River/stream/creek	_____		

* For each wetland type mark: 1: Permanently flooded, 2: Periodically flooded

** For each wetland type mark: I: Fresh water, II: Saline-brackish water

5. a. Location (*compass bearing and distance, in km in a straight line, of the wetland from the nearest significant town or city*):

   b. Altitude:

6. Area (in ha): Approximate

   from _____ to _____

   List your sources of estimation

* Please answer only those questions you know best. Attach more pages if you need more space. The answers can be typed or hand-written.

7. Threats (*Assign with an X*):

THREATS	Big	Medium	Small	Nonexisting	Unknown	Source of Information
A. Pollution from:						
Municipal waste water						
Municipal solid wastes						
Industrial waste water						
Industrial solid wastes						
Farm animal wastes						
Other sources (describe)						
B. Changes due to:						
Drainage and land reclamation						
Sand extraction						
Siltation and/or soil topping						
Building of new housing facilities or expansion of old ones						
Establishment of new tourist facilities or expansion of old ones						
Diversion of surface water supplies entering the wetland						
Overpumping of ground water						
Dam & other hydraulic constructions						
Irrigation schemes						
Expansion of farming						
Intensive aquaculture						
Illegal hunting						
Overfishing						
Overgrazing						
Other reasons (describe)						

8. If known, list some of the species which exist in the wetland:

	Flora	Fauna
Rare		
Common		

9. List the most important values of the wetland for the local people and indicate those which are used today (*Mark with an X*).

	Scale					Intensiveness of use	
Value	Big	Medium	Small	Nonexisting	Unknown	Intensive	Extensive
Drinking water							
Irrigation water							
Fishing							
Grazing							
Recreation							
Hunting							
Environmental education							
Others (*List them*)							

10. List the changes in resource use in the wetland area and major projects (*i.e., dams, intensive aquaculture installation, food processing plants, hotels, irrigation schemes*) which are planned for the future and the agencies involved (*public corporations, co-operatives, municipalities, private corporations*):

11. Are any conservation measures taken or proposed for the wetland? Briefly outline your proposal.

12. Outline map of site with the specific scale given.

13. List all positive actions and their sponsors (CEC, NGOs, institutes, public or private corporations, individuals), which took place or are envisioned to take place in order to protect the wetland.

14. List (only the names) of the prefecture's other wetlands.

15. List all the prefecture's wetlands which have been drained. Which of those could be restored?

16. List all persons and groups who have studied the wetland, especially its conservation aspects.

17. List whatever additional information you think is relevant (*i.e., historical data, cultural and social values or other features*).