MedWet

Volume I

Mediterranean Wetland Inventory: A Reference Manual

Edited by
L.T. Costa, J.C. Farinha, N. Hecker & P. Tomàs Vives

ICN
Instituto da Conservação da Natureza

WETLANDS
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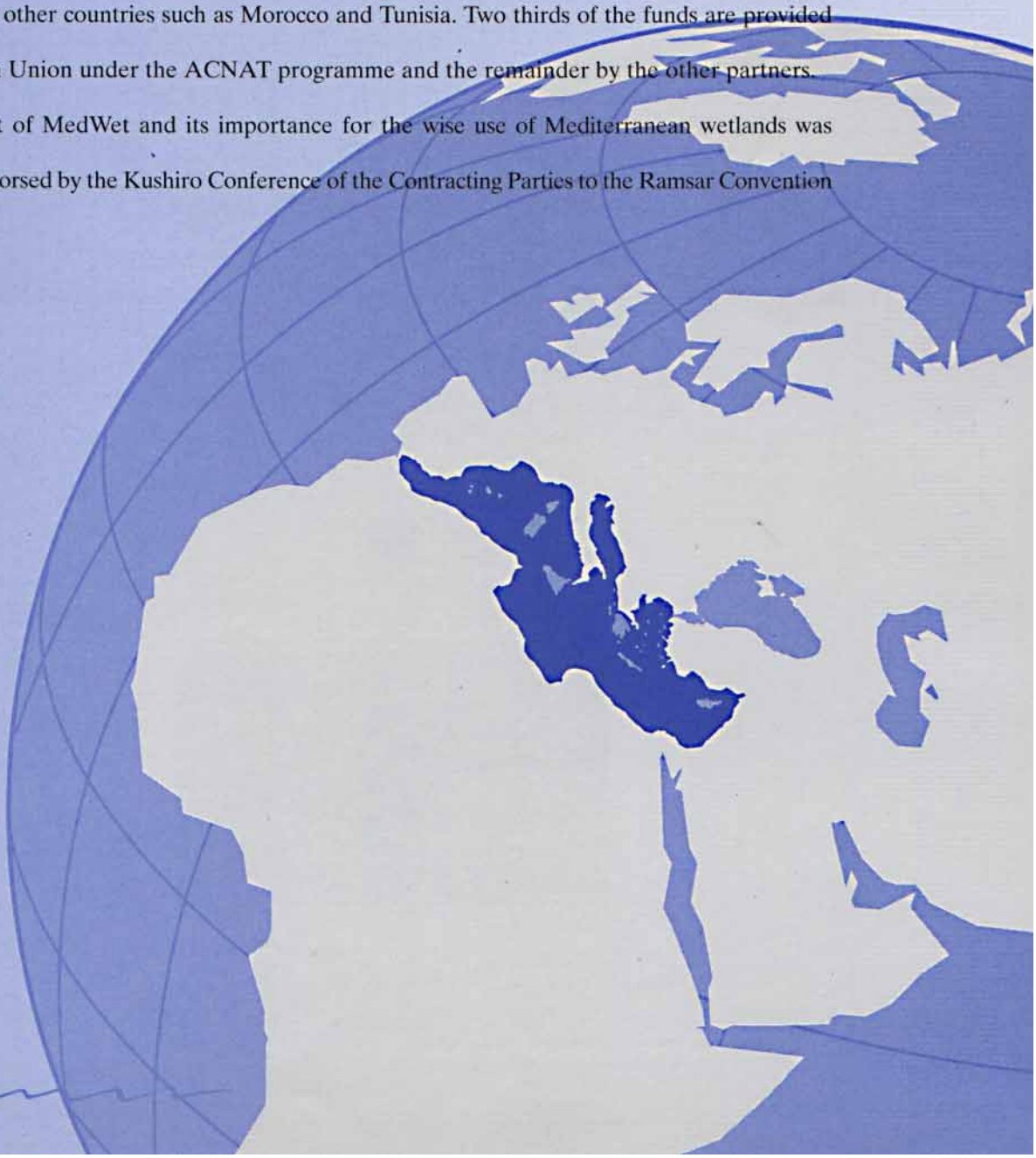
The Medwet Action

The Mediterranean basin is rich in wetlands of great ecological, social and economic value. Yet these important natural assets have been considerably degraded or destroyed, mainly during the 20th century. To stop and reverse this loss, and to ensure the wise use of wetlands throughout the Mediterranean, a concerted long-term collaborative action has been initiated under the name of MedWet.

A three year preparatory project was launched in late 1992 by the European Commission, the Ramsar Convention on Wetlands of International Importance, the governments of France, Italy, Spain, Greece and Portugal, the World Wide Fund for Nature, Wetlands International (former IWRB) and the Station Biologique de la Tour du Valat.

This project focuses on that part of the Mediterranean included within the European Union, with pilot activities in other countries such as Morocco and Tunisia. Two thirds of the funds are provided by the European Union under the ACNAT programme and the remainder by the other partners.

The concept of MedWet and its importance for the wise use of Mediterranean wetlands was unanimously endorsed by the Kushiro Conference of the Contracting Parties to the Ramsar Convention in June 1993.



One of the methodologies developed under the MedWet project concerns Mediterranean wetland inventory. This subproject was undertaken jointly by the Instituto da Conservação da Natureza (ICN) of Portugal and Wetlands International, together with the assistance of a number of other agencies and partners.

The MedWet inventory work aimed to assess the status of existing wetland inventories in the Mediterranean region in order to identify the gaps and review the adequacy of the methods used, and to prepare a standard methodology for carrying out inventories of Mediterranean wetlands.

The MedWet Inventory Methodology includes a Manual for Mediterranean wetland inventory and a suite of publications on separate but linked tools, which allow wetland inventories to be conducted at a number of different levels. The whole methodology can be found in the set of five volumes comprising:

Volume I

Mediterranean Wetland Inventory: A Reference Manual

explains the inventory process and provides a basic introduction to each of the inventory tools.

Volume II

Mediterranean Wetland Inventory: Data Recording

presents the inventory Datasheets and their Guidelines.

Volume III

Mediterranean Wetland Inventory: Habitat Description System

explains the MedWet Habitat Description system and gives guidelines for its application.

Volume IV

Mediterranean Wetland Inventory: Photointerpretation and Cartographic Conventions

describes the MedWet mapping conventions.

Volume V

Mediterranean Wetland Inventory: Database Manual

presents the MedWet inventory Database software and user Manual for data storage (available as a separate publication).

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An Advisory Group of wetland and inventories experts was established initially with Geneviève Barnaud (Muséum National d'Histoire Naturelle, France), Mohamed Dakki (Institut Scientifique de Rabat, Morocco), Patrick Grillas (Station Biologique de la Tour du Valat, France), Faouzi Maamouri (WWF Maghreb, Tunisia), Dorian Moss (Institute of Terrestrial Ecology, UK), Dirk Wascher (European Commission), Don Woodward (US Fish & Wildlife Service) and George Zalidis (Greek Biotope/Wetland Centre). The meetings of this Advisory Groups were crucial from the beginning to establish basic recommendations and conclusions to design the methodology. The meetings were held in Alcochete, Portugal (July 1993), in Bizerte, Tunisia (April 1994) and at Arrábida, Portugal (February 1996).

Many other wetland experts did attend these meetings and contributed with their knowledge and experience: Yousser Achich and Marco Barbieri (Barcelona Convention, Tunisia), Magdalena Bernuès and Manuel Alcántara (ICONA, Spain), Max Finlayson (Australia), Taoufik Gargouri (CORINE Landcover, Tunisia), Barrie Goldsmith (Univ. College London, UK), Tim Jones (IWRB, UK), Christian Perennou (Station Biologique de la Tour du Valat, France), Mark Spalding (WCMC, UK), Paola Talluri (WWF Italia), Domitille Vallée (Barcelona Convention, France) and Susan Watt (Parc Aiguamolls d'Empordá, Spain). We would like to thank also the Reserva Natural do Estuário do Tejo and the Fundação Oriente (Portugal) and the Direction Générale des Forêts (Tunisia) and particularly to António Antunes Dias, Abdel Hamid Karem and Teresa Lopes for their effort in organising these meetings. Valuable help was also obtained from Parque Natural da Arrábida and from Reserva Natural do Paul do Boquilobo.

At some stages of undertaking this sub-project many staff members from Wetlands International and ICN worked hard to develop and test the inventory methodology: Paul Gorbutt, Crawford Prentice, Steve Ridgill (WI), Renato Neves, Rui Rufino, Anabela Trindade, Graça Serra, Emília Paula Silva and Dinah Valmor Sobral (ICN).

Two main steps of the inventory methodology were the development of the mapping method, carried out by the Greek Biotope/Wetland Centre, EKBY) and the MedWet database, developed by Nono Suyatno (Wetlands International Asia-Pacific). They made a tremendous effort in undertaking their tasks. For this, international programmes co-operation was very important, and was fully achieved with the MedWet exercise. Angelo Salsi and Michael Cornaert (DGXI, European Commission), Dorian Moss and Scott Frazier helped a lot here, to ensure full compatibility between CORINE Biotopes and Ramsar with MedWet. Chris Steenmans contributed for the section on CORINE Landcover in this manual.

Testing the methodology was also an essential step for its development. Apart from field testing in Portugal by ICN staff, other pilot studies and test sites were carried out and they improved all our work with their comments and inputs. We would like to acknowledge all the responsibles for these studies and all the people that helped in some way to test the inventory methodology: Mohamed Dakki, Mohamed El-Agbani and Bouchta El Fellah (Morocco), Antonis Mantzavelas and Eleni Fitoka (Greece), Francesca Crespí-Ramis and Raphaël Mathevet (France), Jose Antonio Torres-Esquivias, Baldomero Moreno Arroyo and Armando Alcala-Zamora (Spain).

A very important point when completing this inventory manual was to prepare and edit its publication. Useful inputs did come from Mike Moser (WI), who also edited the draft text, and from António Teixeira and Emília Paula Silva (ICN). The final draft was reviewed by Patrick Grillas, Christian Perennou, Don Woodward, Tobias Salathé, Dorian Moss and Geneviève Barnaud.

Finally, we would like to acknowledge all those who are not mentioned here but who have contributed in any way to criticise and improving the inventory methodology over the three years of this project, in many countries around the Mediterranean. Thank you all.

Luís Costa, João Carlos Farinha, Nathalie Hecker and ***Pere Tomàs Vives.***

Foreword

Wetlands are among the most valuable and productive ecosystems on earth, and offer important opportunities for sustainable development. Therefore, they should be protected and carefully managed, for their importance alone and because they are relevant to a number of different human interests. However, there is a worldwide problem of loss and degradation of wetlands, particularly acute in the Mediterranean region, as was recognised during the Grado Conference on Mediterranean Wetlands in 1991. The consequences of this trend are today being experienced by people around the Mediterranean and include water shortages, floods, decline of fisheries, pollution, toxic algal blooms and loss of biodiversity.

From the awareness and concern raised in the Grado Conference a new regional action for Mediterranean wetland conservation was born: the MedWet initiative. This has completed its first phase by the development and testing of various methodologies to improve Mediterranean wetland conservation. One of these methodologies concerns wetland inventory, and was undertaken in a joint MedWet sub-project by the Instituto da Conservação da Natureza (ICN) of Portugal and Wetlands International (former IWRB), together with the assistance of a number of other agencies and partners (see Acknowledgments).

The immediate aims of the MedWet inventory work were to assess the status of existing wetland inventories in the Mediterranean region in order to identify the gaps and review the adequacy of the methods used, and to prepare a standard methodology for carrying out inventories of Mediterranean wetlands. Outputs of the first part of this work were reported in *The Status of Wetland Inventories in the Mediterranean region* (Hecker & Tomàs Vives 1995), which concluded that comprehensive wetland inventories had been conducted in only five out of the 22 countries considered, and that the results were generally difficult to compare due to the different methodologies used in each case.

This manual, and the associated inventory tools, represent the results of the second part of the MedWet inventory work. In developing the MedWet inventory methodology we have recognised the extremely diverse nature of the region and the resources available. We have therefore sought to present a methodology which is flexible in terms of the level of detail required, and which can be used to address a broad array of needs and situations. Throughout, we have striven to build on existing expertise and techniques, yet to develop methods which will provide results that can be compared across the entire region.

We hope and believe that the MedWet inventory methodology will be applied widely in the Mediterranean region, and will be a model for other regions. Ultimately our hope is that its wide application will have contributed to the original goal of the Grado conference:

To stop and reverse the loss and degradation of Mediterranean wetlands.

AntonioTeixeira
Instituto da Conservação da Natureza

Michael Moser
Wetlands International

1 Introduction

Reliable knowledge is the basic resource on which all decisions concerning the conservation and wise use of Mediterranean wetlands should be made. Information about these wetlands is required for such essential actions as effective planning, management, training, education and public awareness programmes. The gathering, harmonisation and dissemination of information is therefore needed at local, national and international levels. For this reason, one of the five sub-projects in the first phase of the MedWet initiative was designed to assist the collection of information about Mediterranean wetlands. In view of the diversity of needs and resources available in the countries around the Mediterranean, it was decided from the start to present methodologies which would be broad enough for application throughout the region, while flexible enough for application to different needs.

1. Introduction

Reliable knowledge is the basic resource on which all decisions concerning the conservation and wise use of Mediterranean wetlands should be made. Information about these wetlands is required for such essential actions as effective planning, management, training, education and public awareness programmes. The gathering, harmonisation and dissemination of information is therefore needed at local, national and international levels. For this reason, one of the five sub-projects in the first phase of the MedWet initiative was designed to assist the collection of information about Mediterranean wetlands.

The MedWet subproject on inventory and monitoring was undertaken by a joint team from the Instituto da Conservação da Natureza (ICN) and Wetlands International (formerly IWRB), with input from an Advisory Group (experts from the Mediterranean region and elsewhere), focal points in most Mediterranean countries, detailed pilot studies and work at a number of test sites (see Acknowledgments).

In view of the diversity of needs and resources available in the countries around the Mediterranean, it was decided from the start to present methodologies which would be broad enough for application throughout the region, while flexible enough for application to different needs. A prime consideration was to build on existing programmes and tools used in the Mediterranean region and elsewhere, and to produce results that would be comparable nationally and compatible with existing international programmes.

This Manual presents the results of the work on wetland inventory. Here, the structure of a standard method for wetland inventory in the Mediterranean region is described, showing the different steps to be undertaken. In addition to this Reference Manual, the MedWet inventory methodology includes a suite of separate but linked tools. These tools are:

- Data Recording, with the standard datasheets and their guidelines
- Habitat Description System, for the detailed description of wetland habitats
- Photointerpretation and Cartographic conventions, for mapping purposes
- The MedWet Database, the software and a user manual

The whole method is standard, comprehensive, flexible and compatible with existing programmes; it is applicable to all the Mediterranean region, allows the user to select the level of detail desired, and covers all the aspects relevant for the inventory. The methodology and the tools provided for its use can be adapted to different levels of detail but should not be modified if compatibility and standardisation are to be maintained throughout the region.

What are wetlands?

The Mediterranean region is home to many ancient cultures sharing some common influences and values. For the purpose of this Manual it includes all the countries bordering the Mediterranean sea and those contiguous which have a Mediterranean type climate. All these countries have in common a set of wetlands sharing similar characteristics derived from their climate, topography and geology, and marine tide features (Britton & Crivelli 1993). They also face the same problems for the conservation of their wetlands.

Wetlands typically occupy transition zones between aquatic and terrestrial systems, sharing the characteristics of both. Typical wetland landscapes of the Mediterranean region include deltas, coastal lagoons and salt marshes, rivers and their associated floodplains, permanent and temporary marshes and lakes, salinas, oases, chotts and sebkhas (Pearce & Crivelli 1994); tidal wetlands are restricted to the Atlantic coasts of Portugal, Spain and Morocco and to a few specific locations on the Mediterranean coast (Britton & Crivelli 1993).

Mediterranean wetlands have a highly dynamic character and support a regionally important biodiversity. They may be flooded intermittently or only during part of the year; there can be seasonal differences in the water salinity, from fresh to brackish or even salt water; and these changes can lead to different characteristics and life forms in the same wetland throughout the year. The dynamic nature of wetlands is readily apparent to local people by the appearance of algal blooms and changes in the abundance of fishes, waterbirds, and other wildlife.

For all of these reasons, the definition and delineation of wetlands is a complex and often controversial subject. Where does a wetland start and finish? What is the boundary between wetlands and non-wetlands? How long does an area have to be flooded before it can be considered a wetland? These and many other questions do not have consensus in the scientific community. Wetlands were historically defined by scientists working in sectoral fields, such as botany or hydrology. A botanist's definition might focus on the plants adapted to flooding and/or saturated soil conditions, while a hydrologist's definition might emphasise the position of the water table relative to the ground surface over time.

A rather general definition of wetlands was adopted by the "Convention on Wetlands of International Importance Especially as Waterfowl Habitat" (Ramsar Convention), as follows:

> *Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres* (Ramsar Convention, Article 1.1). Furthermore the text adds that wetlands: *'may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands'* (Ramsar Convention, Article 2.1)

While this definition has gained wide international acceptance, it is not by itself adequate for the precise identification and delineation of wetland areas. For this reason, the MedWet inventory methodology has proposed and tested more detailed criteria for the identification and delineation of wetlands based on the presence of essential attributes such as hydrology, soils and vegetation.

see **Chapter 5**

Wetland inventories

Wetland inventory is the process for determining and recording where wetlands are, how many wetlands are in a given area, and what are their characteristics. The inventory is thus a list of wetland sites which contains data such as location and size, physical and biological features present, human activities and impacts, protection status, wetland functions and values, etc.. Maps provide an important tool for collecting and displaying information from wetland

inventories, although the level of detail will vary greatly with the scale chosen.

An inventory should be undertaken within set objectives over a given time-period or as an ongoing project, with a final aim of publishing/disseminating the information or making this readily available in a database system.

Following the conclusions from the meeting of the subproject's Advisory Group, held in Alcochete in 1993 (Tomàs Vives 1993), the objectives of any wetland inventory were considered to be:

- to identify where wetlands are, and which are the priority sites for conservation. All wetlands, independently of their importance, should be covered by a national inventory;
- to identify the functions and values of each wetland site, including ecological, social and cultural values;
- to establish a baseline for measuring future change in wetland area, function and values;
- to provide a tool for planning and management at both practical and/or political levels;
- to permit comparisons at all levels (local, national and international);

Furthermore, the wetland inventory allows:

- to develop networks of experts concerned with wetland conservation;
- to stimulate co-operation for undertaking conservation actions;
- to promote awareness of the values of wetlands amongst the general public and decsion-makers.

Inventories can vary widely in scope and depth, from simple and short lists of only the most important sites, to detailed accounts of all the sites thought to be of some significance for nature conservation. Wetland inventories provide baseline information on wetland characteristics and should be designed in a way that enables priorities to be determined, for comparing between sites, regions or countries, for establishing planning frameworks, and for measuring the success of conservation actions.

In order to achieve these objectives any inventory should:

- use a standardised methodology: classification system, datasheet, data storage system, criteria for wetland site selection, identification and delineation, and mapping procedure;
- incorporate qualitative and quantitative data in order to provide a baseline for monitoring wetland change and loss;
- permit functional analysis of wetlands for monitoring loss of wetland functions;
- be regularly updated;
- be easily disseminated to wetland managers and decision-makers and also the general public;

However, a very important point when carrying out a wetland inventory is to stress that sites are included according to the aim of the inventory and the site selection criteria. Nevertheless, **all** Mediterranean wetland sites are important (Anonymous 1992), even if for some reason they are not covered by the inventory. They must be taken into account for conservation actions, and protected against any development which could destroy or damage them as well as their functions and values.

2 The present situation

The wetlands of the Mediterranean region have been partially covered by a number of inventories carried out at various levels: local, national and international.

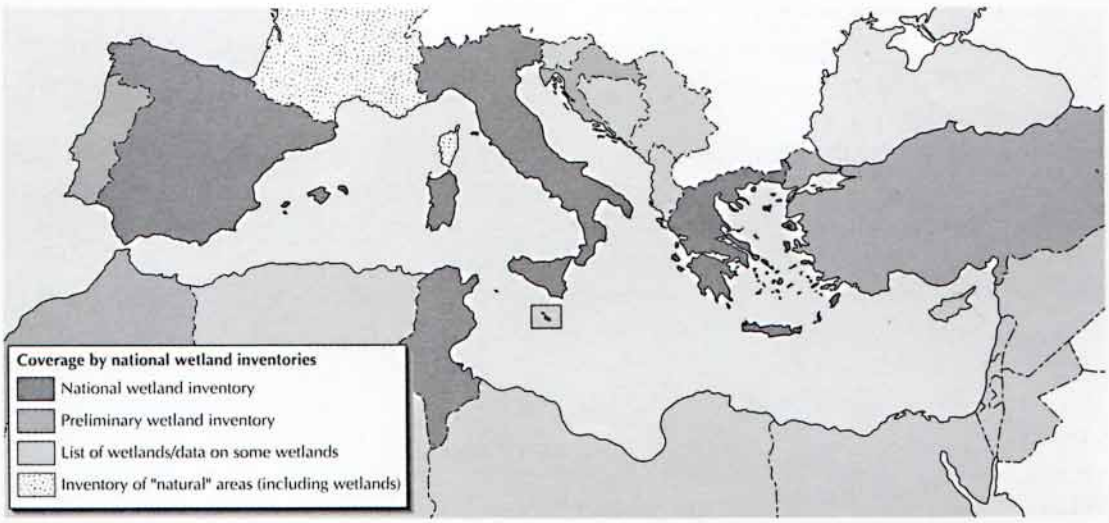
A presentation of the main inventories has recently been published (Hecker & Tomàs Vives 1995) and gives an update on their status throughout the region and an analysis of the various existing methodologies. The first section of the present chapter is extracted from this report and gives an overview of the coverage of the region by national inventories and the main methodologies used.

The Mediterranean region has also been covered by several international programmes and inventories . Three main international initiatives are presented here: CORINE Biotopes and Natura 2000, CORINE Landcover and Ramsar Convention. They are not wetland inventories sensus stricto but they play an important role in the conservation of major wetlands and their habitats at international level. Natura 2000 and CORINE programmes have been developed to collect information on the environment in the countries of the European Union. The Ramsar Convention holds data on wetlands of international importance. The role and actions of these programmes are presented in this chapter.

National Inventories in the Mediterranean Region

Coverage

The coverage of Mediterranean countries by national wetland inventories is very uneven (Hecker & Tomás Vives 1995). Spain, Italy, Greece and Tunisia have carried out a national wetland inventory. France has carried out an inventory of all natural habitats important for the flora and fauna (ZNIEFF inventory), and it includes wetlands. Several countries have a preliminary inventory: Croatia, Turkey, Morocco and Portugal (in this last case, a detailed national inventory was launched as part of this MedWet subproject). The remaining countries have no inventory as such, but a list of wetlands with some information (usually on waterfowl): Albania, Malta, Bosnia-Herzegovina, Cyprus, Egypt, Algeria, Libya, Syria, Lebanon, Jordan, Israel, Slovenia and Yugoslavia. The last three countries have directories or lists of protected areas which include some wetland sites. The four Middle East countries are covered by a detailed international inventory of wetlands (Scott 1995).



Less than half of the Mediterranean countries have a wetland inventory (preliminary or complete) available. The existing ones are not fully comprehensive due to the wetland definition and the selection criteria used. The choice made for these two main components of the inventory procedure led to the exclusion of some sites (e.g. rivers and lakes in Spain). Many sites still need to be included and described at national level.

In many countries the development of a wetland inventory has not been initiated or is still at a very early stage; the knowledge about wetlands is dispersed and incomplete. Scarce data about certain wetland sites are held at national level, but in most cases they refer only to a small number of sites. They can be found in directories of protected areas or in reports of waterfowl censuses. Generally, few data exist on non-protected wetlands.

Methodology

National inventories have been organised in various ways, using different methodologies according to their aims and the resources available:

- The classification systems used to describe the wetland types present in each site are diverse. They have generally been developed either at national level, or based and adapted from an existing international classification used world-wide, such as the Ramsar classification. Each classification is linked to the wetland definition used, consequently some wetland types have not been included in some of these inventories. Therefore the comparison of the wetland types present in different countries is often difficult.
- The criteria for site selection vary from one country to another. They are based on several different parameters mostly related to the biodiversity of the site: the presence of waterfowl, outstanding and rare species, important fauna or flora communities, ecosystem, high biodiversity. The definition of wetland used and the availability of information were also taken into account. These criteria depend on the aim of the inventory. None of the countries decided to include all the wetlands of its territory. This extensive task would nevertheless be required to identify and to conserve all of them.

see Chapter 5

- In most cases, criteria for wetland delineation were not applied. Only three national inventories defined such criteria based on vegetation and geomorphology, or the limit of the peak flood, or the presence of water, hydromorphic soils and hydrophytic vegetation. The delineation of wetlands requires precise techniques which often need substantial time and financial resources to develop and implement. Therefore they are rarely used in a simple inventory.
- The types of data collected in these inventories are generally similar, although their level of detail varies a lot from one country to another and even between sites within a country. The details collected vary according to the aim of the inventory and the available information.

The following table summarises the types of wetland classification, criteria for site selection and delineation in the national inventories carried out in Spain, France, Italy, Greece and Tunisia.

	SPAIN (Montes 1991)	FRANCE (Barnaud & Richard 1993)	ITALY (De Maria 1992)	GREECE (Zalidis & Mantzavelas 1994)	TUNÍSIA (Hughes *et al.* 1994)
CLASSIFICATION	Developed at national level			Adapted from Ramsar	
SITE SELECTION	Area > 0.5 ha., exclude seas, lakes and rivers	the rarity of species, communities, ecosystem, the presence of a high biodiversity;	presence of waterfowl and outstandings species	existing information	no criteria
DELINEATION	Presence of water, hydromorphic soils, hydrophytic vegetation	Vegetation types and geomorphology	no criteria		Limit of peak flood

The low coverage of national wetland inventories and the high diversity of the methods show that there is a need to develop wetland inventories throughout the Mediterranean region. The use of a standard methodology would be very useful for comparisons between countries and will allow a wider approach to gathering knowledge on wetlands.

CORINE Biotopes and Natura 2000

The CORINE Biotopes database

CORINE (**Co**-**OR**dinated **IN**formation on the **E**nvironment) was established in 1985 as an experimental programme for the gathering of harmonised information across the European Community, following common methodologies. The programme was divided into a number of priority topics, of which the Biotopes Project was one. This was defined as an inventory of sites of major importance for nature conservation in the European Community. The criteria for site selection were to be scientific, and independent of existing designation status.

The aim was to assemble a reliable and consistent database on the location and status of habitats and species in need of protection, and to make this information accessible to policy-makers. Although the principle of CORINE was to bring together existing methods, nomenclatures and data, many new initiatives were necessary to ensure that the results were consistent and comprehensive.

Three related steps were necessary to achieve the goals. The first was to define objective criteria on which to judge the importance of a locality for nature conservation at the European level. Secondly, it was necessary to design a common format for the data, which would serve the requirement for extensive information about each site but whose collection to sufficient detail would be feasible in every Member State. Finally, it was necessary to design and implement nomenclatural systems to describe habitats, species taxonomy, and other important site characteristics. These systems were required to be compatible with those in use in individual Member States and by international bodies.

The habitat classification was a key element of the Biotopes Project (see table below), and

was developed as the system by which the habitats found on each site could be recorded. The typology was required to define the recognizable communities formed by the interactions between flora, fauna and the abiotic environment. It aimed to include natural and near-natural vegetation communities, sometimes rare, and the more widespread semi-natural types; to be adaptable to include localised variants of more widespread types; to define units which could easily be recognised in the field; and to be compatible with existing wide-ranging schemes.

CORINE Biotopes Habitat Classification *(European Communities 1991)*

This list covers the CORINE Biotopes habitats (up to the 2nd digit) which include wetlands and can be found in the Mediterranean countries.

1 Coastal and halophytic communities

- 11 Ocean and seas, marine communities
- 12 Sea inlets and coastal features
- 13 Estuaries and tidal rivers
- 14 Mud flats and sand flats
- 15 Saltmarshes, salt steppes, salt scrubs, salt forests
- 16 Coastal sand dunes and sand beaches
- 17 Shingle beaches
- 18 Sea-cliffs and rocky shores
- 19 Islets, rock stacks, reefs, banks, shoals
- 1A Coastal agrosystems

2 Non-marine waters

- 21 Coastal lagoons
- 22 Standing fresh water
- 23 Standing brackish and salt water
- 24 Running water

3 Scrub and grassland

- 31 Temperate heath and scrub
- 37 Humid grassland and tall herb communities

4 Forests

- 44 Temperate riverine and swamp forests and brush

5 Bogs and marshes

- 51 Raised bogs
- 53 Water-fringe vegetation
- 54 Fens, transition miares and springs

6 Inland rocks, screes and sands

- 62 Inland cliffs and exposed rocks
- 64 Inland sand dunes
- 65 Caves
- 66 Volcanic features

8 Agricultural land and artificial landscapes

- 81 Improved grasslands
- 82 Crops
- 86 Towns, villages, industrial sites
- 88 Mines and underground passages
- 89 Industrial lagoons and reservoirs, canals

Other key elements of the data collected were the species of fauna and flora present, with the emphasis on species considered to be threatened over the European Community as a whole. The criteria for selecting sites for inclusion in the database hinged on their importance at either regional or Community level for any of the species identified as threatened, or for any semi-natural or natural habitat type.

Further data fields, in addition to site identification and location, included site designation status, a simple list of human activities, motivation for the inclusion of the site, and text descriptive fields.

The conclusion of the original CORINE programme saw the publication of the Biotopes Report and Manuals (European Communities 1991). At the time of preparation of that Report, 6144 sites had been recorded, covering 288,134 km^2 or 12.2% of the EU land surface area. The database had been used for a number of applications, for example identification of sites which could be affected by Community development investment, implementation of the EC Birds Directive (79/409/CEE, European Communities 1979), and planning of the Habitats Directive (92/43/CEE, European Communities 1992), which used the CORINE habitat classification for its Annex I of habitats requiring protection. The project was described by Moss & Wyatt (1994).

From 1991 to 1994 the Biotopes database was supported by the European Environment Agency (EEA) Task Force of the European Commission. In 1995 with the start of the EEA work programme, its maintenance and further evolution became one of the tasks of the EEA's Topic Centre on Nature Conservation. The 1995 work included consolidation of the database, now comprising 7741 sites in 13 of the 15 Member States (covering 365,395 km^2, or 13%, of the land surface), and the re-orientation of its aims and methods in the light of the establishment of the Natura 2000 network of sites designated under the Birds and Habitats Directives.

The Biotopes database is also undergoing geographical expansion, with projects beginning in 1992 under the European Union PHARE Programme to compile Biotopes inventories in six countries of Central and Eastern Europe, while the Nordic Council of Ministers began funding a similar exercise in three Baltic States and two western regions of Russia in late 1993. These extensions of geographical range have necessitated some modifications of the methodology, especially an expansion of the area covered by the habitats classification. With Council of Europe support, this now covers all of Europe in detail, and the whole Palaearctic region in outline. The lists of threatened species used in the site selection criteria also required modification to include equivalent 'PHARE' and Baltic lists.

The Natura 2000 sites inventory

Natura 2000 aims to establish a network of sites designated under either the EU Birds Directive or Habitats Directive which will ensure the maintenance of populations of threatened species and the existence of vulnerable habitat types with favourable conservation status. By mid-1995 12 EU Member States (omitting those which joined the EU in 1995) had designated almost 1200 Special Protection Areas under the Birds Directive. All member states were then also required to notify the European Commission of lists proposed for designation as Special Areas of Conservation under the Habitats Directive, by virtue of their importance for the habitats or species listed in Annexes of that Directive.

A data recording form for sites in the Natura 2000 network was agreed by the Member States in 1994. It developed several features of the CORINE Biotopes database, although the emphasis was on the recording of habitats and species listed on the Annexes. Judgements are required to be made of the importance of each Annex habitat or species on several criteria. Because implementation of the Directive has legal implications for Member States' governments, it was necessary for the habitat types listed on Annex I to be defined more precisely than was necessary for the CORINE Biotopes database. Other habitats are covered at a more general level, and recording of non-Annex species is optional to Member States.

Habitats Directive Annex I / Natura 2000 Habitat Types

This list covers the Habitats Directive Annex I/Natura 2000 habitat types which include wetlands and can be found in the Mediterranean countries. "P" indicates the priority habitats of the Directive.

Code		**HABITAT TYPE**
1110		Sandbanks which are slightly covered by sea water all the time
1120	P	*Posidonia beds*
1130		Estuaries
1140		Mudflats and sandflats not covered by seawater at low tide
1150	P	Lagoons
1160		Large shallow inlets and bays
1170		Reefs
1180		Marine 'columns' in shallow water made by leaking gases
1210		Annual vegetation of drift lines
1220		Perennial vegetation of stony banks
1230		Vegetated sea cliffs of the Atlantic and Baltic coasts
1240		Vegetated sea cliffs of the Mediterranean coasts (with endemic *Limonium* spp.)
1310		*Salicornia* and other annuals colonising mud and sand
1320		*Spartina* swards *(Spartinion)*
1330		Atlantic salt meadows *(Glauco-Puccinellietalia)*
1340	P	Continental salt meadows *(Puccinellietalia distantis)*
1410		Mediterranean salt meadows *(Juncetalia maritimi)*
15 10		Salt steppes *(Limonietalia)*

2190		Humid dune slacks
2191		Dune-slack pools
2192		Dune-slack pioneer swards
2193		Dune-slack fens
2194		Dune-slack grasslands
2195		Dune-slack reedbeds and sedgebeds
3110		Oligotrophic waters containing very few minerals of Atlantic sandy plains with amphibious vegetation: *Lobelia, Littorelia and Isoetes*
3120		Oligotrophic waters containing very few minerals of West Mediterranean sandy plains with *Isoetes*
3130		Oligotrophic waters in medio-European and perialpine area with amphibious vegetation: *Littorella* or *Isoetes* or annual vegetation on exposed banks *(Nanocyperetalia)*
3131		Oligotrophic waters in medio-European and perialpine area with amphibious vegetation: *Littorella* or *Isoetes*
3132		Oligotrophic waters in medio-European and perialpine area with amphibious vegetation: annual vegetation on exposed banks *(Nanocyperetalia)*
3140		Hard oligo-mesotrophic waters with benthic vegetation of *Chara* formations
3150		Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation
3160		Dystrophic lakes
3170	P	Mediterranean temporary ponds
3220		Alpine rivers and the herbaceous vegetation along their banks
3221		Subalpine willow herb stream community
3222		Alpine gravel bed community
3230		Alpine rivers and their ligneous vegetation with *Myricaria germanica*
3240		Alpine rivers and their ligneous vegetation with *Salix elaegnos*
3250		Constantly flowing Mediterranean rivers with *Glaucium flavum*
3260		Floating vegetation of *Ranunculus* of plane, submountainous rivers
3270		Pioneer annual vegetation on muds *(Chenopodietum rubri)* of submountainous rivers
3280		Constantly flowing Mediterranean rivers: *Paspalo-Agrostidion* and hanging curtains of *Salix* and *Populus alba*
3290		Intermittently flowing Mediterranean rivers
4020	P	Southern Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix*
5140	P	*Cistus palhinhae* formations on maritime wet heaths *(Junipero-Cistetum palhinhae)*
6410		*Molinia* meadows on chalk and clay *(Eu-Molinion)*
6431		Humid tall herb fringes of watercourses and woodlands
6440		*Cnidion venosae* meadows liable to flooding
7110	P	Active raised bogs
7120		Degraded raised bogs (still capable of natural regeneration)
7140		Transition mires and quaking bogs
7150		Depressions on peat substrates *(Rhynchosporion)*
7210	P	Calcareous fens with *Cladium mariscus* and *Carex davalliana*
7220	P	Petrifying springs with tufa formation *(Cratoneurion)*
7230		Alkaline fens
8310		Caves not open to the public
8330		Submerged or partly submerged sea caves
91D0	P	Bog woodland

91D1	P	*Sphagnum* birch woods
91D2	P	Scots pine bog woods
91D3	P	Mountain pine bog woods
91D4	P	*Sphagnum* spruce woods
91E0	P	Residual alluvial forests *(Alnion glutinoso-incanae)*
91F0		Mixed oak-elm-ash forests of great rivers
92A0		*Salix alba* and *Populus alba* galleries
92B0		Riparian formations on intermittent Mediterranean water courses with *Rhododendron ponticum, Salix* and others
92D0		Thermo-Mediterranean riparian galleries *(Nerio-Tamariceteae)* and south-west Iberian Peninsula riparian galleries *(Securinegion tinctoriae)*

The Natura 2000 data format includes national and international site designation types, as for CORINE Biotopes, and a greatly extended list of human activities and impacts, with the possibility to indicate whether their action has positive or negative influence on the nature conservation interest.

Software for site recording using the Natura 2000 format was completed at the end of 1995, when site data started being transmitted to the European Commission. The proposed sites will be evaluated by the Commission during 1996-1998, and then Member States will be required to complete the designation process on the accepted list of sites during 1998-2004.

Current developments

An international workshop was held in Paris in October 1995 to discuss the issues of the future of CORINE Biotopes and its relation to Natura 2000. It was agreed that there is a need for scientific information, as complete as possible, on the presence and status of species and habitats across the European Union and other collaborating states in Europe. This information should be distinguished from, but associated with the Natura 2000 network, since the successor to the CORINE Biotopes database will serve the need to inform the EEA, while Natura 2000 will have a legal basis in the Habitats Directive.

In implementing the Habitats Directive, the European Commission also requires a reference database on nature conservation (informally referred to as "NatRef"), and one component of such a system could be provided from selected elements of the CORINE Biotopes database.

The CORINE Habitat classification was also discussed at the Paris workshop. It was agreed that there is a need for a habitat classification to cover all European habitats, with clear definitions and principles, and that the existing Palaearctic classification (developed from the CORINE classification) should be developed further for this purpose. Use of the classification would be enhanced through the development of a number of descriptive parameters (e.g. soils, climate, regions of occurrence, characteristic species). Implementation of these recommendations has begun in early 1996. A new international working group is likely to be established to manage the classification; however stability with its antecedents in CORINE will be a pre-condition required by the EEA. This will ensure that its use by other projects such as MedWet continues to be supported.

CORINE LandCover

The aim of the CORINE Landcover project is to provide those responsible for and interested in European policy on the environment with quantitative and descriptive information on land cover which is consistent and comparable across Europe. Data on land cover is necessary for environment policy as well as for other policies such as Regional Development and Agriculture. At the same time it provides one of the inputs for the production of more complex information on other themes.

To achieve this, a standard methodology for data collection and presentation has been developed for Europe. The methodology consists of a computer-assisted photo-interpretation of earth observation satellite images, with the simultaneous consultation of ancillary data, into one of the 44 categories of the European CORINE Landcover nomenclature. This land cover inventory at scale 1:100,000, which allows to stratify a study area for more detailed land cover or land use studies, contains at level 3 five different wetland categories (see table below).

Organisation

In 1985, the Commission of the EU established an information system on the state of the environment called CORINE. Since 1994, the results have been transferred to the European Environment Agency (EEA) located in Copenhagen to form an important source of environmental information for the EEA. Since end 1995, an EEA European Topic Centre on land cover (ETC/LC) is supervising the European land cover related activities.

The CORINE Landcover project has been extended to the Central and East European countries through the PHARE Programme and towards the Mediterranean countries through the METAP and MEDSPA programme.

The land cover data is collected by different national teams, and integrated into a seamless European Technical Unit (LCTU). The main objectives of the LCTU, nowadays integrated in the ETC/LC, are:

- the implementation of the CORINE Landcover project according to European standards
- training of the CORINE Landcover methodology to the national teams
- quality assurance and control of the results between the different land cover teams to guarantee homogeneous results
- integration of land cover results into a seamless European database
- surveillance of methodological improvements and reporting

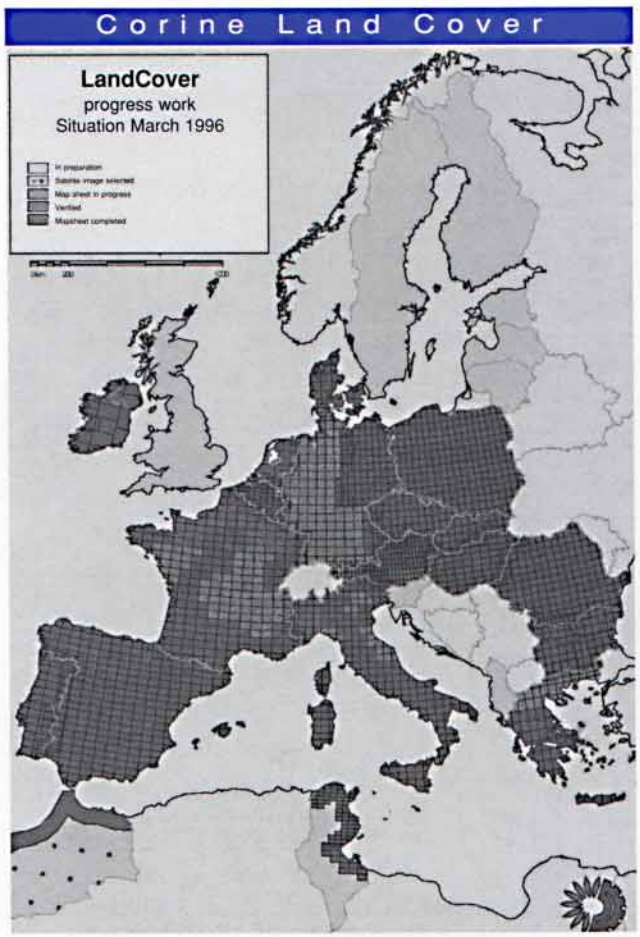
The LandCover database compilation

LANDSAT and SPOT multispectral data, with respectively 30 m and 20 m ground resolution, are used as the main source for visual interpretation of the data. Existing ancillary data, mainly topographic maps and aerial photographs, are consulted for completion and verification of the land cover data. Field checking completes the verification of the obtained land cover inventory before digitising and validation. The minimum mappable unit for the land cover project at scale 1:100,000 is 25 m. No line or point elements are included in the land cover data base. Linear features with a minimum width of 100 m are included and represented as areas.

CORINE *LandCover Nomenclature*

LEVEL 1	LEVEL 2	LEVEL 3
1. Artificial surfaces	1.1. Urban fabric	1.1.1. Continuous urban fabric
		1.1.2. Discontinuous urban fabric
	1.2. Industrial, commercial and transport units	1.2.1. Industrial or commercial units
		1.2.2. Road and rail networks and associated land
		1.2.3. Port areas
		1.2.4. Airports
	1.3. Mine, dump and construction sites	1.3.1. Mineral extraction sites
		1.3.2. Dump sites
		1.3.3. Construction sites
	1.4. Artificial, non-agricultural vegetated areas	1.4.1. Green urban areas
		1.4.2. Port and leisure facilities
2. Agricultural areas	2.1. Arable land	2.1.1. Non-irrigated arable land
		2.1.2. Permanently irrigated land
		2.1.3. Rice fields
	2.2. Permanent crops	2.2.1. Vineyards
		2.2.2. Fruit trees and berry plantations
		2.2.3. Olive groves
	2.3. Pastures	2.3.1. Pastures
	2.4. Heterogeneous agricultural areas	2.4.1. Annual crops associated with permanent crops
		2.4.2. Complex cultivation patterns
		2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation
		2.4.4. Agro-forestry areas
3. Forest and semi--natural areas	3.1. Forests	3.1.1. Broad-leaved forest
		3.1.2. Coniferous forest
		3.1.3. Mixed forest
	3.2. Scrub and/or herbaceous vegetation association	3.2.1. Natural grasslands
		3.2.2. Moors and heathland
		3.2.3. Sclerophyllous vegetation
		3.2.4. Transitional woodland-shrub
	3.3. Open space with little or no vegetation	3.3.1. Beaches, dunes, sands
		3.3.2. Bare rocks
		3.3.3. Sparsely vegetated areas
		3.3.4. Burnt areas
		3.3.5. Glaciers and perpetual *snow*
4. Wetlands	4.1. Inland wetlands	4.1.1. Inland marshes
		4.1.2. Peat bogs
	4.2. Marine wetlands	4.2.1. Salt marshes
		4.2.2. Salines
		4.2.3. Intertidal flats
5. Water bodies	5.1. Inland waters	5.1.1. Water courses
		5.1.2. Water bodies
	5.2. Marine waters	5.2.1. Coastal lagoons
		5.2.2. Estuaries
		5.2.3. Sea and ocean

All data is collected at national level according to the national topographic map sheet subdivision, mostly available at scale 1:100,000. In total over 2500 map sheets covering over 3 million km² are mapped and converted to the standard European reference system for edgematching between countries. Figure 1 shows the progress of work for July 1995. The seamless, initially vector oriented, land cover data base is very large to handle. For small scale applications at European level, generalised data sheets, mainly grid oriented data are made available to the users.



Uses

The CORINE LandCover data base has recently become available for large parts of the European territory. Although its exploitation is just starting, it offers the potential for a wide array of uses. The fact that it is in a GIS format means that it is very flexible.

It can be used on its own for simple cartographic or statistical presentations. Combined with other data it can contribute to a more detailed analysis of land cover, land use, spatial analysis and modelling. The capacity to model and query relating to existing or potential land cover is an extremely useful tool particularly in relation to determining different scenarios with respect to Common Agricultural Policy, reforms, Regional Policy and regional impact studies, though the scale used (maximum 1:100,000) rules out its use for more detailed local environment impact assessments.

A CORINE Landcover brochure prepared for the International Space Year Conference in Munich provides a number of examples of its use. These include:

- the land cover of biotopes of major importance for nature conservation in Portugal by combining CORINE Landcover and Biotopes databases
- land cover in relation to potential vegetation and land quality in Corsica
- evaluation of emissions of volatile organic compounds by vegetation in Portugal.

Ramsar Convention

The Ramsar Convention on Wetlands of International Importance has now spanned a quarter-century. It all began in the town of Ramsar, Iran in February 1971, where 18 states signed the text of this agreement. The Convention, which entered into force on 21 December 1975, is the only global conservation treaty that focuses on a distinct family of ecosystems - wetlands.

The Convention text defines wetlands as '*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*'. Furthermore the text adds that wetlands: '*may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands*'. This broad definition of wetlands has ensured applicability around the globe.

A Contracting Party to the Convention has four main obligations, which are briefly:

- to designate one or more sites to the Ramsar List, and maintain their ecological character;
- to promote the wise use of wetlands within its territory through national wetland policies and a wide range of other measures;
- to promote conservation of these wetlands through establishment of nature reserves, and provision of staff training (e.g. on wetland management);
- to consult with other Contracting Parties about implementation of the Convention, especially concerning shared resources

Implementation of all of these obligations can be enhanced by application of Ramsar's wetland inventory tools: a standard wetland classification, criteria (for identifying wetlands of international importance), datasheet and database (see Boxes with wetland classification and criteria).

On 8 May 1974, the first site was designated for the List of Wetlands of International Importance. Until 1989 information on Ramsar Sites was contained in a 'series of structured narrative accounts held on a word-processing system' (Scott 1989). These accounts formed the basis of site entries in *Directories of International Importance*, which were typically published to coincide with each regular Ramsar Conference.

It was proposed in late 1988 to update both the datasheet (i.e. the structured narrative

account) and the database (i.e. the word-processing system and its narrative files). A study was commissioned to provide a report with recommendations. The consultant solicited a wide range of wetland and data management expertise to provide input. A meeting was organised in March of 1989 at Slimbridge, UK, to finalise details of the proposed datasheet and database. Significantly it was decided that 'no attempt should be made to produce a formal wetland classification system or typology for use in connection with Ramsar sites'. The participants concluded that a simple hierarchy of 'wetland terms' be devised to describe the 'principal types of wetlands in the world' and that codes for these terms could be used to assist database

Ramsar Wetland Types

Codes facilitate data recording and analysis. Ramsar wetland types are represented by the following database codes:

A Permanent **shallow marine waters** less six metres deep at low tide; includes sea bays and straits.

B Marine **subtidal aquatic beds**; includes kelp beds, sea-grass beds, tropical marine meadows.

C **Coral reefs**

D **Rocky marine shores**; includes rocky offshore islands, sea cliffs.

E **Sand, shingle or pebble shores**; includes sand bars, spits and sandy islets; includes dune systems.

F **Estuarine waters**; permanent water of estuaries and estuarine systems of deltas.

G **Intertidal mud, sand or salt flats**.

H **Salt marshes**; includes salt meadows, saltings, raised salt marshes.

I **Intertidal forested wetlands**; includes mangrove swamps, nipah swamps and tidal freshwater swamp forests.

J **Coastal brackish/saline lagoons**; brackish to saline lagoons with at least one relatively narrow swamp forests.

K **Coastal freshwater lagoons**; includes freshwater delta lagoons.

L Permanent **inland deltas**

M **Permanent rivers, streams or creeks**; includes waterfalls.

N **Seasonal/intermittent/irregular rivers, streams or creeks.**

O **Permanent freshwater lakes** (over 8 ha); includes large oxbow lakes.

P **Seasonal/intermittent freshwater lakes** (over 8 ha); includes floodplain lakes.

Q **Permanent saline/brackish/alkaline lakes**

R **Seasonal/intermittent saline/brackish/alkaline lakes***

Sp **Permanent saline/brackish/alkaline marshes or pools**

Ss **Seasonal/intermittent saline/brackish/alkaline marshes or pools***

Tp Permanent freshwater marshes or pools; ponds (below 8 ha), marshes and swamps on inorganic soils with emergent vegetation water-logged for at least most of the growing season.

Ts **Seasonal/intermittent freshwater marshes or pools** on inorganic soil; includes sloughs, potholes, seasonally flooded meadows, sedge marshes.*

U Non-forested **peatlands**; includes shrub or open bogs, swamps, fens.

Va **Alpine wetlands**; includes alpine meadows, temporary waters from snowmelt.

Vt Tundra wetlands; includes tundra pools, temporary waters from snowmelt.

W Shrub-dominated wetlands; shrub-swamps, shrub-dominated freshwater marsh, shrub carr, alder thicket; on inorganic soils.*

Xf Freshwater, tree-dominated wetlands; includes freshwater swamp forest, wooded swamps; on inorganic soils.*

Xp Forested peatlands; peatswamp forest.*

Y Freshwater springs; oases

Z Geothermal wetlands.

Zg Geothermal wetlands.

Zk Subterranean karst and cave hydrological systems.

Man-made/intensively farmed or grazed wetlands

1 Aquaculture (e.g. fish/shrimp) **ponds**

2 Ponds; includes farm ponds, stock ponds, small tanks (generally below 8 ha).

3 Irrigated land; includes irrigation channels and rice fields.

4 Seasonally flooded agricultural land.#

5 Salt exploitation sites; salt pans, salines, etc.

6 Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha).

7 Excavations; gravel/brick/clay pits, borrow pits, mining pools.

8 Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc.

9 Canals and drainage channels; ditches.

0 No information

* As appropriate, includes: floodplain wetlands such as seasonally inundated grassland (includ ing natural wet meadows), shrublands, woodlands or forest.

\# To include intensively managed or grazed wet meadow or pasture.

processing. The results of the meeting, and written comments, were used in the formulation of the consultancy report (Scott 1989).

This paper provided the basis for major provisions of a 1990 Ramsar Conference recommendation at Montreux, Switzerland, namely, the data categories for the *Information Sheet on Ramsar Sites and the Classification System for 'Wetland Type'* (Rec. 4.7, Annex 2, parts A and B, respectively). This recommendation stated that the 'datasheet developed for the description of Ramsar sites ... be used by Contracting Parties and the [Ramsar] Bureau in presenting information for the Ramsar database...' This datasheet, entitled the *Information Sheet on Ramsar Wetlands*, covers a range of 32 topics as set out in the recommendation. Later at the next Ramsar Conference (Kushiro, Japan, 1993), a resolution (Res. 5.3) reaffirmed that a completed 'Ramsar datasheet' and site map should be provided upon designation of a wetland to the Ramsar List, and emphasised that information concerning **conservation measures**, the (hydrological, biophysical, floral, faunal, social and cultural) **functions and values** of the site, and criteria for inclusion (i.e. Ramsar criteria) were particularly important data to be supplied. The present version of the Ramsar criteria were accepted at the Montreux Conference (Rec. 4.2) as *Criteria for Identifying Wetlands of International Importance.*

The Ramsar Database (established and managed on behalf of the Convention by Wetlands International), as a *database-file-format* system, also came into being in 1990. Its data fields also

derived from Information Sheet categories approved in the aforementioned Montreux recommendation. The classifications embodied in Convention recommendations, i.e. the Ramsar criteria and the Classification System for 'Wetland Type' form two of the most important components of the Ramsar Database. While the Ramsar Criteria classification already contained codes which could be used on their own in the database, the Wetland Type classification necessitated development of a coding system. The classification and its codes have always been intended to provide only a very broad framework to aid rapid identification of the main wetland habitats represented at each site. This has ensured its global applicability. This framework should not be considered as an attempt at a comprehensive wetland classification. Additional wetland types (**Geothermal wetlands** and **Subterranean karst and cave hydrological systems**) were added to the classification by the Sixth Meeting of the Contracting Parties (Brisbane, Austrália)

At the Montreux Conference, there were 55 Contracting Parties to the Ramsar Convention with 464 designated sites. By September 1995 this had increased to 756 Ramsar Sites from 90 Contracting Parties covering almost 50 million hectares. This major growth in the size of the Convention has also resulted in an increased demand on the Ramsar Database to provide for the Convention's information management needs. These include:

- maintenance of the Ramsar List of Wetlands of International Importance, and the Montreux 'Record of Ramsar sites where changes in ecological character have occurred, are occurring or are likely to occur';
- provision of site data to support monitoring or management guidance missions;
- provision of site data in support of responses to reports of changes in ecological character at listed sites;
- provision of thematic data in support of wise use and management plan projects;
- preparation of analyses for Ramsar regional meetings;
- preparation of site texts and illustrations for Ramsar publications; and
- processing of an extensive range of other information requests.

Once sufficient and manageable as a single database file, the Ramsar Database now consists of a suite of more specialised databases that can be linked to the parent *sites-database*. This is but the first step towards realisation of a *relational* database system, replete with a user-friendly menu-driven shell and a host of pre-programmed report formats, and perhaps linkage to a simple mapping or GIS application. No matter what its form and structure, a database must be backed up with complete, accurate and contemporary data. The strength, and weakest link, in any information system is the data it contains. For the Ramsar Database, an instrument exists to help provide these data in the most suitable form, therefore encouraging harmonisation of information. This is the *Information Sheets on Ramsar Wetlands* and its associated *Explanatory Note and Guidelines*.

Further reading

Ramsar Convention Bureau 1990, 1991, 1993;IWRB 1992-95; Matthews 1993; Davis 1994; De Klemm & Creteaux 1995.

Ramsar criteria

The list of Ramsar criteria was approved in 1990 by the Fourth Meeting of the Conference of the Contracting Parties (Montreux, Switzerland) and expanded by the Sixth Meeting of the Contracting Parties (Brisbane, Australia) in order to identify wetlands of international importance. A wetland is identified as being of international importance if it meets at least one of the criteria set out below:

1. Criteria for representative or unique wetlands:

a wetland should be considered internationally important if:

1a. it is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region, *or*

1b. it is a particularly good representative example of a natural or near-natural wetland, common to more than one biogeographical region, or

1c. it is a particularly good representative example of a wetland which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position, *or*

1d. it is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region.

2. General criteria based on plants or animals

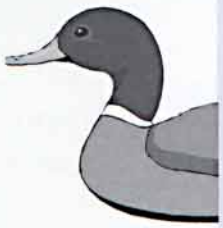
a wetland should be considered internationally important if:

2a. it supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species, *or*

2b. it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna, *or*

2c. it is of special value as the habitat of plants or animals at a critical stage of their biological cycle, *or*

2d. it is of special value for one or more endemic plant or animal species or communities.



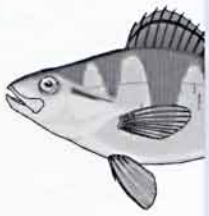
3. Specific criteria based on waterfowl

a wetland should be considered internationally important if:

3a. it regularly supports 20,000 waterfowl, *or*

3b. it regulary supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity, *or*

3c. where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.



4. Specific criteria based on fish

a wetland should be considered internationally important if:

4a. it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity, *or*

4b. it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

3 The inventory process

A great deal of human and financial resources and very careful planning are necessary for undertaking a wetland inventory. Before launching a wetland inventory project, the objectives and the available resources must be determined. Many problems will be avoided if the project is well planned and organised and if the objectives, resources, methodology and outputs are clearly defined from the beginning. In this chapter the most important phases in the preparation of an inventory are described, from evaluation of resources to organisation and sequence in the inventory process. A preliminary assumption in the preparation of the methodology was that the resources available to undertake the wetland inventory vary from country to country in the Mediterranean region, and sometimes even within each country. So, the whole method is standard for the Mediterranean region but is flexible, allowing different levels of resources and different phases in order to undertake the inventory at different levels of detail.

3. The inventory process

A great deal of human and financial resources and very careful planning are necessary for undertaking a wetland inventory. Before launching a wetland inventory project, the objectives and the available resources must be determined. Many problems will be avoided if the project is well planned and organised and if the objectives, resources, methodology and outputs are clearly defined from the beginning.

The objectives and scope of a wetland inventory were already described in Chapter 1. In this chapter the most important phases in the preparation of an inventory are described, from evaluation of resources to organisation and sequence in the inventory process.

A preliminary assumption in the preparation of the methodology was that the resources available to undertake the wetland inventory vary from country to country in the Mediterranean region, and sometimes even within each country. This will affect the level of application of the inventory components and the level of detail of the information collected. This means that the whole method is standard for the Mediterranean region but is flexible, allowing different levels of resources and different phases in order to undertake the inventory at different levels of detail. However, flexibility should not be confused with the possibility of changing any part of the method, which would contribute to a loss of standardisation.

Catchment, site and habitat levels

The inventory procedure is based on a three-level hierarchy: (1) catchment area, for compilation of all common characteristics of the wetlands included in the same catchment area; (2) wetland site, for gathering all the information for each site; and (3) wetland habitat, for which more detailed information can be taken for each habitat found at a site.

The setting of these levels will enable the structuring of data collection according to the objectives of the inventory and the availability of resources.

Catchment area The catchment is considered to influence all the wetlands occurring within its area, since they share common characteristics. Hydrological features will be shared by all the wetlands due to rainfall, river flow, dam regulation, etc. Data collection and analysis for the catchment area will save time, because similar data are recorded for all wetland sites within each catchment .

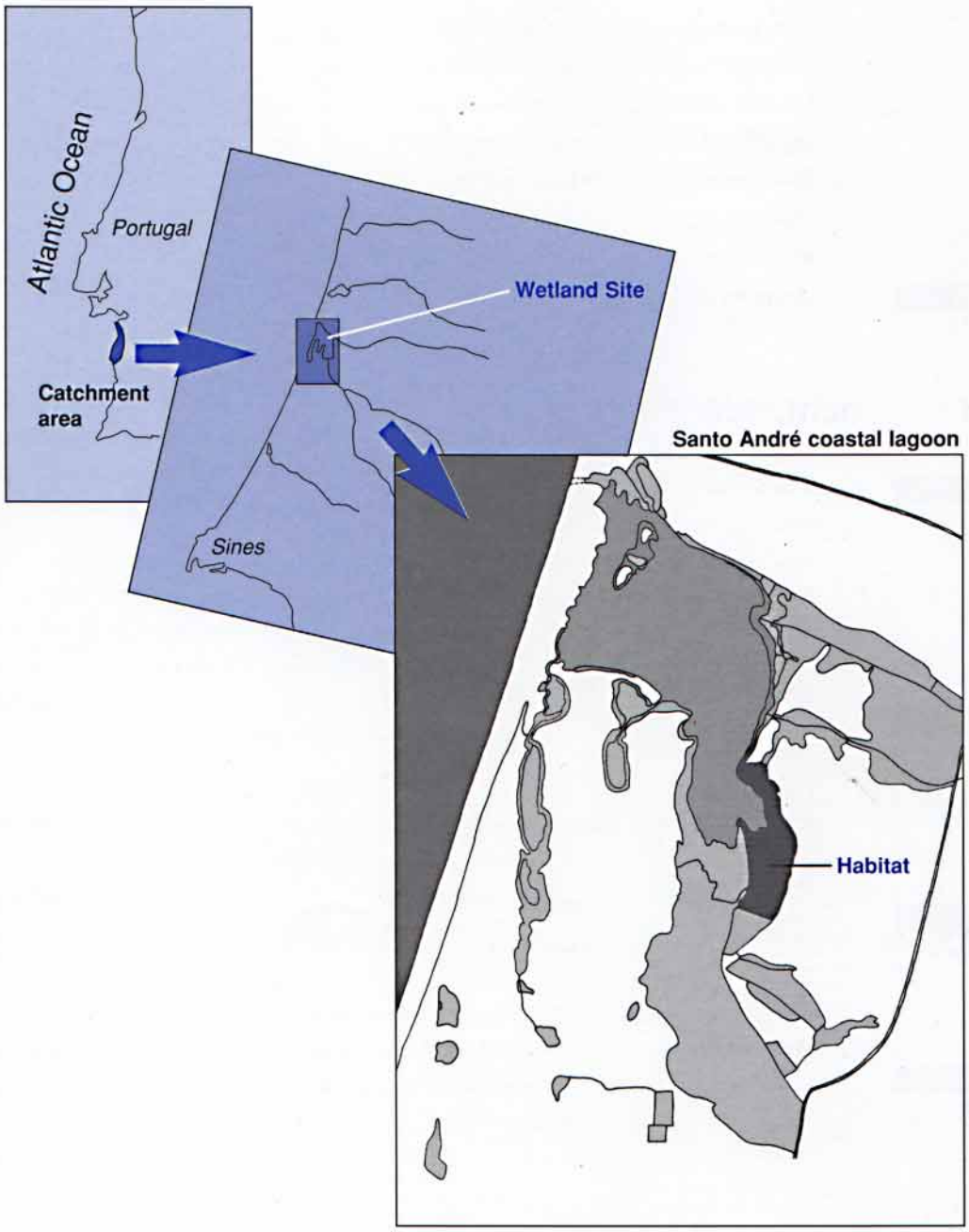
see Chapter 4

Wetland site The wetland site is the essential area to be inventoried, and data collected at this level should be the minimum necessary for regional planning, management and generic monitoring.

see Chapter 5

Wetland habitats The wetland habitat level allows recording of data which are detailed and give a good knowledge of the wetland site, either by the complexity of the data or by the creation of maps representing ecological units. This information is essential for site management and monitoring.

see **Chapter 6**



The inventory components

A common set of procedures must be considered at any level, in order to define the baseline methodology of the inventory. The five main components of a wetland inventory are: (1) site selection; (2) wetland identification; (3) classification system; (4) data collection and storage; and (5) mapping procedure (Tomàs Vives 1993).

For these five main components of the wetland inventory process standards must be set out in order to achieve a coherent baseline of methods.

Site selection

Criteria for wetland site selection must be defined and may include sites with some degree of information, sites with a minimum surface area, sites of a particular wetland type, etc. Sites must be defined as units to be inventoried and the selection of sites should be determined according to the objectives of the inventory.

see Chapter 5

Wetland identification

Wetlands must be defined and criteria for their identification must be adopted in order to know which areas are going to be inventoried. Also, the setting of these criteria will lead to coherence in wetland delineation and to comparisons between different wetland sites.

see Chapter 5

Classification system

A classification system to describe wetland types and/or the structure of their habitats for the Mediterranean must be relevant to the key characteristics of wetlands and should provide easily recognisable units for inventory and mapping. It should have a hierarchical structure and allow a consistent application of the terminology.

see Chapter 6

Data collection and storage

The way of collecting and storing the data from the inventory process must be defined, namely by the creation and use of standard datasheets and by the use of a database which will be used for storing and analysing data collected.

see Chapter 7, 8

Mapping procedure

Mapping is essential for the recognition and delineation of wetland units and constitutes an important output of the inventory process. It must be based on the classification system adopted for the inventory.

see Chapter 9

Developing the inventory

From the beginning, the primary concern in conducting the inventory should be the formulation of objectives and the identification of available resources. Before launching, it is essential to assess what resources are already available in terms of staff, expertise, equipment, and information.

Depending on the availability of these resources three main phases can be identified in order to carry out a wetland inventory. The process becomes more comprehensive and complex from phase 1 to phase 3, but can start at any point, depending on the available resources.

The three phases identified are (Tomàs Vives 1993):

Phase 1

Research of existing information

Compilation of existing data on known sites, using all the available sources of information (bibliography, maps, databases). This should be undertaken before collection of new data and does not require fieldwork.

Phase 2

Simple inventory

Compilation of additional information about all the sites identified in phase 1, with a higher level of detail, including at least a sketch map for each site, plus gathering of information on 'new' sites. It may require some field work and moderate resources. It is essential for recognising the wetlands within the area considered and their attributes.

Phase 3

Detailed inventory

Compilation of very detailed information about each site and production of detailed maps, ideally using a Geographic Information System (GIS). At this phase, the importance of the sites for nature conservation and for local communities should be fully evaluated. Intensive field work and wetland knowledge will be necessary, and more substantial resources are needed. This phase is particularly useful for local management, providing baseline information for planning and monitoring.

These three phases should not be seen as three different blocks of procedures, but as a continuum. For each phase there is a minimum degree of development and detail for the different components of the inventory (see box next page). It is also important to note that by choosing to undertake an early phase of the wetland inventory process does not imply that a more detailed inventory could not be done later, if more resources become available.

Phasing the components of the inventory

The entire process of wetland inventory is based on five components that are together fundamental for selecting, collecting, storing and viewing all the information. Because available resources vary between Mediterranean countries three development phases were identified to undertake the inventory: Research of existing information, simple inventory and detailed inventory. For each phase there is a minimum degree of development of each one of the components (site selection, wetland identification, classification system, data collection and storage, and mapping procedure). However, all the phases should be seen as a continuum instead of three different phases.

	Research of existing information	Simple inventory	Detailed inventory
site selection	Include all the sites for which there is some information.	New sites must be located and recorded. Criteria for their inclusion must be set out, depending on the objectives of the inventory.	A fully comprehensive inventory should be completed with all the wetlands within the area considered.
wetland identification	No effort is required for precise wetland identification.	Wetland identification should be assessed at least for the less obvious boundaries of the site.	Precise identification should be undertaken, allowing ecological units to be delineated using the appropriate classification system.
classification system	A detailed wetland classification is not needed at this phase, but some general categories or description should be used.	A wetland type classification, such as Ramsar system or CORINE (up to the second level) is sufficient.	A detailed classification system of wetland habitats is required.
data collection and storage	It is important to assess the information already existing and to identify the people with knowledge about each wetland site. It could be done by a small group of	Standard datasheets and data base should be completed. The process should involve contacting people throughout the area of the inventory.	Data sheets and data base should be fully completed in order to allow a comprehensive coverage and output of the information.
mapping procedure	At least a national map with the location of the sites	A sketch map for each site should be included.	Detailed habitat maps, ideally using Geographical Information Systems (GIS) and photointerpretation devices should be produced.

It is obvious that the development of the three main phases of the inventory will lead to different types of results (see box below).

Searching for existing information will provide the baseline information for undertaking a future or more detailed inventory. Simple and detailed inventories reflect the work for searching and recording 'new' sites and will provide different outputs. The simple inventory is enough to give a broad level of information on wetland sites occurring within the area considered. The detailed inventory allows a more comprehensive knowledge for planning and monitoring possibilities to the local manager.

Nevertheless, it must be emphasised that these phases constitute a continuum, and each component of the inventory can be developed to the desired level of detail according to the objectives of the inventory.

Results of the inventory

The development of the five main components of the inventory (site selection, wetland identification, classification system, data collection and storage, and mapping procedure) for each phase leads to different types of results. The phase to be chosen when undertaking the inventory will depend on the resources available but also on the type of results and outputs that are desired. However, it is recommended to undertake the inventory to the more detailed level when resources allow, due to the more complete data that will be obtained and to the broader possibilities for application of the inventory.

Research of existing information	Simple inventory	Detailed inventory
• List of wetlands with available information • Location of the sites • Data on biological, social, economic and legal status of the wetlands included	The same as in the earlier phase, plus: • Identification of the wetland sites occurring within the area considered • Complete data at site level • Wetland area identification for the sites included and their boundaries • Compatibility of data with other international programmes • assessment of the relative importance of sites	The same as in earlier phases, plus: • wetland habitat map for each site • Other maps depicting combined information for the abiotic and biotic parameters of wetland habitats (e.g. water regime and vegetation or flora and fauna, wetland habitats and flora or fauna or human activities or impacts, etc.) • More detailed data on ecological and socio-economic issues within the site • Geographical database of all the acquired information (if GIS is used)

Phase 1. Research of existing information

A good review and compilation of all available information is crucial to obtaining a sound basis for wetland inventory. Four types of information might be available for this first phase of wetland inventory: (1) earlier inventories; (2) bibliography; (3) expert framework; and (4) legal status.

In addition, it is very important to make an early 'inventory' of people with knowledge on wetland study, conservation and management. The identification of those people and their contribution can make the search for information richer and more effective at all levels.

Earlier inventories

Inventories have been carried out in some countries of the Mediterranean region, either at a national, regional or broader scale (Hecker & Tomàs Vives 1995). Some essential information can usually be located.

Various international projects and programmes with information on the Mediterranean region have been published. Sometimes these projects are concerned with all natural environments and not exclusively with wetlands, but wetland information will appear for many important sites. In many cases a number of wetlands or wetland types are considered in these inventories and important baseline information is available to be taken and updated. Some relevant international projects and programmes are listed in the box below.

Bibliography

In any inventory process, bibliographic research is essential. Scientific papers, reports on conservation and management of sites and catchment areas, and reports on flora, fauna, land uses and impacts, will be a very important source of information.

This information is usually available in libraries and universities, in governmental agencies, in research centres, non-governmental organisations or other environmental organisations. The search can be a tedious and time-consuming task, but is often helped by using catalogues and databases. However, it is always a crucial and profitable step, which will provide clues for finding data of other types.

Expert framework

The establishment and updating of a list of experts and local contacts working in wetland issues is a very important item to consider. These experts are not only scientists or managers but also owners, local decision makers, local contacts, etc. They can then be asked to contribute relevant information. This is useful for two main reasons: first, it enables access to information on wetlands that can only be transmitted by people because it is not published; and secondly, because these people can contribute to increase the amount of information available.

Furthermore, a continuous updating of this framework can also contribute to an updating of the information on wetlands.

Legal status

Some major wetlands are designated under regional, national or international legislation and agreements. For those sites, information is usually more extensive, as it served as a basis for the designation of the site. Among national designations are nature reserves, national parks and other categories varying from country to country.

Many international designations, under several programmes, can be considered, such as the Ramsar Convention, the World Heritage Convention, the Barcelona Convention, the UNESCO Man and Biosphere Reserves, the Council of Europe Network of Biogenetic Reserves, the European Union Special Protection Areas under the Birds Directive, and soon sites under the Habitats Directive, which will

see Chapter 2

contribute to constitute the Natura 2000 network. Information can be extracted from datasheets available from the relevant secretariats or national representatives. The addresses of some of these secretariats are listed in **Appendix 1**

Some International programmes and inventories

Various international projects and programmes have already collected and published valuable information on Mediterranean wetlands. Sometimes these projects are concerned with all natural environments and not exclusively with wetlands, but wetland information will appear for many important sites. In many cases a strict number of wetlands or wetland types is considered in these inventories but important baseline information is available to be taken and updated. This list includes inventories and programmes dealing with some Mediterranean wetlands and is summarised in Hecker & Tomàs Vives (1995).

Project or programme	Reference
Project Aqua	Luther & Rzóska 1971
Project MAR	Olney 1965
A Directory of Western Palearctic Wetlands	Carp 1980
A Directory of African Wetlands	Hughes & Hughes 1992
African Wetlands and Shallow Water Bodies	Burgis & Symoens 1987
Zones Humides d'Afrique septentrionale, centrale et occidentale	de Beaufort & Czájkowski 1986
Wetlands of West Asia	Scott 1993
A Preliminary Inventory of Wetlands of International Importance for Waterfowl in Western Europe and Northwestern Africa	Scott 1980
Important Bird Areas in Europe	Grimmett & Jones 1989
Directory of Marine and Coastal Protected Areas in the Mediterranean	UNEP/IUCN 1989
Important Bird Areas in the Middle East	Evans 1994
CORINE Biotopes Database	European Commission 1991
A Directory of Wetlands of International Importance (Ramsar)	Jones 1993
EU Special Protection Areas under the Birds Directive	European Commission 1994
International Waterfowl Census	Rose 1990
A Directory of Wetlands in the Middle East	Scott 1995

Phase 2. The simple inventory

In this phase, new sites are identified and data on their functions and values are gathered. The simple inventory should be the process of gathering the maximum amount of data with a low level of resources. It leads to a collection of important information on wetland sites within the area covered.

At this stage, new sources of information must be used to obtain data for the inventory. In addition to the four sources already mentioned, two more are used: (5) maps and remote sensing; and (6) fieldwork.

Maps and remote sensing

Maps, aerial photographs and satellite imagery are essential tools to help locate wetland sites for the inventory (see Chapter 5). Maps at several scales will help to locate and to identify where the wetlands are. They will help also to identify catchment areas. Thematic map information is important for providing data on several characteristics of catchment areas and wetland sites (e.g. soil, hydrology, land use, climate, vegetation, etc.).

Fieldwork

Fieldwork is the final and most conclusive step as a source of information. Usually the wisest way to collect information will be a field visit after having compiled information from other sources.

Field visits allow checking and updating all the information gathered so far, as well as a search for all the information that is missing, depending on the amount of data available.

The tools developed under MedWet wetland inventory are used from this stage on. These tools include datasheets and their guidelines for recording information; and a database (the MedWet Database). The integrated use of these tools will assist in matching the main objectives of the inventory: the availability of standard data on wetlands and the possibility of producing reports from the available information.

The use of datasheets provides uniformity in the recording of information and entry of data to a standardised database. The datasheets can be used in every Mediterranean country, and their format is compatible with existing programmes which include wetland inventory: Ramsar Convention, CORINE biotopes and Natura 2000.

see Chapter 7

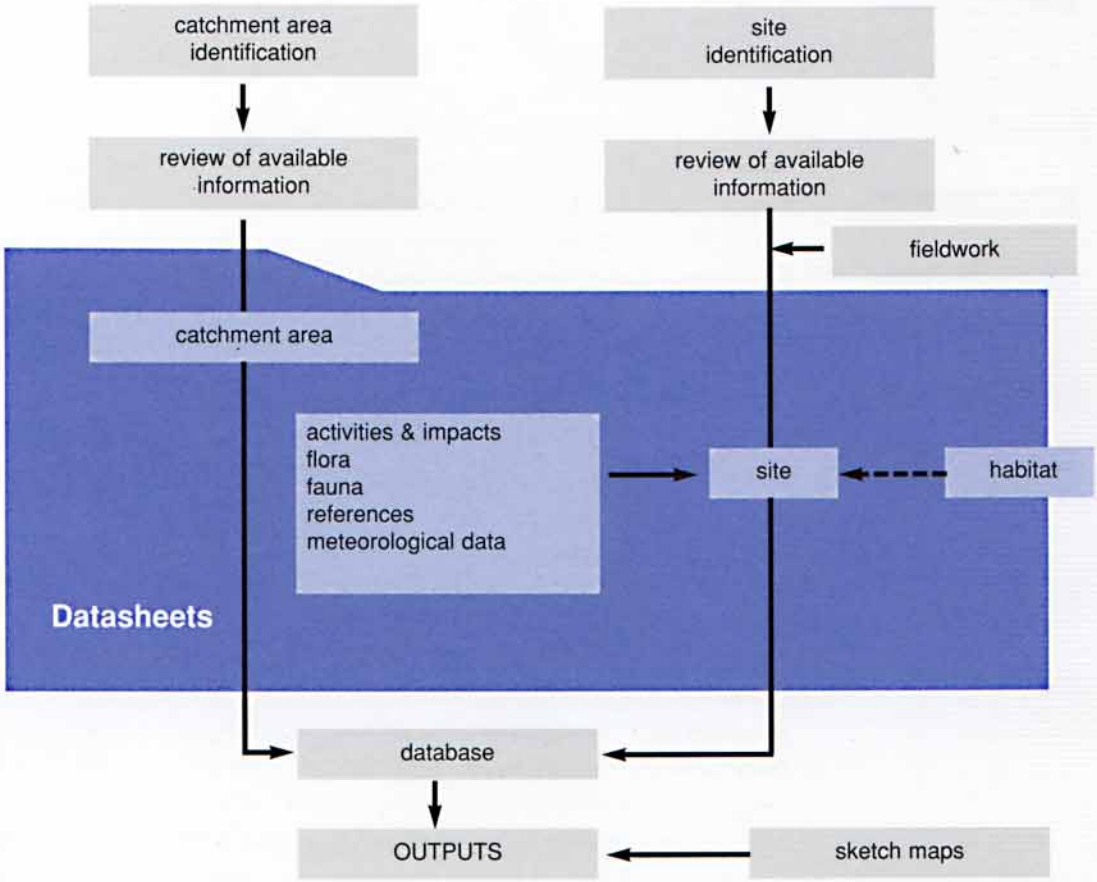
Only the datasheets concerning catchment area and wetland site information need to be used for a simple inventory. Habitat datasheets can also be completed as well, if desired. The complementary datasheets for fauna, flora, human activities, meteorological data and references can also be completed and will refer to the wetland site.

see Chapter 7

All the information collected with these datasheets can be entered in the MedWet Database, which allows the storage, analysis and presentation of the inventory information and a possible compilation at a national or Mediterranean regional level.

see Chapter 8

The sequential procedure for conducting this simple inventory phase, starting from gathering of information and catchment and site identification, is shown in the figure below. Fieldwork should complete the information that is to be included in the datasheets and in the database. As one of the final outputs, at least a sketch map should be produced for each wetland site, ideally indicating what wetland types occur there.



Phase 3 The detailed inventory

The detailed inventory provides the ideal collection of information for use both at national, regional and local levels. Of course it requires more resources than the earlier phases, but a higher level of detail will be achieved. It deals with ecological description of the sites, and data assigned to them will be very useful for a good understanding of the functions and values of the site. The use of such information is of great importance as a basis for site management and monitoring.

So, in addition to the catchment area and wetland site levels there is the habitat level to be considered. In this advanced type of inventory the spatial identification of wetland habitats is introduced. For this purpose three new tools are provided:

see
VOLUME III
Mediterranean Wetland Inventory. Habitat Descryption System

- Habitat Description System in order to provide definitions for delineating ecological units for mapping ;

see
Chapter 9

- Mapping Method which combines field data and remotely sensed data to minimize the cost and time of inventory;

see
VOLUME IV
Mediterranean Wetland Inventory. Photointerpretation and Carthographic Conventions

see
Chapter 6

see
VOLUME II
Mediterranean Wetland Inventory. Data Recording
Chapter 7

see
VOLUME IV
Mediterranean Wetland Inventory. Photointerpretation and Carthographic Conventions

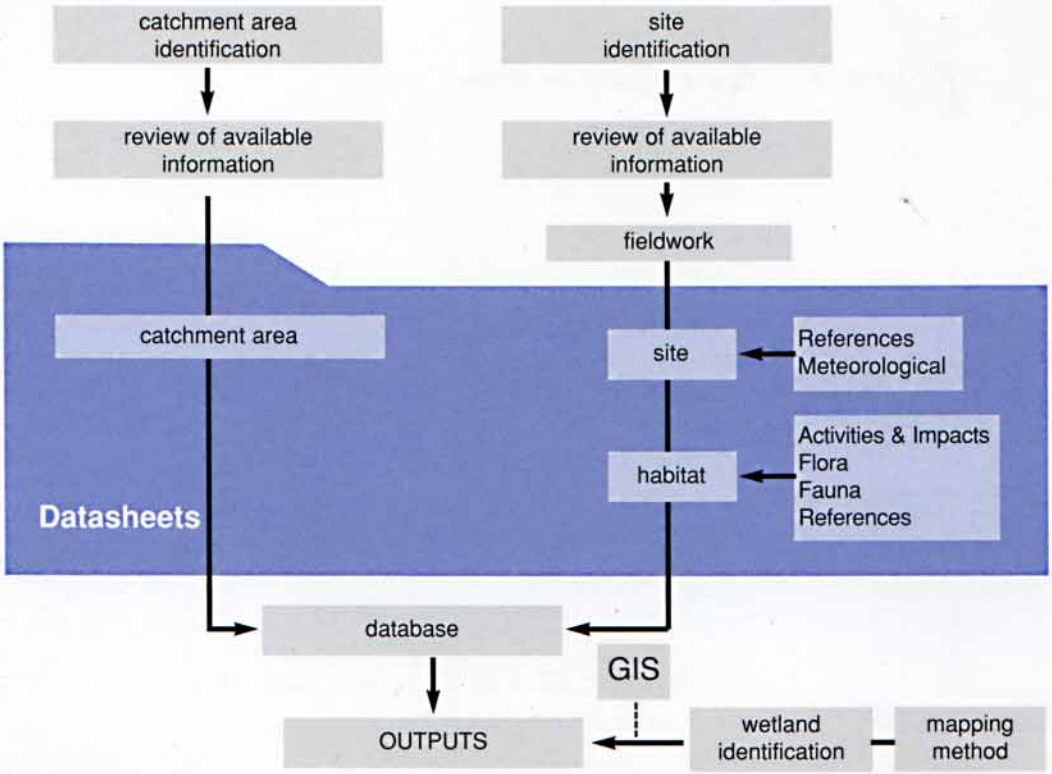
- Photointerpretation and Cartographic Conventions to provide standard interpretation effort and outputs.

The full set of datasheets should be used, including catchment area, wetland site and wetland habitat levels. For the habitat datasheets a description or classification system must be chosen. Depending on the aims of the inventory, the Ramsar or the CORINE Biotopes classifications or the MedWet habitat description system can be used. The complementary data sheets for fauna, flora, human activities, meteorological data and references should refer to the wetland habitat whenever possible, although sometimes it is difficult to assign the information for very small areas.

From this stage, a new tool is considered: the mapping method. Although map production is encouraged even for the simple inventory phase, from now on there is a standard mapping method which allows illustration of the ecological structure of the habitats within the wetland site. For aiding the production of standard maps, conventions on photointerpretation and cartography are provided.

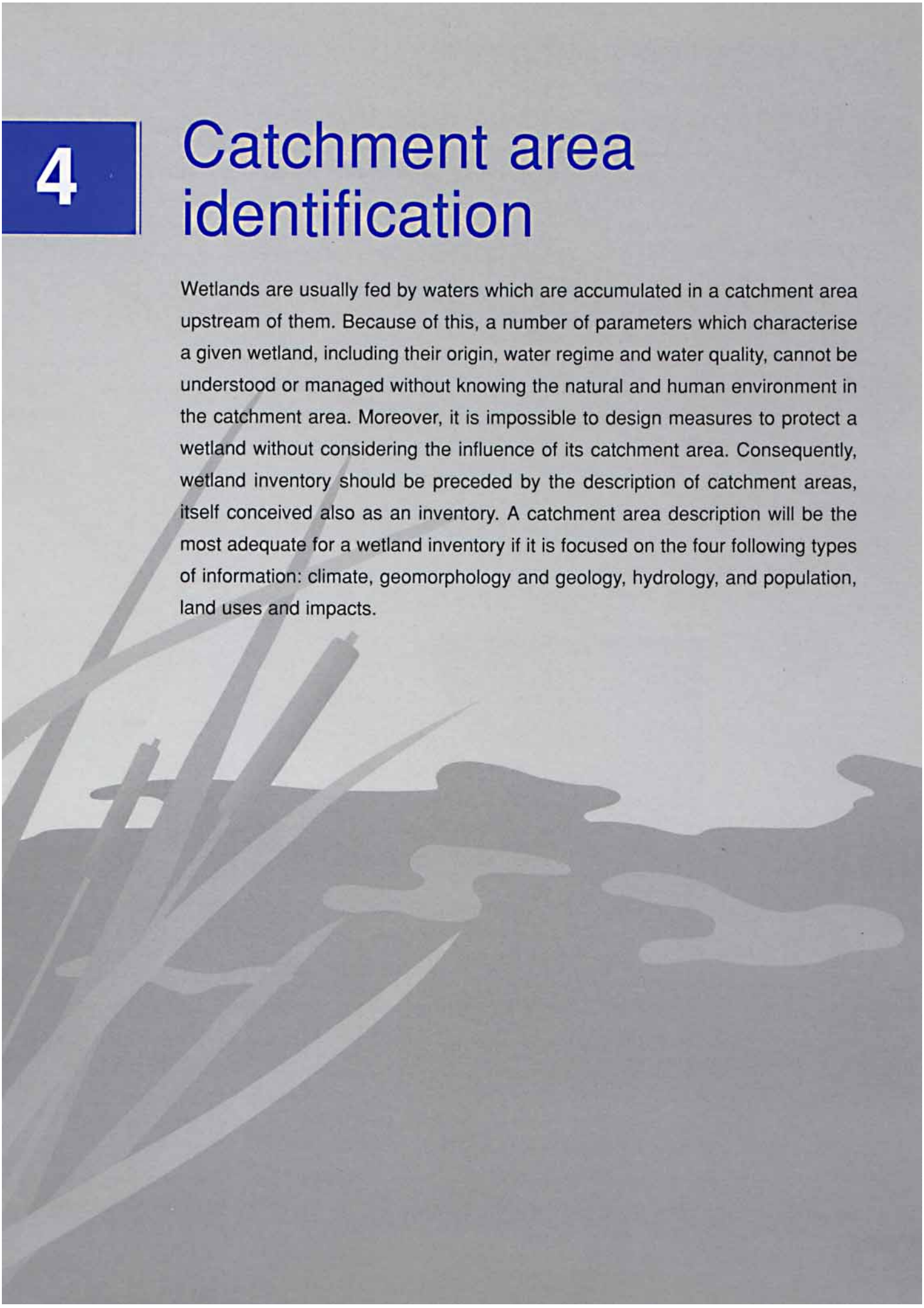
All the information collected with the datasheets is entered in the MedWet Database. Ideally, the maps should be linked to the information stored in the database and datasheets, through a Geographic Information System (GIS).

The sequential procedure for this detailed inventory phase, starting from gathering of information and catchment and site identification is shown in the figure below. Fieldwork should complete the information that is to be included in the datasheets and in the database. Detailed maps of the site include delineation of wetland habitats following the habitat description system, which will allow linking of information between the database and a GIS program.



4 Catchment area identification

Wetlands are usually fed by waters which are accumulated in a catchment area upstream of them. Because of this, a number of parameters which characterise a given wetland, including their origin, water regime and water quality, cannot be understood or managed without knowing the natural and human environment in the catchment area. Moreover, it is impossible to design measures to protect a wetland without considering the influence of its catchment area. Consequently, wetland inventory should be preceded by the description of catchment areas, itself conceived also as an inventory. A catchment area description will be the most adequate for a wetland inventory if it is focused on the four following types of information: climate, geomorphology and geology, hydrology, and population, land uses and impacts.



4. Catchment area identification

Wetlands are usually fed by waters which are accumulated in a catchment area upstream of them. Because of this, a number of parameters which characterise a given wetland, including its origin, water regime and water quality, cannot be understood or managed without knowing the natural and human environment in the catchment area. Moreover, it is impossible to design measures to protect a wetland without considering the influence of its catchment area.

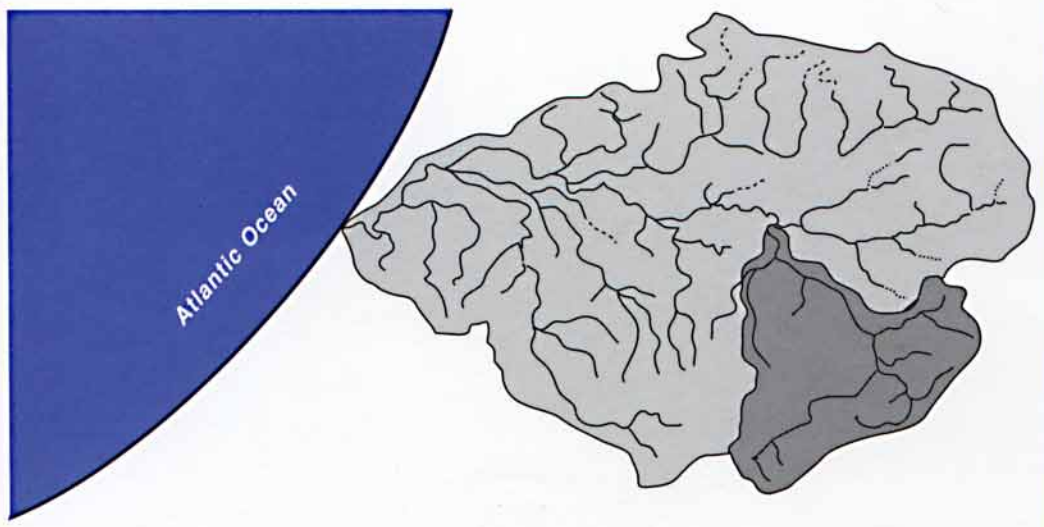
Consequently, wetland inventory should includes the description of catchment areas.

The concept of catchment area (or river basin) is most appropriate to an entire fluvial systemdischarging into the sea (exorheic); it is simply delimited by joining the watersheds which separate all the tributaries of this system from the neighbouring catchments. This delineation leads to a sack-form figure open only at the river mouth (Figure 1). It is also well adapted to endorheic catchments, where several streams converge to the same lowland, corresponding generally to a lacustrine wetland without outflow (e.g. some large chotts or sebkhas in arid and Saharan zones). Catchments of rivers which disappear in Saharan regions are also considered as endorheic.

Wad Sebou catchment

the largest fluvial system of Marocco (40.000 Km²)

1



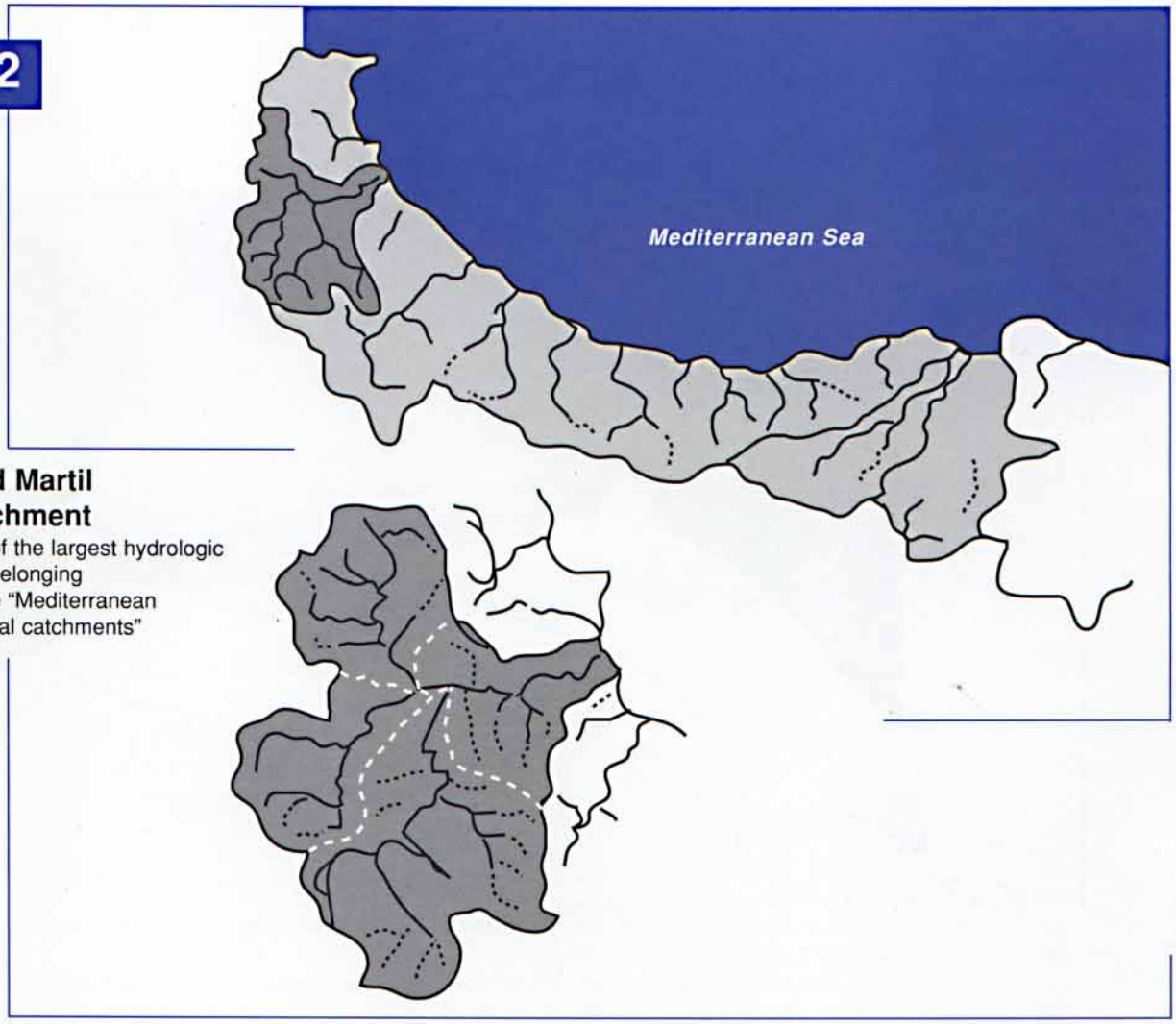
- *An entire river system discharching directly in the sea is the most adequate unit in a national hydrological subdivision*
- *the Sebou catchment may be subdivided into 5 or 6 sub-catchments (or more) corresponding to its main tributaries:*

However, the term 'catchment' is often adopted for 'hydrologic regions', where the fluvial systems are of small size and/or less well defined. For example:

- The case of small coastal catchment areas of streams which have their sources few kilometres from the coast and which discharge directly in the sea. Often, several independent streams

(but with similar characteristics) are grouped in a single 'catchment area'; generally they cover the same watershed (Figure 2). Numerous typical examples of this assemblage exist in the Mediterranean region because of the presence of the Alpine Chain of mountains, overhanging most of the Mediterranean coast. Being generally close to the sea these mountains develop on their watershed many small fluvial systems which reach quickly to the sea .

Mediterranean coastal catchment
of Morocco (12.600 m²)

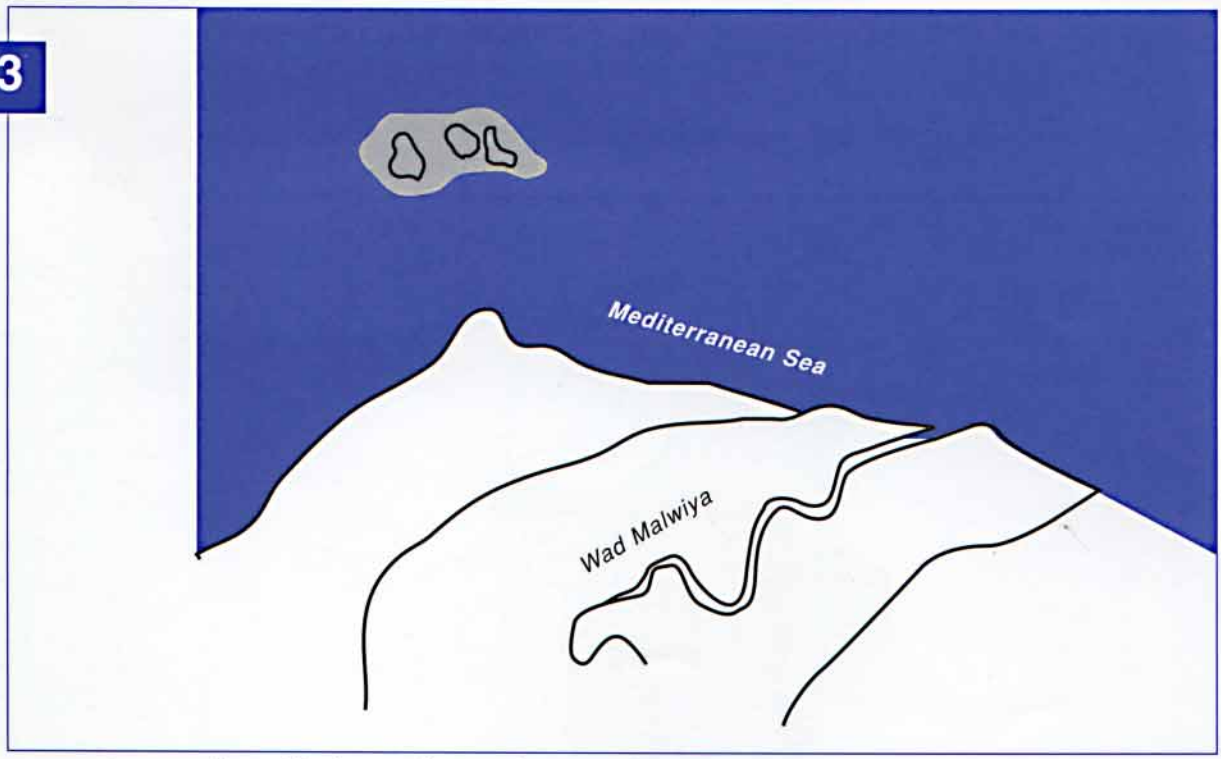


- *On the Northern watershed of the Rif Mountains severall small rivers discharge directly into the same Mediterranean sea sector. In the hydrological subdivision scheme of Morocco, they have been grouped into a "hydrological region" which is considered as a first level national subdivision, equivalent to the Sebou catchment.*
- *Wad Martil is an entire fluvial system, but coded as a 2nd level national catchment subdivision; this "sub--catchment may be divided as indicated for the upper Sebou catchment.*

- In some vast flat lands where the watershed limits are poorly defined; typical examples are found in desert and sub-desert regions and also in some calcareous plateaux. In such cases, several small catchments, mainly endorheic or arheic, should be assembled in a large 'catchment area', based upon practical criteria, even if they are sometimes arbitrary.
- The concept of catchment area is inappropriate for the particular case of the coastal islets, especially when they are of small size and without any hydrographic system (Figure 3). The full area of an islet could be assigned to a catchment; otherwise, the nearest continental slopes could have some influence on the islet, by supporting fresh waters or pollutants, etc. It could be useful to link this islet to the continental catchment where this influence happens, although possibly treating it as a sub-catchment.

Chafarines Islands
one of the numerous Mediterranean small coastal islands

3



- *These islands are close to the coast; they may constitute their own catchment, including the surrounding tidal wetlands.*
- *However, several geologic and climatic data are needed from the nearest continental catchment (Nador). So, the national catchment unit which will be defined in some cases (like this one) may be very arbitrary.*

However, some 'hydraulic' subdivisions are based on administrative criteria, for development needs. It may be inadequate to use these subdivisions as a reference scheme in a catchment inventory focused on the description of natural features.

Instead of catchment descriptions, it is sometimes preferable to consider the sub-catchments (see Figures 1 and 2); the principal reason for this is that most wetlands are often influenced only by the components of their catchment, which may constitute a limited part of a larger one.

In reality, when the description concerns a wide area, it is unlikely to give detailed information on all the sub-catchments. So, the data contained in this description may be insufficient for the understanding of these wetlands. A typical case corresponds to mountainous sites which are not influenced by lowlands. On the other hand, data are often difficult to obtain for a limited sub-catchment and it is necessary to search for information (particularly related to the climate) in the nearest catchments. So, the description at the sub-catchment level may require a substantial supplementary effort in searching for detailed data, but in exchange it will reduce the search for 'foreign' data, when a catchment is common to different countries.

A catchment area description will be the most adequate for a wetland inventory if it is focused on the four following types of information:

Climate

The hydrology of wetlands depends largely on the climate features (Frecaut & Pagney 1952). The bioclimate (owing to the method of Emberger, 1952) constitutes a tool to combine the annual mean of temperature and precipitation in a very significant formula; the indication of percentages of cover of the different types of bioclimates in the catchment area will give a good idea of the general climate. Other climatic factors can play determinant roles in the creation and the functioning of wetlands; this is particularly the case of the wind in desert regions, of the frost on high mountains, of the annual divergence of temperature (even if it is included in the formula of the bioclimate) and of thermal inversions (frequent in Mediterranean valleys), etc..

Geomorphology and geology

These features are highly interdependent particularly in terms of causality (Ottman 1965, Derruau 1974, Castany 1982). A physiographic presentation of the catchment area will be adequate in this context, but the most important feature is the lithologic nature of the dominant rocks drained by the waters of the catchment area, which give an idea of the mineralisation of wetlands (Welch 1952, Dussart 1966, Nisbet & Verneaux 1970, Stumm & Morgan 1981). The abundance of chalk rocks in the Alpine Chain is the principal nature cause of the high degree of mineralisation of Mediterranean wetlands, with a predominance of hard waters (rich with Calcium and Magnesium ions). The Triassic salty rocks are also widespread in this region and the continental wetlands are often relatively rich with chloride (Schoeller 1962).

This lithologic nature combined with the tectonics, the geomorphology and the climate, can also explain the origins of some wetlands (karst, natural barrages, flood plains, etc.), their functioning conditions (water reserves, inflow/outflow, permanency/seasonality, etc.) and their functions (flow regulation, groundwater recharge, etc.). Some dominant pedological aspects should also be considered, particularly if they are determinant in the wetlands: intensity of erosion, filling of wetlands, etc.

Hydrology

This is a key-parameter for understanding the origin and the water regime of wetlands. The inventory should give a summarised spatio-temporal presentation of the hydrology of the catchment area. The seasonal differences in flow, particularly between the summer and the winter, which are relatively large and significant in the Mediterranean region (Giudicelli *et al.* 1985, Dakki 1987), and the permanency/intermittence of flow in water courses should be taken into account. This parameter is highly dependent on the climatic and geologic features in the catchment, which vary largely through the Mediterranean basin, and create a complicated mosaic of natural zones. So, a very great variety of hydrologic situations exists in this basin; the sub-catchment detailed approach is clearly useful to describe this diversity and to permit an adequate typology of the catchments.

The hydrology of coastal wetlands (lagoons, tidal rivers, etc.) is often more closely related to the sea/ocean than to the other continental features. So the hydrological data given in a catchment description is not always sufficient to explain the water regime of these wetlands; otherwise, in some catchments, the input/output of marine water should be described as a catchment component.

Hydraulic managements play an important role in determining the hydrology of some highly modified wetlands and may be as important as the natural hydrological aspects. These managements may be very old in the Mediterranean region and continue to increase (especially in the southern, relatively dry, countries), because of water demands for agriculture, industry and urban centres, which are continuously growing. This aspect becomes predominant because of the great efficiency of the new techniques used in water management, allowing rapid and complex changes in the natural hydrology.

Population, land uses

The aridity of the Mediterranean region makes the presence-and impacts of water the most decisive factor for the spatial distribution of human populations. Thus the great majority of urban and rural centres, particularly in southern and eastern Mediterranean margins, are close to rivers and springs (Dakki & El Agbani 1995). This generates a special situation, characterised both by the increase of pollution and the decrease of water flow, which is generalised in the totality of some catchments (where human density is high).

In rural zones, the agriculture has been largely developed trough the sacrifice of the forests (Quezel 1980). This resulted in a severe erosion in the Mediterranean region and is, consequently, accelerating the filling of wetlands. At the present time, the vegetation cover (forests, matorrals, garrigues, steppes, etc.) is still more or less developed in mountains and in desert and sub-desert regions, in some lowlands which have been protected earlier or as abandoned agricultural lands (particularly in Southern Europe).

The human parameters should not be considered only as sources of pressure on wetlands, but also as indicators of wetland values (in terms of social and economic benefits). In addition, this information may help wetland managers to get an idea on the population which should be considered and involved in wetland managements.

The data needed for the catchment area description are generally published or available in different national or regional administrations (Hydraulics, Agriculture, Meteorology, Planning...), often in compiled formats, such as atlases (Anonymous 1970), databases/GIS (Raveneau 1992). If so, they may constitute official data which will be probably preferable to 'separate' results, except if these are more significant for the catchment description as conceived in this manual.

The indication of the relative importance of each descriptive parameter into a catchment may seem sufficient to understand the whole features about the wetlands belonging to this catchment. However, when possible, a cartographic illustration of the data will be more informative and more useful for the wetland inventory, even if it does not cover all the catchment area. This can be enhanced by the utilisation of a Geographic Information System (GIS).

A national codification system is very useful to identify the catchment and sub-catchment areas, particularly when using a database or a GIS, This supposes the existence of a national scheme of hydrologic subdivisions; otherwise, a first step of the national wetland inventory will be to elaborate this scheme. In any case, a map (and/or a list) representing these hierarchical subdivisions is essential (including the eventual codification system, with the criteria used for its conception).

5 Site and wetland identification

Once the aims of the inventory are set, it is essential to define the criteria for site inclusion. They will determine which type of wetland sites will be included in the inventory. The long term objective of wetland inventories should be to include all the wetlands of the area covered. At the same time, it is important to establish a clear definition of what is a site and where are its boundaries. It is recommended to define a site at the appropriate scale as a hydrological unit whose limits coincide with the wetland boundaries. The sites to be included in the inventory region are then located using maps, aerial photographs and/or satellite images. For details on wetland identification and delineation, three criteria can be used based on hydrology, vegetation and soils. Their application will be essential to demonstrate the wetland character of areas which are not obvious wetlands, and also to delineate precisely these areas.

5. Site and wetland identification

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Which sites to include in the inventory?

A wetland inventory can have various aims and these should be defined at the beginning of the process in terms of criteria for site selection. They should take into account the future uses of the inventory and the needs of the users (and potential users) in order to include all types of information required.

The criteria for site selection will be determined according to the aims of the inventory and may include:

- sites with some existing information: this is the case of most preliminary inventories (e.g. Portugal (Farinha & Trindade 1994));
- sites with a minimum surface area (this was one of the criteria used for the national inventory in Spain (Montes 1991));
- sites which are characterised by certain wetland types (e.g. the inventory of peat-bogs in France (Géhu et al. 1981));
- sites important for fauna or flora (e.g. the presence of a large number of waterfowl is often used as a criterion: Italy (De Maria 1992), France (Yésou 1983));
- sites which are protected (in general this type of inventory is not specific to wetlands but takes them into account (e.g. Israel (Hareuveni 1994), France (Derenne 1979)).
- all sites including wetlands; this would be a comprehensive wetland inventory.

This list is not complete, as any criterion for selection can be chosen depending on the aim of the inventory and the resources available. In most cases, several criteria will be combined. The selection criteria must be established at the beginning of the inventory process.

The ideal situation would be to include all wetlands (above a minimum size) occurring in the area covered by the inventory. This would provide an excellent baseline for conservation actions. Such an objective can be planned as a long term initiative which will be attained through different phases.

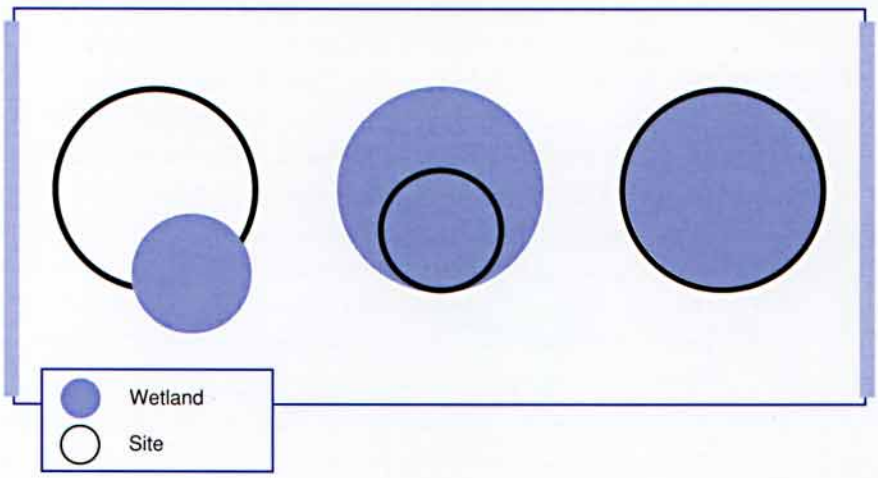
see **Chapter 3**

What is a site?

At the same time, it is important to define clearly what will be considered as a site and how to define its boundaries. Existing inventories generally include sites whose boundaries have been determined for a variety of different reasons. Thus, the boundary of the site could correspond either to the wetland itself or topographical features or the boundary of a protected area or an administrative unit, etc. This leads to three different situations:

- some sites include not only wetland areas but also other biotopes (case 1);
- some sites cover only part of a larger wetland area (case 2); and
- some sites coincide with wetland areas (case 3).

Therefore site boundaries and wetland boundaries are very often different.



Most of the sites can be considered as complexes of separated or contiguous wetland areas, depending on the scale at which they are examined. It is recommended to define a site as a hydrological unit. Such limits would be meaningful at hydrological, ecological and management levels. It would avoid having wetland areas which are divided into several "sites" without clear reasons or huge complex areas which are considered as a single site. Nevertheless, this issue has to be considered at a useful and meaningful scale.

In the present Manual, a "true" wetland site means that the site boundaries should be as close as possible to the wetland boundaries (i.e. case 3). However, a site is defined as the unit to be inventoried and the boundaries will have to be defined for each specific case.

Locating wetland sites

see **Chapter 2**

Most wetlands can first be localised using topographic or thematic maps (e.g. geological, vegetation, etc.) and aerial photographs. Landcover maps or databases are also a useful tool e.g. CORINE Landcover. Aerial photographs generally enable the recognition of flooded areas and wetland vegetation. Their spatial resolution is high (scale 1:15,000 or 1:20,000 allowing the detection of small patches of water and wetland vegetation. The cost of analysis is quite low. However, to cover large areas will require the purchase of numerous photographs and the cost

may become high. Therefore this tool is recommended for small areas. Available photographs may not be taken at the best time for the identification of flooded areas and wetland vegetation. Thus it may be difficult to locate wetlands, such as temporarily flooded areas, which may not be flooded when the photograph was taken or where the hydrophytic vegetation does not persist all year round.

Satellite images are becoming a more common tool and can be used to identify flooded or saturated areas and particular vegetation types (Lenco *et al.* 1990, Vogt & Vogt 1990, Jensen *et al.*1995, Sandoz 1996). However their spatial resolution is lower than aerial photographs (i.e. SPOT: 10x10m or 20x20m, LANDSAT 30x30m), and does not allow localisation of some small wetlands e.g. narrow channels, riparian zone (Finlayson 1994). Digital data can be processed in order to obtain a quantitative analysis. Data can be integrated with other sources of data in a Geographical Information System. The financial investment to obtain the equipment for data analysis is high. If facilities are available, the cost of the analysis is low when taking into account the large area which can be covered (Budd 1991). Satellite images can provide regular data for the same sites. This regularity is crucial in order to detect the inundation periodicity of temporary wetlands. On the other hand, this may be limited by the atmospheric conditions (cloudiness). To avoid this problem, new satellite systems may be used in the future such as radar (ERS-1, ERS-2 and RadarSat) (Merot & Chanzi 1991, Normand 1991, Hess & Melack 1993, Melack *et al.* 1993). These allow images to be obtained even during unfavourable climatic conditions, with a high regularity (35 days) and a better spatial definition (12.5x12.5m) (Sandoz 1996). Up to now, these tools are still being developed, but they may soon become cost effective and allow quick and cheap localisation of wetlands over large areas. However, they still require high financial and technical investments which are only available in a few places in the Mediterranean region.

The level of precision with which the wetlands are recognised and localised will depend on the level of precision of the sampling methods and the scale used. This localisation will have to be complemented by field work.

Most of the obvious wetlands (e.g. lakes, rivers, lagoons, etc.) will be localised using one of the above techniques and can easily be characterised using the Ramsar Convention's definition of wetlands.

see Chapter 2

However, field work will be needed in order to:

- check the reliability of the method;
- identify difficult cases (e.g. identification of wetlands which are very rarely flooded and often appear as dry lands); and
- ascertain the limit of some wetlands especially at the landward side.

Wetland identification

In the field, wetlands can be identified rather precisely with ecological criteria which can be applied objectively in any situation. The proposed criteria can be used to define a wetland and its boundaries at the landward side on the basis of the presence or absence of essential attributes.

These attributes are:

- hydrology: periodicity of floods and saturation of the soil with water,
- Soil: presence of hydric soils, and
- vegetation: predominance of hydrophytes.

These criteria do not need to be applied in order to carry out a simple inventory or for obvious wetland areas. However, they will be required for precise delineation of wetlands.

These criteria are based on the work done for the wetland inventory of the United States (Federal Interagency Committee for Wetland Delineation 1989, National Research Council 1995). In the Mediterranean region, they have been adapted and tested in Greece only (Mantzavelas *et al.* 1995).

The basic criteria presented here must be adapted to the specificity of each part of the Mediterranean region. This preliminary adaptation is necessary for a successful application of the criteria and a reliable identification of wetlands (see National Research Council 1995 for further reading).

Application of these criteria requires a general knowledge in specific fields of natural sciences, particularly plant and soil identification. As a result, a training programme on the application of the identification criteria in field survey may be needed before launching the inventory. In heavily disturbed areas (e.g. areas having a dense irrigation network), or areas with special morphological characteristics (e.g. areas having a wavy relief), the identification process should be carried out by well trained personnel and guided by expert institutions.

The hydrologic criterion may be difficult to apply for some Mediterranean wetlands due to the lack of, or the difficulty in, collecting the required hydrological data. Furthermore, indicators of hydrology are much more variable on a short time scale than are the main indicators of the substrate (hydric soils) and biota (hydrophytic vegetation). Hydric soils and hydrophytic vegetation are reliable indirect indicators of wetland hydrology and can be used when the hydrology has not been modified. However they are not reliable if the hydrology has been altered. Therefore, it is important to evaluate the hydrology of all the sites in order to determine whether it has been changed and to know the reliability of the indirect indicators (National Research Council 1995).

An area is considered as a wetland if it fulfils one or more of the following attributes:

Hydrology

This criterion can be applied whenever adequate hydrological data are available, according to which an area is identified as a wetland if:

- it is permanently or periodically flooded for at least ***several*** successive weeks during the ***growing season*** and for most of the years of observation, or for at least ***x years*** (see below) out of 10 years of observation; or
- it presents conditions of soil saturation (ground water close to the soil surface) for at least ***several*** successive weeks during the ***growing season*** and for the most of the years of observation, or for at least ***x years*** out of 10 years of observation.

Different American authors (reviewed in National Research Council 1995) give a different critical depth of soil saturation. These values vary from 60cm deep up to the soil surface. The depth of saturation should be based on the depth of wetland plant roots. Most roots and rhizomes of wetland species occur within the first 30 cm from the surface. Therefore, 30cm should be considered as the critical zone for assessment of saturation (National Research Council 1995).

What needs to be defined before using the hydrology criteria ?

Each country or region wanting to use the hydrology criteria needs first to answer the following questions:

- ***How many weeks do the minimum periods of flooding or soil saturation last?*** (definition of "several weeks"). This will be established from existing baseline information (measurement of the water table or the height of standing water, use of aerial photographs and infra-red images).
- ***What is the flood periodicity of the less regularly flooded wetlands ?*** (definition of x years out of 10) Some wetlands are not flooded every year. This will vary a lot according to the climatic conditions of the inventory region.
- ***What is the length of the growing season ?*** This varies according to the climatic conditions of the country, the latitude and altitude of each site and the habitats considered. The length could vary from several months in cold places to all year, such as in some coastal temporary wetlands where the hydrophytic vegetation grows all through winter.

A case study: the application of the hydrology criterion on some Greek wetlands

- it is permanently or periodically flooded for at least ***two*** successive weeks during the growing season and for most of the years of observation, ***or for at least 6 out of 10 years of observation;***
- it presents conditions of soil saturation (ground water depth less than 45 cm) for at least two successive weeks during the growing season (***March-April to September in the case study sites***) and for most of the years of observation, or for at least ***6*** out of 10 years of observation.

Vegetation

The vegetation is greatly influenced and determined by the environmental conditions of an area. The dominance of plant species known as indicators of wetland conditions (e.g. flooded or soil saturation conditions) allows the identification of an area as a wetland. As such, it constitutes an important criterion for the identification of wetlands and their boundaries at the landward side.

- *A list of flora species* indicative of wetlands should be established for each country or region to be covered by the inventory. This list will include hydrophytes which are "species that have demonstrated an ability (because of morphological and/or physiological adaptation and/or reproductive strategies) to achieve maturity and reproduce in an environment where all or portions of the soils within the root zone become, periodically or

continuously, saturated or inundated during the growing season" (Reed 1988). Amongst this list will be selected the indicator species which are restricted to wetlands. These indicator species can vary from one region to another because of ecotypic variation within species (National Research Council 1995).

- A field survey will then be carried out in each area for which the wetland character needs to be identified. It is important to conduct this field survey when most of the hydrophytic plant species are present, which is during the *growing season* and when the area is flooded. The dominant plant species of the area will be recorded. The measure of dominance can be made in terms of frequency, density, percentage cover, etc. The most abundant species is used to determine whether the vegetation as a whole is predominantly (more than 50%) hydrophytic. If these dominant species belong to the list of wetland indicators then the area will be identified as a wetland.

This criterion has to be used carefully for controversial areas where the vegetation is only marginally hydrophytic (e.g. on the margin of a wetland area, or when the area is temporarily invaded by upland plants, etc.). A prevalence index (using a fidelity rating system which gives the wetland affinity of each species) could be used to ascertain the wetland character of the plant communities of the site (see National Research Council 1995 for further reading). The other criteria (hydrology and soils) should also be used to demonstrate the wetland character of these difficult areas.

What needs to be defined before using the vegetation criterion ?

Each country or region which wants to use the vegetation criterion needs first to answer the following questions:

- Which are the plant species representative of the wetlands of the inventory area ? A list of hydrophytes including indicator species will be established;
- What is the growing season ? This may vary according to the climatic conditions of the country, the latitude and altitude of each site and the habitats considered. The length could vary from several months in cold places to all year, such as in some coastal temporary wetlands where the hydrophytic plants grow throughout the winter.

A case study: the application of the hydrology criterion on some Greek wetlands

- A detailed list of flora species representative of wetland has been established (see **Appendix 2**). Each species has a moisture index which goes from 1 to 12 according to its tolerance to water conditions. All species with an index greater than 7 are considered to be indicator species for wetland conditions.
- A detailed identification of the different wetland units with precise delimitation of the wetland area

at the landward side was carried out during the growing season (March-April to September in these wetlands). The field survey included:

a) spatial identification of the following vegetation units of the area:

- aquatic bed vegetation, which consists of species growing principally on or below the surface of the water (algae, rooted vascular plants, and floating vascular plants);
- emergent vegetation, which consists of erect, rooted, herbaceous hydrophytes and are present in areas such as marshes, wet meadows, etc.,
- shrubs, which are woody plants less than 6m in height; and
- trees, which are woody plants more than 6m in height.

b) recording of dominant plant species for each vegetation unit

In areas where the vegetation is stratified, the recording of plant species took place separately for each overstorey and understorey (e.g. overstorey consisting of trees and understorey consisting usually of herbaceous plants). For more details about vegetation units see also Vol. III. Habitat Description System.

A wetland unit was identified if indicator species of wetland conditions are dominant in this unit.

Soil

The identification of hydric soils by field survey is required. Hydric soils are those usually found in the vicinity of water bodies (temporarily flooded and/or high level of ground water), are poorly drained and under natural and undisturbed circumstances, support wetland vegetation (Gerakis *et al.* 1991). They are of two types:

- **Organic hydric soil**s are "composed primarily of the remains of plants in various stages of decomposition and accumulate in wetlands as a result of anaerobic conditions created by standing water or poorly drained conditions" (Mitsch & Gosselink 1993). The organic materials can present different stages of decomposition: in some soils (called muck) most of the material is decomposed and in some other (peat) it largely remains. They are generally dark, ranging from dark black soils characteristic of muck to the dark brown colour of peat. These dark colours indicate the presence of organic matter.
- **Mineral hydric soils** have little or no organic matter. Due to their wetness, the iron present in these soils is reduced, this leads to the development of a characteristic grey colour (or greenish and blue-grey). Spots with orange to brown colour (called mottles) among the grey matrix suggest temporary flooded soils. These mottles are formed by oxides of iron and manganese during the dry period. Oxidised iron with an orange colour can also be found along the plant roots. (Mitsch & Gosselink 1993).

The identification of hydric soils by field survey, can be performed by the use of easily determined indices (Karathanasis 1992, Misopolinos 1992) and is often done by determining soil colour to a standard colour chart (Macbeth Division of Kollmoggen Instruments Corporation 1992). Soils characterised by low chromas of black, grey, or brown and red indicate hydric soils (Mitsch & Gosselink 1993).

The soil criterion may need to be adapted for each inventory region according to its soil specificity. This adaptation can be based on the following example applied to Greek wetlands (see box)

A case study: the application of the soil criterion on some Greek wetlands

The soils of these wetlands present at least one of the following features:

Organic soils:

- the presence of a peat layer on the soil surface thicker than 40 cm;
- the presence of a thick organic layer in sandy soils (thicker than 10 cm) of dark, almost black, on the soil surface, as well as the presence of dark coloured perpendicular stripes (organic matter depositions) which start from the soil surface;

Mineral soils:

- the presence of blue-ash, blue-green or ash tints in the soil mass, of matrix chroma ≤1 in the Munsell Colour System (Macbeth Division of Kollmoggen Instruments Corporation 1992.), at a depth related to the plant rooting zone (conditions of permanent soil saturation). When a root layer is not present, the top 30 cm of the soil layer should be examined;
- the presence of the above-mentioned characteristics in the soil mass, of matrix chroma ≤2 in the Munsell Colour System, in combination with red-yellow (orange) mottles of Fe, especially along the roots at depths less than 30 cm (conditions of temporarily soil saturation);
- the presence of Fe-Mn concretions (nodules of varying size) or dark coloured nodules at depths less than 30 cm (conditions of temporarily soil saturation);
- the presence of reduced iron (Fe^{++}) according to the a,a,-dipyridyl colorometric test at depth less than 30 cm, and the presence of a redox potential smaller than 100 mV.

6 Wetland habitats

A simple inventory with a generic description of wetland types or the site should be an efficient way to increase knowledge of the wetlands occurring within the inventory area. It gives basic information and this should be a useful tool for regional or national planning and monitoring of wetlands. However, it does not provide enough detail on the wetland site itself for the purposes of site management and monitoring. For this purpose a detailed inventory is necessary, allowing collection of data on fauna, flora, human activities and threats, hydrology, etc. within different parts of the wetland. It is necessary to consider the description of the wetland habitats occurring within the site. The wetland habitats must be described by a number of categories, which will allow their delineation and the production of precise maps. Three description systems are proposed and compared: Ramsar, CORINE Biotopes and MedWet.

6.Wetland habitats

The importance of considering wetland habitats

A simple inventory with a generic description of wetland types or the site should be an efficient way to increase knowledge of the wetlands occurring within the inventory area. It gives basic information on how many wetland sites are in the area, what is the surface area occupied by wetlands, and what are their functions, values and threats. All of this should be a useful tool for regional or national planning and monitoring of wetlands. However, this simple inventory does not provide enough detail on the wetland site itself for the purposes of site management and monitoring.

For this purpose a detailed inventory is necessary, allowing collection of data on fauna, flora, human activities and threats, hydrology, etc. within different parts of the wetland; it is therefore necessary to consider the description of the wetland habitats occurring **within** the site.

The wetland habitats must be described by a number of categories, which will allow their delineation and the production of precise maps. All this information will be essential to site management, planning and monitoring, since data are more detailed, organised and spatially distributed. Also, it allows temporal monitoring comparison of the ecological character of the wetland site.

So, the most important advantages of considering wetland habitats when undertaking a wetland inventory include:

- more detailed information for management;
- knowledge on ecological character of the wetland;
- mapping using distinct ecological units; and
- tools for monitoring the wetland.

Systems for habitat description

A system for the description of the wetland habitats for a Mediterranean wetland inventory should (Tomàs Vives 1993):

- have a hierarchical structure;
- have an open structure, which could be adapted to the peculiarities of the different countries;
- be simple and clear;
- be able to be fully translated into the different languages of the region;
- be consistent: the types in the same hierarchical level must indicate the same degree of detail; and
- be comprehensive, covering wetland types and habitats in the region.

see
VOLUME III
Mediterranean Wetland Inventory. Habitat Description System

Taking this into account, and in order to describe the wetland habitats within a site, three systems may be used for Mediterranean wetlands: the Ramsar Convention wetland type classification system; the CORINE Biotopes classification (European Communities 1991); and the MedWet Habitat description system. This latter allows a very detailed level of description since it is specific to the main attributes of wetlands.

Both the Ramsar and CORINE systems have been in existence for several years, and are widely used at least in some countries within the Mediterranean region. They can be useful to describe habitats in terms of generic habitat types (for CORINE classification this correspond to the first two levels) and to maintain compatibility with ongoing projects. The MedWet Habitat Description system was developed during this project with the aim of providing a specific tool for Mediterranean wetland habitat description, which could be useful for mapping purposes.

Each of these systems is based on different assumptions and has different aims and advantages:

Ramsar

The Ramsar Convention adopted a classification system for wetland types, incorporating a three-level hierarchy. All these categories are quite easy to understand and apply, and the classification system has been used in many countries, worldwide.

see
Chapter 2

CORINE Biotopes

The CORINE Biotopes project was lauched in 1985, as an inventory of sites of major importance for nature conservation in the European Community. The nomenclature system to describe habitats was developed to define the recognizable communities formed by the interactions between flora, fauna and the abiotic environment. The classification is distributed in up to 8 levels and has a comprehensive coverage of habitats (wetlands and non-wetlands). The first two levels are usually easy to understand and apply, but further levels require good knowledge of botany and phytosociology. It has been applied in 13 EU countries and is being applied in 10 non-EU countries.

see
Chapter 2

MedWet

The MedWet habitat description system is specific for wetland habitats in the Mediterranean region and was based on the habitat classification adopted in the United States of America (Cowardin *et al.* 1979). This system was designed to meet the following needs: to describe and define Mediterranean wetland habitats; to provide easily recognisable units for inventories and mapping purposes; and to arrange these units in a hierarchical structure which can be compared to existing biotope classifications in the region. The system is arranged in four levels and includes complementary modifiers on hydric regime, water salinity and artificiality.

see
VOLUME III
Mediterranean Wetland Inventory. Habitat Description System

The advantages for the use of each of these systems in the wetland inventory are summarised in the table below. However, it is very important to note that the MedWet methodology allows the use of two systems at the same time. For example, the MedWet habitat description system can be applied because it provides the most detail for mapping and management, and the Ramsar or CORINE Biotopes systems can be used at the same time because compatibility with these systems is wanted.

At the simple or the detailed inventory phases, three systems may be used: the Ramsar Convention classification of wetland types, the CORINE Biotopes classification and the MedWet Habitat Description system. Each has different advantages that encourage their use. In this table, the advantages of their use are summarised.

	RAMSAR CONVENTION	CORINE BIOTOPES	MEDWET
Hierarchical structure	Yes.	Yes.	Yes.
Open structure	Yes.	Yes.	Yes.
Expertise needed	Little expertise needed.	At generic level, no expertise is needed; at more detailed levels, adequate botanical knowledge is necessary.	A good knowledge of the definitions for each category is necessary
Specificity for wetlands	Yes.	No. Developed for all biotopes. Wetland and non-wetland categories are found among different major divisions of the hierarchy.	Yes.
Consistency	Wetland types in the same hierarchical level indicate the same degree of detail.	Wetland biotopes are found in several parts of the classification and do not have the same degree of detail.	Wetland habitats in the same hierarchical level indicate the same degree of detail.
Applicability in the Mediterranean region	Yes. Also worldwide.	Comprehensive in most EU countries, outline in some other countries.	Developed to fit the conditions prevailing in the Mediterranean region.
Applicability for mapping	There is no developed method. However, it is possible to produce maps at site level. (of low detail)	There is no developed method. However, it is possible to produce maps if used for a very general level.	A well defined method for mapping wetland habitats exists (see Chapter 9 and Zalidis *et al. 1996, Mediterranean Wetland Inventory: Photointerpretation and Cartographic Conventions).*
Hydrological data	Yes. General categories exist.	No.	Yes. Specific modifiers exist.
Availability of information on the system	Can be provided by the Ramsar Bureau/Wetlands International (see Appendix 1).	Detailed definitions are available in software format and as a publication (European Communities 1991).	Detailed information is available as a publication (Farinha *et al.* 1996, *Mediterranean Wetland Inventory: Habitat Description System).*
Adequacy for MedWet inventory phases	May be used for simple and detailed inventories (but limited use for mapping)	Simple inventory and detailed inventory for description only (but limited use for mapping).	May be used for detailed inventory (mapping excluded).
Compatibility with existing data	Used for Ramsar sites within the Mediterranean region	The CORINE Biotopes database has applied the classification in 13 EU countries and is applying it now in 10 non-EU countries	Was developed recently and fieldtested in Portugal and Greece

7 Data recording

The existing national and international wetland inventories carried out in the Mediterranean region and elsewhere in the world have been analysed in order to identify all the possible requirements and uses of the different components of the methodology. The analysis of the types of information collected in these various inventories has enable selection of those which are essential for a complete description of any wetland area. A set of data sheets and a database were produced with the objective of providing basic concepts and procedures for the recording and storage of data necessary for the inventory and mapping of wetlands throughout the Mediterranean region. The MedWet data sheets were elaborated to incorporate three main principles: compatibility, uniformity and flexibility.

7. Data recording

The existing national and international wetland inventories carried out in the Mediterranean region and elsewhere in the world have been analysed (Hecker & Tomàs Vives 1995) in order to identify all the possible requirements and uses of the different components of the methodology. The analysis of the types of information collected in these various inventories has enable selection of those which are essential for a complete description of any wetland area. A set of data sheets and a database were produced with the objective of providing basic concepts and procedures for the recording and storage of data necessary for the inventory and mapping of wetlands throughout the Mediterranean region.
The MedWet data sheets have been designed to incorporate three main principles:

- **Compatibility:**

  The data sheets are based on existing experiences. They contain the information fields required by existing international programmes which include wetland inventory: Ramsar Convention, CORINE Biotopes and Natura 2000. Their format is compatible with these programmes.

- **Uniformity:**

  The data categories presented in the data sheets cover a broad array of information. Although Mediterranean wetlands are very diverse, they can be described in a standard way. The data categories required for their description are common to all of them. Their presentation in a standard way in the data sheets and their storage in the MedWet Database will allow further comparisons and analysis of inventories from different countries or different regions within a country. The key for these future uses is the uniformity in data collection and data storage.

see
VOLUME V
Mediterranean Wetland Inventory: Database Manual
see
Chapter 8

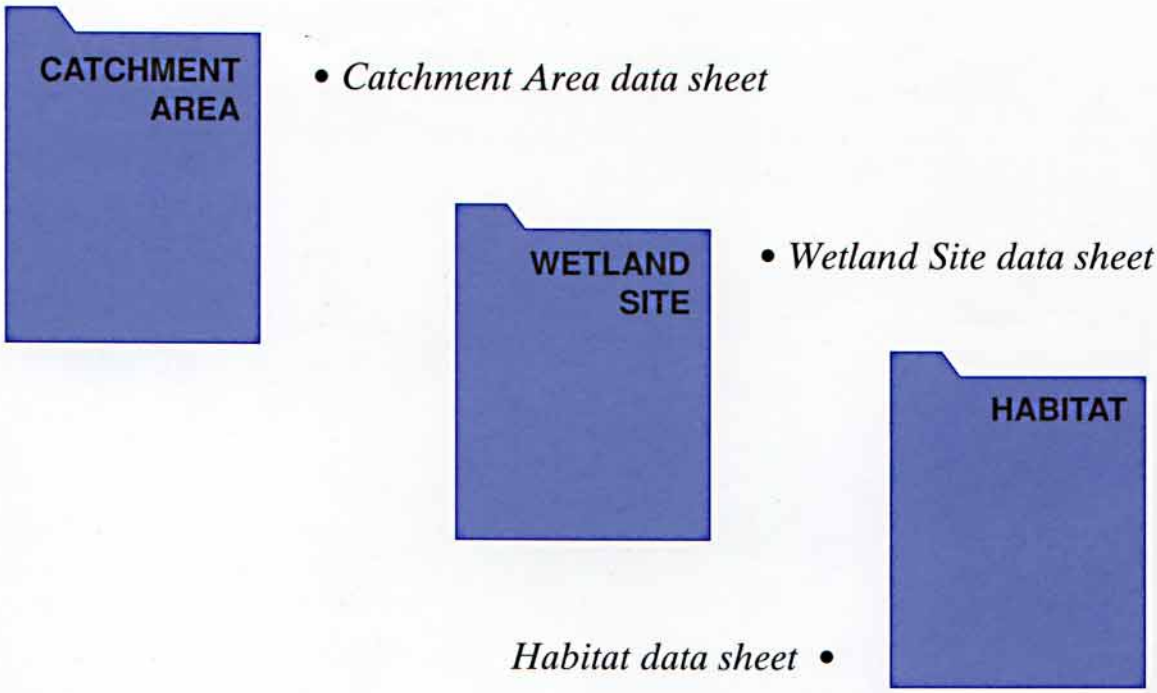
- **Flexibility:**

  Although it is necessary to carry out inventories in a uniform and compatible way, it is essential that the methodology fulfils the requirements of each user according to his or her objectives, to the technical ability and financial and human resources available. Therefore, the data sheets include a large number of data categories from which the user should choose those that are needed for that particular wetland inventory. This flexibility allows the user to start with a simple inventory, as a first step in the procedure, and to make it more complete as soon as information and/or resources are available. Some data categories should always be retained as the minimal basic information. The data sheets can be used by scientists, conservationists, water and river authorities, developers, etc.. This tool must be usable and useful for any organisation or country who needs it, whatever their technical and financial resources.

see
Chapter 3

The data sheets have been tested in six countries of the Mediterranean basin in order to ensure their applicability to a wide range of situations.

The MedWet methodology for data recording proposes three data sheets, each with a different scope:



see Chapter 3

They correspond to the three possible levels of information required to describe wetlands. These data sheets allow the recording of information at the level of detail required in each case and avoid duplication. To complement them, additional information can be collected in specific forms: Flora, Fauna, Activities and impacts, Meteorological data and References.

see Chapter 8

see Volume V Mediterranean Wetland Inventory: Database Manual

All the information collected with these data sheets can be entered into the MedWet Database developed under this sub-project, which allows the storage, analysis and presentation of the inventory information and a possible compilation at a Mediterranean regional level. This relational database could be linked to a detailed mapping system using Geographic Information System technology.

Which data sheets to complete for a simple or a detailed inventory?

see Chapter 3

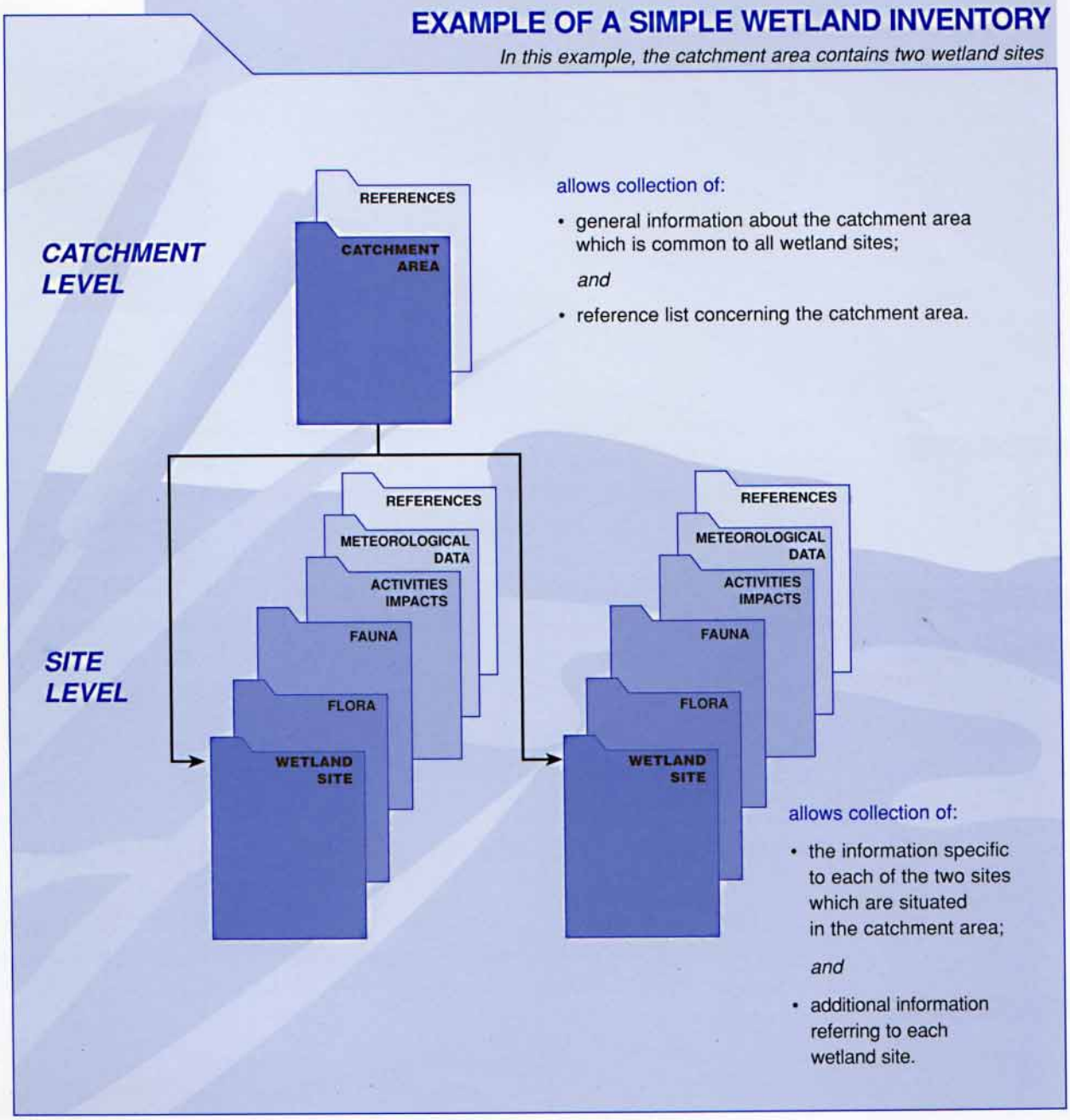
According to the resources and the time and information available, the inventory can be carried out at different levels: research of existing information, the simple inventory or the detailed inventory. This set of data sheets should be used as a flexible tool which can be adapted to any special needs.

For a **simple wetland inventory**, the catchment area and the wetland sites should be described. A References form should be appended to the *Catchment Area data sheet* and to the *Wetland Site data sheet.* Specific forms to collect site data on *Flora, Fauna, Acti ities and impacts* and *Meteorology* should be attached (see box below).

Simple and detailed inventories have been separated in order to simplify the explanations. However, the inventory is an evolutionary process and there are no strict limits between these two phases. If the inventory is carried out at simple level (up to wetland site), it is nevertheless possible to describe some target sites in detail using the *Habitat data sheet.*

EXAMPLE OF A SIMPLE WETLAND INVENTORY

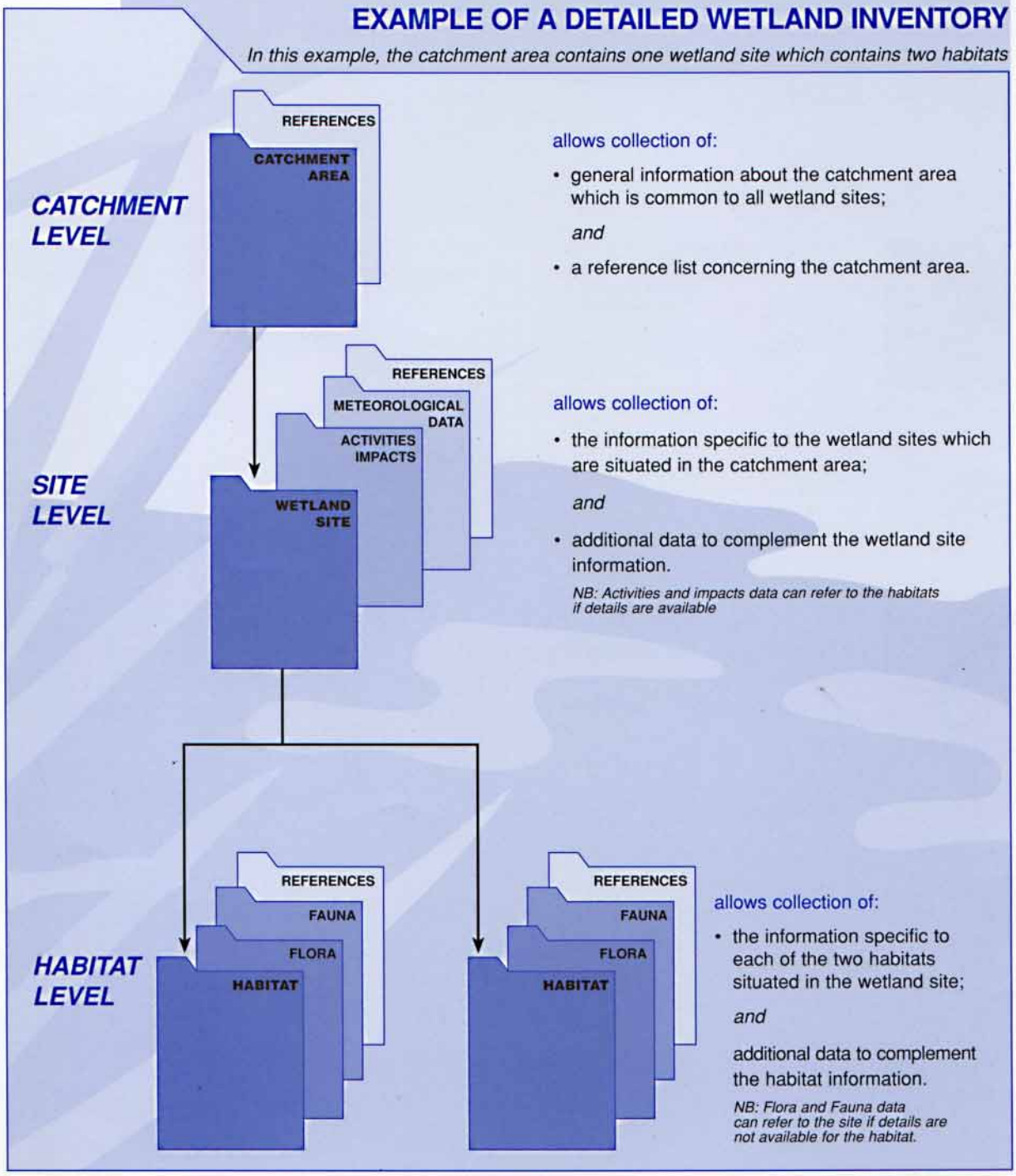
In this example, the catchment area contains two wetland sites



For a **detailed wetland inventory**, the wetland site will be divided into discrete units of wetland habitats. Therefore, three levels will be described: *Catchment area, Wetland site* and *Habitat* (see box below). The *Meteorological data* will always refer to the site. Data on *Flora*, *Fauna* and *Acti ities and Impacts* can be collected on specific forms. They refer independently either to the site or to the habitats according to the available information and resources. In the example presented below (see box) *Acti ities and Impacts* refer to the site, and *Flora* and *Fauna* refer to the habitats. A *References* form will be appended to the *Catchment area data sheet* and another one to the *Site data sheet*. This last will include all the references concerning the site and its habitats.

EXAMPLE OF A DETAILED WETLAND INVENTORY

In this example, the catchment area contains one wetland site which contains two habitats



Which data can be collected with these data sheets?

Wetlands cannot be considered as independent entities. They are strongly linked to their catchment areas (see Chapter 4). Therefore, the MedWet inventory methodology allows the collection of general information about the catchment area, which normally includes several wetland sites. This helps to avoid duplication of information in the *Site data sheet.*

One ***Catchment Area data sheet*** will contain information concerning one or more wetland sites.

The Catchement Area data sheet includes:

- Identification of the Catchment area;
- Location;
- Physiographical information;
- Population, landcover;
- Impacts and threats.

The ***Site data sheet*** allows the collection of information about the wetland site as a whole. If more details are required the site can be divided into habitats. These habitats will be described in the *Habitat data sheet.*

The Site Data Sheet includes:

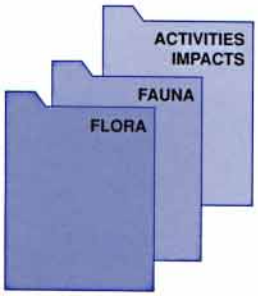
- Identification of the site;
- Location;
- Description (physiographical and ecological information);
- Values;
- Status (designation, site tenure, management).

The ***Habitat data sheet*** allows the collection of information about each habitat occurring at the site. The habitats can be identified and coded according to either the CORINE biotopes (level 2) or the Ramsar typologies, or using the MedWet Habitat Description system. The choice between the different systems depends on the level of detail required by the user. (see chapter 6)

The Habitat data sheet includes:

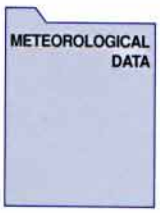
- Coding of the Habitat;
- Water permanency and Salinity if Ramsar or CORINE biotopes classifications are used;
- Area;
- Maximum depth;
- Condition of the habitat concerning human-induced changes;
- Artificiality of the water regime;
- pH range of the water;
- Description of the habitat.

Additional data



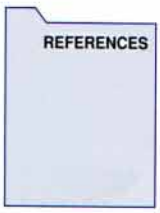
Activities and impacts are listed with their trend and importance at various levels. ***Flora*** species are listed with the cover and height of each one. ***Fauna*** species are recorded with their abundance and their status (breeding, wintering, etc.).

These forms may refer independently to the wetland site or to the wetland habitat according to the level of detail required in each case.



If available, ***Meteorological Data*** from the most relevant meteorological station should be appended to the *Site data sheet.*

The Meteorological Data form includes information on evaporation, ice/snow cover duration, temperature and rainfall.



A ***References*** form should always be completed even for a simple inventory. Before starting the inventory, it is recommended to compile a list of all the relevant references dealing with the wetlands. If possible, the references will be entered in the *MedWet Database* in order to produce a list which will be available to the compilers. If you do not have the *MedWet Database* yet, it is still recommended to establish a list of all references (e.g. using a Word Processor).

The References form allows information to be collected about references (publications, maps, aerial photographs) and key contacts.

Which data to select for a simple or a detailed inventory?

The information fields presented in these data sheets are quite complete. Among these fields, we have selected key fields which are essential to describe wetlands. They are easy to recognise: in the guidelines and in the data sheets, they are marked with * (e.g. **Date***), and with a blue arrow in the left hand margin of the guidelines

- **We advise users to complete these key fields** as they represent basic information needed for wetland description, we consider them as essential fields which should be recorded in all wetland inventories even for a simple inventory.

Other fields are complementary and will be selected according to the aim of the inventory. A detailed inventory could include all of them.

However, the choice of the information fields to be completed depends on the aim of the inventory and on the inventory co-ordinator. For example, if the aim of the inventory is very specific or if very few resources are available, it is possible to make a restricted selection of fields. In this case, the completion of the other key fields can be planned for the future.

Many entries on these data sheets include "remarks" fields which allow the addition of extra information if necessary. These "remarks" correspond to memo fields in the MedWet Database, where free text can be entered.

Once the information fields are selected, the inventory co-ordinator can (if needed) elaborate *Simplified data sheets* which only include these selected data categories. It is strongly recommended not to add new fields in these data sheets, because it would not be possible to enter these data in the database which has a strict format. If extra information needs to be recorded, it can be included in the "remarks" fields.

The information fields include two types of data: data which can be found in existing publications or with key contacts, and data which will be collected in the field. The choice of data to be collected in the field will depend on the availability of existing information. For example, if there are very few existing data, or only out of date information, then the field work will be a very significant part of the inventory. *Field data sheets* **(see Appendix 3)** can be elaborated with only the required data categories to be collected in the field.

The following guidelines should be used as a key tool for the completion of the data sheets.

8 Data storage: the Medwet database

8. Data storage: the MedWet database

Why a MedWet Database?

One way to improve the conservation and wise use of wetlands is to improve the management of information on wetlands. This entails not only compiling more accurate and complete data, but also improving access to it (Suyatno *et al.* 1994). Putting together the available information relevant to wetlands in a database greatly increases the ability to analyze this information and to maximise its utility.

A computerized database does not answer all the questions or perform all information management tasks. It is a tool that can alleviate many of the deficiencies of traditional data management systems. It is difficult to update data recording cards, for instance, in a clear and unambiguous way, without re-writing the entire card. Storage of a large volume of paper records requires significant space, which may be available only some distance from an office where it is needed. In addition, paper records can only be filed (i.e. indexed) according to one set of conditions, say alphabetically by a site's name. It can prove a very laborious task indeed to retrieve information according to a different set of conditions in a large paper database, for example to extract, a list of sites of a specific wetland type. With a database program, the tasks for storing, filing, sorting and retrieving data can be accomplished quickly and accurately. Furthermore, transfer of data between different databases has become common practice, so that information collected and stored in one format can usually be transferred to another database format.

Background

During the first meeting of the Advisory Group of this MedWet sub-project, held in July 1993, in Alcochete, Portugal, it was recommended that data on wetlands collected through the inventory should be stored in relational databases, which should be centrally coordinated (Tomàs Vives 1993).

Since 1990, Wetlands International - Asia Pacific (formerly the Asian Wetland Bureau), has developed a database called Wetland Database (WDB) to manage data collected through wetlands in the region. This database was presented to the sub-project Advisory Group at its second meeting held in Bizerte, Tunisia, in April 1994, and the Advisory Group recommended the adoption of a WDB-derived database for MedWet purposes. It was necessary to proceed with some changes to this software in order to make it compatible with the Mediterranean wetland requirements and to include all the items necessary to ensure compatibility with Ramsar and CORINE Biotopes/Natura 2000 programmes (Tomàs Vives 1994).

Over a period of almost two years the MedWet teams at ICN and Wetlands International have collaborated, in the development of the MedWet Database (MWD), following the recommendations of the Advisory Group. This has not been a simple task, given that the inventory methodology, a rapidly evolving protocol, was being developed and tested during the same period. Thus the database was tested in parallel during the pilot studies carried out in different countries, and it evolved following the testing and evolution of the inventory methodology.

This made the development of the MedWet DataBase a very dynamic process with an intense interaction between the different teams involved in all the phases of the process: planning, research, designing, coding, programming, testing, debugging and, finally, producing the version presented here.

Specification and computer requirements

The MedWet DataBase (MWD) is a computer program created to enter, store and analyze the data recorded using the MedWet methodology for wetland inventory. The software mimics as closely as possible the datasheets used for recording the data of the inventory.
All the data categories included in these datasheets have the corresponding fields in the MedWet DataBase.

The first version of the MWD programme has been produced in the programming language of FoxPro® version 2.6 for DOS. This commercial package allows the storage of data in DBF files, so they can be easily imported from and to other database software (e.g. dBase V®). The MWD is distributed with the User's Manual, which explains how to make the best use of this computer programme.

see Chapter 9

The MedWet DataBase is a compiled package that runs on PC-compatible computers. The minimum recommended computer requirements are specified in the box below.

Computer specifications

The performance of the MedWet Database (MWD) depends on the specifications of the computer on which it runs. The hardware specifications recommended are:

80486 (the minimum is 80386)
DOS 6.0 (the minimum is DOS 4.0)[1]
2 Mb of RAM memory
approx. 12 Mb of space in the hard disk[2]
Colour VGA screen is recommended (not necessary)
Mouse (not necessary)
Printer (dot matrix, deskjet, inkjet, laser...)

[1]MWD also runs on Windows 3.11 and Windows 95 environments
[2]MWD program, data dictionaries and support files; extra space is needed to store the actual site data

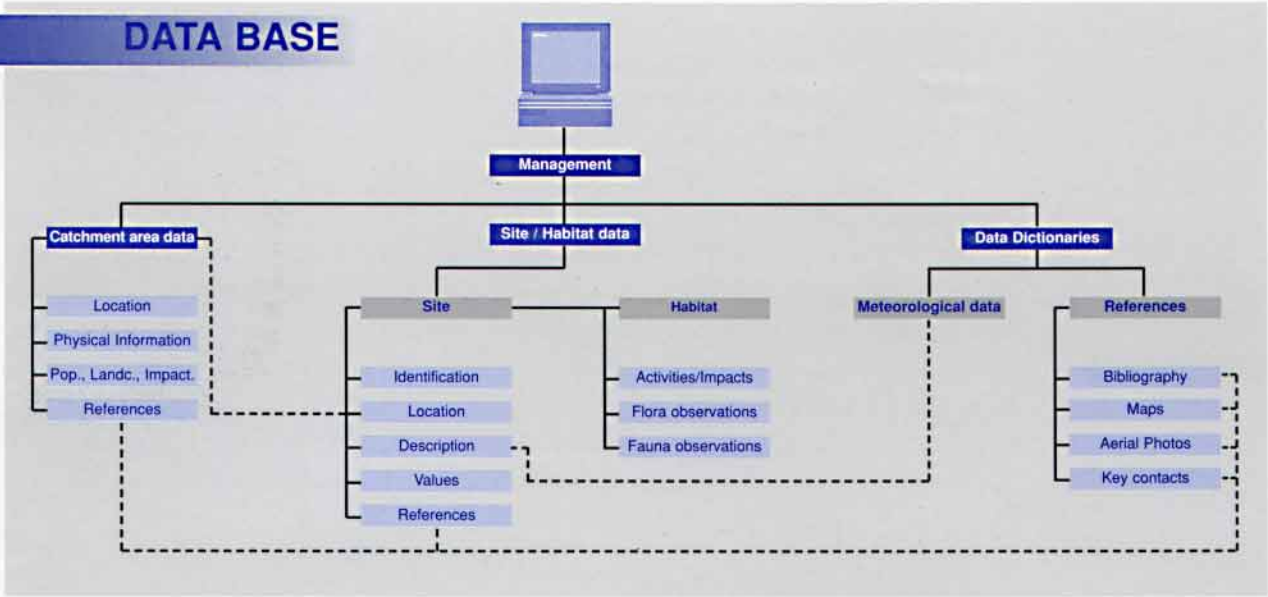
The main MedWet Database program

Input of Data

The MedWet Datbase software is structured to allow data to be entered directly from data sheets into machine-readable files. All wetland site information is stored in data files which always contain a Site code.

Wetland site data may be linked to a particular catchment area (by association with a catchment area code in the site information file). Similarly, a unique wetland habitat within a site is identified by a habitat code (stored in association with the site code).

Data dictionaries are accessible at data entry positions to enable importation of long strings of information, thereby enhancing and safeguarding the data entry process. Other information, without direct linkage to either catchment or site, are also stored in the database (such as meteorological data and different types of references, including bibliographical references, maps, aerial photographs and key contacts).



Dictionaries

What are data dictionaries?

Data dictionaries are tables with names and/or descriptions associated with a unique set of codes. During data entry into the different files (e.g. catchment area, site or habitat files), dictionaries can be used to look up all of the appropriate data options available for a particular field. By selecting a detailed entry in a dictionary, an appropriate code is imported into an associated data file. This feature makes storing and retrieving data more efficient and also reduces potential typographical errors since the codes replace long character strings of often redundant data, which would otherwise need to be typed and entered repeatly. When outputting reports (to the screen or printer) the program can replace these codes with their full descriptions or names from the appropriate data dictionary (Suyatno *et al.* 1994).

MedWet Database also includes a Coded Data Dictionary application for adding and editting dictionary codes and descriptions. This program is called from the C:\> prompt by the command: MWDDIC + <Enter>. Dictionaries contain the most accurate information presently available and should only be changed in exceptional circumstances.

Species dictionaries

There are Species Dictionaries for all the following taxa:

- Birds
- Mammals
- Amphibians
- Reptiles
- Fishes
- Invertebrates
- Plants

Each distinct genus-species-subspecies name (associated to a unique identity code) selected through the data entry screen can be linked to a particular site or habitat. Species synonyms, while actually representing the same species, still have distinct identity codes because their names differ.

Lists of species were compiled using standard reference works for each taxonomic group. This work was undertaken by the CORINE Biotopes team.

The species dictionaries not only consist of species names, but includes other data associated with species such as:

- listing in appendices of the Bern Convention *(Conservation of Wildlife and Natural Environment);*
- listing in Annex I of the birds Directive 79/409/EEC *(Conservation of Wild Birds);*
- listing in appendices of the Bonn Convention *(Conservation of Migratory Species of Wild Animals);*
- listing in appendices of the CITES *(Convention on International Trade of Endangered Species);*
- listing in the IUCN Red Lists; and
- indication of endemic, vulnerable and rare status for species in each country of the Mediterranean region.

Habitat dictionaries

Habitat description has been given major emphasis during data collection using the MedWet methodology. This encouraged development of a MedWet database that allows entry and editing of data according to three different habitat systems: the CORINE Biotopes, Ramsar Wetland Types and MedWet Habitat Systems. The Coded Data Dictionaries can be used to assist data entry or to merely display the lists of CORINE Biotopes and Ramsar Wetland Types. A code-building hierarchical keyword facility exits for selection and recording information according to the MedWet Habitat Description System.

Outputs

Output procedures will allow the user easily to produce reports from the MedWet Database. Choosing "Create" at the main menu avails the user to a wide range of programmed report formats. Reports can be created each time they are needed. Each information category has its own set of standardized but often flexible reports.

Catchment area	Site information	Habitat	Observations
Summary report	Summary	MedWet Habitat	Flora
Site list	Wetland Functions/Values	CORINE Biotope	Fauna
Reference list	Ramsar Criteria	Ramsar Wetland Types	Human Activities
Key contact list	Bibliography list		
Map list	Map list		
Compiler list	Site list		
	Compiler list		
	Ramsar Site info		
	Natura 2000 info		

After generating a report, the application allows the user to view it on screen, to print the results or to copy it as a text file for editing in a word-processing program.

Database files can also be saved for possible use in GIS programs.

9 Mapping wetlands

Mapping In this chapter a mapping procedure is proposed in order to spatial identify wetland habitats. The identification and delineation of wetland habitas are based on the MedWet Wetland Habitat Description System (Farinha *et al.* 1996) and detailed informaiton for its application are applied by standard conventions (Zalidis *et al.* 1996). The proposed method consists of 4 phases and is based on information captured from aerial photographs combined with ground data and pre-existing data. The final information for the wetland habitats is transferred onto a base map and, after quality control of the product, the final map is produced. The hierarchical structure of the MedWet Wetland Habitat Description System, the use of remotely sensed data and the field surveys allow us to gather, store and use detailed information for each wetland habitat and to potentially associate different levels of information.

9. Mapping wetlands

The gathering of data on the location, size and quality of wetlands, is a prerequisite to effective management and monitoring. Wetland inventory becomes more effective if it is carried out by methods which permit the identification and delineation of distinct wetland habitats and accommodate the spatial storage and presentation of the acquired information.

Because of the diversity and regional differences evident in wetlands, and because the boundaries between wetlands and other environments are often gradual, there has been no general agreement on their identification, description, or limits. Thus, spatial identification of wetland habitats is better to be based on their fundamental components such as vegetation types or life forms, substrate types, water regime and water salinity, than to use common terminology taken from existing classification systems. This requires that inventory data are organised at the wetland habitat level. This also, permits the reliable delineation of wetland habitats and consequently defines the boundaries between wetland and non-wetland, combining remotely sensed data and ground data. Following a specific monitoring procedure based on a random stratified sampling design, habitats trends can be recognised as a consequence of anthropogenic activities.

see
VOLUME III
Mediterranean Wetland Inventory. Habitat Description System

Such an approach to wetland inventory has not so far been carried out at the European level (Zalidis & Mantzavelas 1994). For this reason it was decided to develop and test a wetland habitat mapping method. To apply this method the MedWet Wetland Habitat Description System was developed and tested based on Cowardin *et al.* (1979) classification system.

see
VOLUME IV
Mediterranean Wetland Inventory. Photointerpretation and Carthographic Conventions

It is proposed to spatial identify wetland habitats using a mapping procedure. The objective of the proposed procedure is to develop a well-described method and the corresponding specification guidelines to implement it accurately. These specifications cover field investigations, photointerpretation and cartography. At the field investigation level the wetland identification criteria were developed; at the photointerpretation and cartographic levels conventions were developed to maintain consistency in the Mediterranean region.

see
Chapter 5

The mapping method and its different phases

Today it is commonly accepted that remotely sensed data coupled with field surveys comprise the most timely, cost-effective and accurate way for mapping natural resources (Karteris 1992). In particular, aerial photographs have proved the best remotely sensed data for the identification and classification of wetlands (Federal Geographic Data Committee 1992). The proposed method is based on information captured from aerial photographs combined with ground data and pre-existing data. The final information for the wetland habitats is transferred onto a base map and, after quality control of the product, the final map is produced.

Maps produced by following the proposed methodology are useful tools for accurate determination of coverage and spatial distribution of wetland habitats, and being considered with other data sources in planning activities. In addition, digital wetland habitat data can be merged with other databases within a Geographical Information System (GIS) to support further analysis and modeling. The hierarchical structure of the MedWet Wetland Habitat Description System, the use of remotely sensed data and the field surveys allow the gathering, storage and use of detailed information for each wetland habitat and to potentially associate different levels of information.

The application of mapping in Mediterranean wetland sites will help to produce several tools to assist with identifying wetlands in the field (e.g. to prepare a list of wetland plants and divide them into categories based on a species' frequency of occurrence in wetlands, and to prepare a list of regional or national soils with actual or high potential for hydric conditions).

The objective of the proposed method is to organize systematically the mapping effort, which consists of the 4 following phases. The fourth phase concerns those who have the opportunity to produce a digital wetland map and integrate the information into a Geographical Information System (GIS).

Phase 1 Collection, screening and evaluation of existing data and integration of extracted information in photointerpretation procedure

Phase 2 Fieldwork

Phase 3 Photointerpretation and production of the final Wetland Habitat Description map

Phase 4 Digital Wetland Habitat Description map production using Geographical Information Systems (GIS)

The identification and delineation of wetland habitats based on the MedWet Wetland Habitat Description System and detailed information for its application is applied by standard conventions.

Phase One. Collection, screening and evaluation of existing data and integration of information

The first phase covers the collection, screening, and evaluation of required information and material. Aerial photography provides the raw material for constructing the wetland habitat maps and offers the bulk of the information for the classification of wetland habitats. All the other information, which is grouped under the heading "collateral data", supports the aerial photography interpretation. This stage includes preliminary photointerpretation. The integration of collateral data into this process helps clearly to determine the limitations due to lack of information.

Sources of information

Aerial photographs

Vertical aerial photographs are the main source of information and the main material for wetland habitat mapping. They can provide both a detailed picture of the real situation and synoptic viewing of the project area. These help the photointerpreter to make identifications and classifications and accurately draw the wetland habitat borders. The photo elements usually considered during the photointerpretation process are: colour and tone, texture, pattern, site and association.

The factors that affect the quantity and quality of derived information are the type of aerial photography film, the date and the time of acquisition and the scale. A suitable combination maximises the opportunity to discriminate between different wetland habitats. Furthermore, selection of the suitable aerial photography scale should depend not only on being able to detect required parameters but also on such factors as cost and organisational capabilities.

If there is no capability of designing an aerial photography survey it is important to use the most recent photographs in order to be as close as possible to the present situation of the wetland.

The information that can be extracted from aerial photographs for the identification and delineation of the wetland habitats as those are described by the proposed MedWet Wetland Habitat Description System is:

- The vegetation type of life form and its aereal coverage (successful photointerpretation of vegetation is achieved by matching the diagnostic phenological reflectance of plants of interest to the spectral sensitivity of the aerial photography film type to be used);
- The substrate-feature composition (sand, cobble-gravel, salt crust etc.)
- The water regime determination (hydrological conditions, like the relative soil moisture content of bare soil which can be used to determine the extent of flooding);

Collateral data

Many sources of data are often available in the following forms:

- Literature on the vegetation, hydrological conditions, soil characteristics, water quality and management activities of the wetland site and its catchment area.
- Topographic, vegetation, geology, land-use and other thematic maps, orthophotomaps.
- Records in tabular and graphic form (hydrological or land-use data collected by individuals or official agencies).
- Field surveys and laboratory measurements and analyses.

The acquisition and analysis of collateral data should be viewed as an essential element of photointerpretation, providing significant information in order to successfully interpret and classify wetland habitats. As such, it must be realised that these data have their own variance and, like the remotely sensed data, are subject to interpretation.

The supportive collateral data aids not only the interpretation of aerial photographs, but may also produce a better definition of the problems associated with the project area. An initial field reconnaissance visit is particularly useful if it is seen as a tool for screening and evaluating the collateral data. The nature, amount, timing and method of acquisition and integration of the collateral data must be thoroughly considered and planned depending on the individuality of each specific wetland area.

Preliminary Photointerpretation

'Photointerpretation has been defined as the act of examining photographs for the purposes of identifying objects and phenomena and judging their significance. In carrying out this task, an interpreter may use much more information (collateral data, field data) than that recorded on the photos he is to interpret.' (Reeves *et al.* 1975).

In this step all the photographs are thoroughly examined and only a sample part of the entire area is photointerpreted. Actually it is not practical to do a significant amount of photointerpretation before the fieldwork. The area to be interpreted represent the entire range of

wetland habitat types and covers about the 10% of the project area. By this preliminary photointerpretation, habitat identification and descriptions are made and relevant problems appear.

Specifically, the preliminary photointerpretation includes:

1. Preparing the aerial photo mosaic, so as to have a whole view of the site (it is important for the interpreter to possess the flightline maps of the photos);
2. Thorough examination of each photo in order to have an initial idea of the appearance of the wetland habitats;
3. Registration of transparent overlays on each photograph that is interpreted;
4. Determination of overlap area of each photograph with the adjacent photos and framing it into a polygon;
5. Performance of photointerpretation closest to the geometric centre of the photo, which assures minimum displacement;
6. Noting the doubtful or questionable interpretation decisions.

Phase Two Fieldwork

In most Mediterranean countries specific information (collateral data) on wetlands, like national lists of wetland vegetation species, soil maps, and systematically collected hydrological data, is limited or scattered. This makes fieldwork a significant source of information for the identification and classification of wetland habitats. For this purpose the criteria for wetland identification (see Chapter 5) are primarily considered during this stage in order to support the identification process in the field and also the registration of vegetation and soil features. Field investigations aim to solve complications identified during the first stage and also to collect information for the completion of wetland habitat classification. Successful and fruitful fieldwork requires careful preparation.

Pre-fieldwork preparation

Fieldwork preparation is required in order to plan fieldwork and to determine the parameters that need to be investigated. It consists of:

a) Reviewing all the collected data and extracted information from the previous steps. Problems of wetland habitat description that have been faced are explicitly determined.

b) Selecting the field checksites. Most of the field cheksites should be located in marginal areas, since these are the most difficult to identify on the photos. Obvious wetland habitats are only visited to confirm the classification (e.g. water regime, salinity, etc.). The checksites are marked on photographs and topographic maps for route planning but are numbered during the fieldwork as the team gets to them. In addition to the preselected checksites, the field team may visit other areas which are identified as wetlands during the field visit. The choice of the field checksites is based on photo signatures of:

- commonly occurring habitats that characterise the area;
- habitats located in transitional zones where it is difficult to determine the wetland from non-wetland area by photointerpretation;

- unusual pattern of habitats but important because of their large coverage or of difficulties to describe them;
- hydrological conditions (correlating signatures with permanently flooded, seasonally flooded, temporarily flooded areas etc.);
- water or substrate salinity;
- specific problems related to the date and time of photography (e.g. clouds).

see
VOLUME II
Mediterranean Wetland Inventory. Data recording

c) *Gathering all the necessary material that will be used during the fieldwork. This must include:*

- topographic maps and/or other thematic maps
- aerial photographs
- inventory data sheets
- soil probe and soil spade/shovel
- list of soil indicators for hydric soil identification (see Chapter 5)
- munsell soil colour chart
- salinity meter
- plant identification books/keys
- magnifying glass in order to closely view the photo features in the field
- stereoscope in order to examine on photos the visited checksites (this is important to learn the subtle signature differences that often serve as identifiers for the description of wetland habitats).

Fieldwork

Fieldwork in this phase involves training the photo interpreters to recognise the aerial photo signatures of the wetland habitats in the project area and collection of detailed data on the vegetation communities, hydrological conditions, water salinity and soil/substrate characteristics, in order to solve classification problems that have arisen during the preliminary photointerpretation.

During the fieldwork the team examines: (1) representative wetland habitats to confirm the classification and improve the wetland habitat description (e.g. water regime, water salinity, dominant species, etc.) and (2) wetland habitats located in transition zones between wetlands and non-wetland areas. In these zones wetland habitats are not easily identified and classified by photointerpretation alone, and the team should implement the criteria for identification of wetlands in order to determine their borders. The team also visits areas where the information on photos is deficient.

The field trip is ideally done during the same season that the aerial photographs were taken and repeated at a different time in the season in order to see differences. Sometimes several field visits are required at different seasons in order properly to describe the wetland habitats (especially if there are few data regarding the water regime).

The objectives of the fieldwork are:

- The training of the photointerpreters. During field examinations, the photo interpreters are trained to identify and classify wetland habitats accurately. By continuously comparing the photo signatures with the ground observations, the field team is able to

describe the photoelements of each wetland habitat. Accurate identification and classification by aerial photographs, requires experience of photointerpretation techniques and knowledge of the wetland area and the Wetland Habitat Description System. It is also imperative that the photointerpreters are the same people who conduct the field examinations.

Simple Stereocopes
Photo of Wild Heerbrugg Inc.

Zoom Stereoscope
Photo of M. karteris

- The collection of ground data regarding the wetland habitat description. Simultaneously with training on photo signatures of the sample areas, which represent the entire range of wetland habitat variability, the team confirms or completes the preliminary classification, in order to fill in the wetland habitat description data sheets of all representative habitats of the project wetland site. The fieldwork data that are collected concern:
  - the dominant species of the upper stratum (not more than 3 codominants) of each wetland habitat;
  - hydrological signs for supporting the determination of water regime: current conditions, evidence of surface inundation if dry conditions exist during the field visit;
  - measurements of water salinity
  - hydric soil indicators; these observations are used in combination with vegetation and hydrological condition data, to support examinations of transitional zones between wetlands and non-wetlands and identify an area as wetland.

Upon completion of the field trip, the team delineates representative wetland habitat boundaries and prepares a general trip summary report which provides: (1) a description of the area, (2) descriptions of wetland habitats, (3) relations between vegetation, water regime salinity and soil characteristics, (4) a discussion of photointerpretation signatures and (5) specific problems faced during the field trip.

Phase Three
Photointerpretation and production of the final map

This phase results in the production of the wetland habitat map. The quality of the final photointerpretation results depends primarily on the quality and quantity of the data collected during the previous stages and also on the photointerpreter's skills and experience. After completion of the final photointerpretation and quality control, the final map is almost ready. Transferring the final information to a base map locates it planimetrically. The final step of the map production is the cartographic design.

Final Photointerpretation

Before performing of the photointerpretation the minimum mapping unit is decided. This depends mainly on the photo scale, the size of the project area, the study objectives and the available budget. This decision is crucial because wetland habitats with a smaller aerial extent than the minimum photointerpreted unit, are represented either as lines or points.

see
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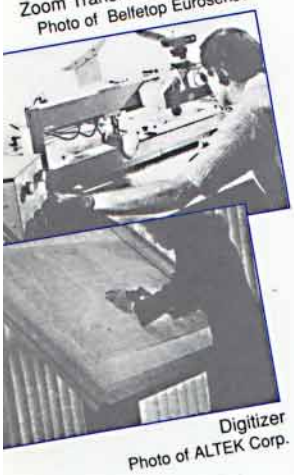
Mediterranean Wetlandd Inventory: Habitat Description System
VOLUME IV
Mediterranean Wetlandd Inventory: Photointerpretation and Cartographic Conventions

At this step, all the photographs are interpreted. The initial photointerpretation results are corrected and final photointerpretation and classification of the entire area is carried out. Information gained from fieldwork combined with the collateral data and the photointerpreter's skills and experience, will result in the successful completion of this step.

The photographs are visually interpreted under a stereoscope. The various wetland habitats are delineated on transparent overlays that are registered on the photographs. For each photograph, the area of overlap with the adjacent photos is determined and area closest to the geometric centre of the photo is interpreted, assuring minimum displacement. The photointerpretation is based on MedWet wetland habitat description system and according to photointerpretation conventions.

In addition to the identification and classification of wetland habitats, the interpreter identifies on the photos important man-made features (e.g. roads, trails). These are delineated only in cases where they are not displayed on the base map (e.g. topographic map) and according to the interpreter's decision whether or not to include them in the final map. Delineation of these is done on different transparencies.



Zoom Transfer Stereoscope
Photo of Belfetop Eurosense

Digitizer
Photo of ALTEK Corp.

Transferring the interpreted information to a base map

The photointerpreted information constitutes the basic part of the final map. Topographic maps are used as base maps onto which the interpreted information is transferred in order to be positioned planimetrically. This procedure is accomplished with the Zoom Transfer Stereoscope, which enables the operator to view the photograph and the map simultaneously. Selected control points are located on the topographic map and are fitted to the same points on the photos, in order to transfer the delineation with reasonable accuracy. Through this procedure the distortions of vertical aerial photographs are corrected to a certain extent.

Quality control

Quality control of the output product follows. The map is reviewed by scientists or agencies that are working in the project area. Considering their experience, the photointerpreter's decisions on wetland habitat descriptions and classifications are tested.

The map accuracy is also verified. Two major types of map error have been identified, attribute error and location error. Attribute error (also called thematic or descriptor error) occurs when a thematic attribute or class name is incorrect, but the boundaries are correct. Location error, which has also been termed cartographic or position error, is the error in the geographic location of cartographic features such as points, lines, and polygons. In reality, both types of error occur together, making them difficult to separate. Error checking cannot be done in all wetland habitats on the ground due to time and cost constraint. Therefore, by developing a formal sampling scheme, efficient testing of each map attribute at each level can be achieved (Karteris 1990).

Cartographic presentation of the map

The wetland habitat description map is composed of the identified delineated and properly classified wetland habitats and the necessary base map elements.

The wetland habitats are displayed as polygons, lines and points associated with their attributes. All these cartographic elements are drawn with the same pen colour and width.

- Dot wetland habitats are represented by points;
- Linear wetland habitats are represented by dashed lines with uniform type;
- Polygon wetland habitats are represented by continuous lines and are displayed with different patterns. Five different patterns are used in order to indicate the corresponding Systems.

Base map elements are added to the wetland habitat map in order to produce a more reliable representation of the wetland site. They include: (1) topographic elements (contour lines, altitude points, trigonometric points); (2) stream network: when the catchment area is also depicted on the map, streams are displayed as linear features and coded by the proper wetland habitat according the proposed Wetland Habitat Description System; (3) primary or secondary roads, paths or tracks: all these are represented as linear features; (4) dams, canals and other infrastructure which is related to the wetland site; (5) administrative and catchment area boundaries; (6) location and/or extent of residential areas.

In cases where, the base map (topographic maps or orthophotomaps) do not reflect the present configuration and do not include elements which should be depicted on the wetland habitat map, they are photointerpreted by the aerial photographs and transferred to the base map using the Zoom Transfer Scope.

In addition each map should contain: a) a location map depicting the geographical position of the wetland site; b) the north symbol; c) the base map legend, and; d) the diagram of the MedWet Wetland Habitat Description system.

Phase Four
Digital wetland habitat description map production using GIS

This phase is for those who have the capability to produce a digital wetland map and integrate the information into a Geographical Information System (GIS). In very general terms, the procedure is completed in three steps: (1) Data input to the geographical information system, (2) Geographic database development, (3) Outputs. The basic concepts and functions of the procedure are described below.

Data input to the Geographical Information System

Data are input to a geographical information system both by digitising and scanning methods depending on the equipment available and user's skills. Digital data are categorised in three different types: polygons, lines or points. Polygons represent geographic aereal phenomena or objects, lines represent geographic linear features and points represent data with no length or area such as dot wetlands, wells, and cultural features (e.g. discontinuous urban areas, archaeological sites etc.) that are of interest only for their location. The type of data is dependent on the minimum mapping unit. This means that geographical features that have been mapped as lines on a given mapping scale, will be represented by polygons if a greater scale is used.

The information to be digitised comes from the final wetland habitat map. In order to accurately and rapidly transform the analogue wetland habitat map into digital form the data are traced on clear separate transparencies. For the wetland habitats two transparencies are used,

one for their spatial distribution and the other for their description codes. Base map elements are grouped and traced on different transparencies according to their intensity and complexity.

Finally, if further spatial analysis of the relationships between wetland habitats and other factors affecting the wetland site (e.g. abiotic, biotic, anthropogenic) is carried out, then thematic maps may be used as a source of information.

Geographic database development

The geographical database is the core of a GIS. Spatial data and their associated attributes are the two components of a geographical database and are linked together by a common identifier. Spatial data is translated into simple objects like points, lines and areas. Attribute data records a description of spatial data like the wetland system, subsystem, class, subclass, water regime, water salinity, and description of base map elements (e.g. names of residential areas, administrative boundaries etc.).

Data input is followed by automated procedures which build the topology of all the features stored in the database. Standard columns of the geographical database are created containing spatial data (e.g. an identifier for each feature, the length of lines, the area of polygons, etc.). After the topology is built the user can add to the database other descriptive data (attribute data) related to the features.

Outputs

With the use of a GIS, spatial and attribute data are associated to support map display of wetland habitats and their descriptions.

10 Use of the inventory

Inventories are essential tools for the conservation of wetlands. They are a key instrument to gather existing information and collect new data in order to make them available to users. The information collected can be used at local, national and international level for various purposes. Inventories provide information for the identification of priority sites which need urgent actions; they gather the base-line information for the establishment of planning, management and monitoring schemes; and they can provide international programmes with updated data. Information on wetlands needs to be disseminated to a wide audience including the general public and decision makers, to increase there awareness of wetland values and the need for their protection. They should stimulate co-operation for undertaking conservation actions at any level.

10. Use of the inventory

Identification of priority wetlands

It has been proposed that all remaining wetlands in the Mediterranean countries should be preserved and that their loss and degradation should be stopped and reversed (Finlayson *et al.* 1992, Anonymous 1992). All wetlands are important. Nevertheless, it is necessary to identify those sites which need priority conservation actions. The inventory procedure helps to identify these sites by analysing the data and using criteria to assess the site values. Sites can be considered as priority if they are particularly threatened and/or for their intrinsic values. National wetland inventories can stimulate identification and even designation of priority sites.

Identification of threatened sites

When a site is threatened by destruction or degradation, immediate actions need to be taken. Wetland inventories are one of the key tools which can provide figures about these threats. Amongst the information collected in the inventory, the data concerning the activities and impacts allow detection of the most important threats which need to be monitor and against which action should be taken. The inventory data not only give a static view of the present situation of the wetlands, but can also measure trends if the inventory is updated. These data will show if any activity is increasing or likely to increase in the near future. If this activity can generate a threat to the wetland, then it is important to consider the wetland as a priority site. In this case, there is an urgent need to find efficient tools to stop the threat and ensure the conservation of the site. All threatened wetland sites should be considered whatever their size, location or the information available about their functions and values.

see
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Mediterranean Wetland Inventory. Data recording

Identification of sites with high intrinsic values

A site should be selected as a priority site when it plays an essential role in the conservation of biodiversity and/or in maintaining natural processes, and/or in generating products for human communities. The inventory procedure is useful to assess the intrinsic functions and values of wetlands.

Ecological importance

The inventory gathers detailed data about the fauna, flora and the habitats. These data should focus on the most important aspects such as threatened or endemic species, habitats listed in Annex I of the EU Habitats Directive and habitats important in the region. In gathering published and unpublished data complemented by field information, the inventory offers a synthesis of the present knowledge on each wetland. This constitutes an efficient tool to assess the biodiversity of a site and especially the key species and habitats which should benefit from conservation actions.

Functional importance

The inventory should provide information about the main natural functions of each wetland. These functions such as groundwater recharge and discharge, flood control, sediment and toxicant retention, nutrient retention and recycling, shoreline stabilisation, storm protection and food chain support are essential to maintain natural processes in the general environment and

benefit the human communities (Dugan 1990, Skinner & Zalewski 1995). Their assessment provides strong arguments to select sites as priority wetlands.

Importance for human communities

Although difficult to calculate in economic terms, the values and services given by wetlands to local communities represent highly valuable benefits (Skinner & Zalewski 1995, Davies & Claridge 1993, Dugan 1990). Many activities using wetland resources contribute to the local or regional economy, such as fisheries, hunting, reed cutting and shellfish harvesting. Wetlands are often utilised as a source of water for domestic, agricultural and industrial use; their socio-cultural significance is also important; they may be appreciated for their aesthetic values and used for recreation and tourism; and they may be used for research and education. The diversity of these values shows that wetlands play a considerable role for human communities. Wetland inventories should collect detailed data on these subjects. The analysis of the information should be used as criteria for the selection of priority wetlands. The evaluation of wetland resources, values and functions during the inventory is a crucial step to select priority sites.

see Chapter 2

see Chapter 8

The Ramsar Convention has developed criteria in order to identify wetlands of international importance. The MedWet database allows assessments of wetland values and functions and of Ramsar criteria once the data are entered. According to the aims of the selection, the user may define more specific criteria, such as priority sites for the conservation of some species or some habitats or conservation of some types of human activities.

The inventory procedure gives an evaluation of the values of each site and therefore helps to determine the priority ones. In some countries the results of this assessment are very useful for legal decisions to be taken and legislation to be implemented. For example, in Spain the National Wetland Inventory (Montes 1991) has been fundamental in order to recognise the important role of wetland ecosystems in the National Hydrologic Plan (MOPT 1993). This plan establishes the official water policies for the whole country and, consequently, the values of the wetlands existing in the catchment need to be considered when taking decisions about hydraulic actions, which will be defined in the Basin Plans (Planes Hidrológicos de Cuenca). Wetland inventories can provide essential data for the implementation of policies and actions towards the wise use of their resources.

Planning, Management and Monitoring

One aim of the wetland inventory procedure is to provide reliable information which can be used as a baseline to develop planning, management or monitoring actions.

Planning and Management

Inventory data are useful at two main levels: at a wide scale (i.e. catchment) they can be used for landuse and water resources planning, and at local level (i.e. site) the inventory is the basis for management.

Planning

At national level, it is important to know the extent of wetlands, the water resources available, and the wetland biodiversity. Therefore, an integrated approach is required to develop planning frameworks for water resources and landuse (Commission des Communautés Européennes 1995). For example in France, integrated management of water resources has been identified as a national need. A governmental action plan for the protection and recovery of wetlands has been elaborated and there are ongoing procedures for the establishment of planning frameworks for the management of catchment areas and their water resources (Guilhaudin 1992, Redaud 1995). These planning frameworks are part of the legal requirements for the implementation of the national water law (3 January 1992). This law also requires that a legal decision ("arrêté préfectoral") needs to be taken before any action is conducted on any wetland area of more than one hectare. This national example shows the need for inventory data in order to implement legislation and to promote an integrated approach to water management. Planning frameworks should take into account the whole catchment areas and be elaborated with the participation of all the responsible and interested bodies. Wetland inventories must include catchment areas in order to collect data on these vast areas and to show their links with the wetlands of the region. These data are the base for elaborating catchment planning for the wise use of water and to lower the impacts on wetlands.

see Chapter 4

Management

At local level, detailed data are needed for the designation of protected areas and for the management of sites or ecosystems. A full inventory of a region will show the relative importance of specific sites (e.g. habitats, wildlife, human activities) and determine their natural and cultural "heritage". This will help to orientate the management towards the enhancement of the important features of each site. It will assess the site priorities and support the definition of the management objectives of each area. The inventory is also a tool to identify the missing information concerning a site and where research or survey efforts should focus (e.g. data on certain fauna or flora, data on soils, etc.) (Crespí Ramis & Mathevet 1995). To store data in a database will facilitate the updating of this information and help to identify management decisions to be taken.

Monitoring

Data collected through the inventory can be used as a baseline for general monitoring of the catchment and the site. Regular updating of the inventory (e.g. every five or ten years) can provide information useful for monitoring changes occurring in the catchment area, at the wetland site (e.g. the total surface area and the surface area of different wetland habitats), and to the particular features occurring at the wetland, such as the important species of flora and fauna, the values of the wetland, the human activities and threats (Dugan & Jones 1993).

Change in wetland area is perhaps one of the most important aspects that can be monitored using the data of the inventory as a baseline. This is possible providing that the initial inventory (and its updates) includes a map defining the boundaries of the wetland site and, ideally, the

habitat types present, and that the delineation process is done using the same criteria (hydrophytic vegetation, hydric soils, presence of water) and under similar conditions (resolution, equipment...).

see Chapter 5, 6 and 9

Furthermore, certain features included in the inventory, both physical (hydrological parameters, geomorphology), biological (flora, fauna) and human (values and functions, activities and impacts) can be monitored by collecting new data using the same method (i.e.: data categories and data sheets) and at pre-determined intervals (e.g. every five years). However, monitoring all the aspects would normally be very difficult, time consuming and costly, so it is recommended to focus on those features that are good descriptors of the specific wetland site and for which change will produce significant impact.

However, monitoring cannot always be achieved through repeated inventories. In most cases it is necessary to detect a specific threat or change affecting a particular type of wetland as a result of a human activity (known or unknown), and to measure its effects on the ecological character of the wetland. In those cases, detailed scientific monitoring programmes must be carefully designed. It is essential that the planning of the monitoring is done systematically and in a structured way, as described in the "MedWet Methodological Guide for Monitoring Mediterranean Wetlands" (Tomàs Vives 1996).

Dissemination of knowledge

Sound knowledge about the wetlands at local, national or international level is essential for their conservation. It is therefore essential that the information collected through wetland inventory be managed in a way that can provide open and up-to-date access to a wide variety of users.

As described above, information from wetland inventories is vitally important for setting priorities, and for planning, management and monitoring. In all these areas, such knowledge should be incorporated into training programmes and appropriate training materials .

A further vital use of inventories is to provide information for education and raising awareness about wetlands. Wetland conservation will only succeed if it has the support of those who make decisions concerning the wetlands (decision-makers), and those who are affected by such decisions (the general public, and particularly those who live in and around wetlands). The presentation of the information will need to be carefully designed to target these different audiences.

Information on the importance of different wetlands, and the presence of threatened or endemic species will be of interest. They should be made available for EIAs related to wetlands and for the implementation of national and international measures. Additionally, information on the values of wetlands, threats and rates of loss and degradation will be particularly important in influencing public opinion. For example, in the United States the publication of Status and Trend reports by the National Wetland Inventory Office led to the adoption of the Emergency Wetlands Conservation Act of 1986.

Use of the National Wetland Inventory in Tunisia:

The inventory of Tunisian wetlands (Hughes *et al.* 1994) has been used to launch several actions:

- Designation of protected areas: The Direction Générale des Forêts analysed the inventory data in order to identify wetlands of international importance. This analysis led to the designation of three wetlands as natural reserves: Sebkha Kelbia, Lake Mejen Echitane and Kneiss Islands in the Gabes Gulf.
- Public awareness: A leaflet presenting Tunisian wetlands and their importance has been produced by the Direction Générale des Forêts and disseminated to a wide public. The Korba lagoon has been selected among the inventory sites as a test site for launching a public awareness campaign organised by WWF Mediterranean Programme and the MedWet Project.
- Training: The inventory has been used as a reference document to present the status of Tunisian wetlands during training sessions addressed to teachers.

Information provided by Faouzi Maamouri - WWF Mediterranean Programme

11 References

11. References

Anonymous 1970. *Atlas du Sebou.* Min. Agr. Réf. Agraire, Rabat.

Anonymous 1992. *A Strategy to Stop and Reverse Wetland Loss and Degradation in the Mediterranean Basin.* IWRB and Regione Friuli-Venezia Giulia, Trieste, Italy.

Barnaud, G. & D. Richard 1993. *Les zones humides, un patrimoine irremplaçable, une responsabilité partagée.* M.N.H.N./E.S.N.M./S.F.F., Ministère de l'Environnement, Paris.

Britton, R.H. & A.J. Crivelli 1993. Wetlands of Southern Europe and North Africa: Mediterranean Wetlands. *In* Wigham, D.F., D. Dykyjová & S. Hejny (editors). *Wetlands of the World I: Inventory, Ecology and Management.* Handbook of Vegetation Science 15/2: 129-194.

Budd, J.T.C. 1991. Remote sensing techniques for monitoring land-cover. In Goldsmith, B. (editor) *Monitoring for conservation and ecology.* 2nd ed. Chapman and Hall, London: 33-59.

Burgis, M.J. & J.J. Symoens (editors) 1987. *African Wetlands and Shallow Water Bodies.* ORSTOM, Paris.

Carp, E. 1980. *A Directory of Western Palearctic Wetlands.* UNEP, Nairobi & IUCN, Gland.

Castany, G. 1982. *Principles et méthodes de l'hydrogéologie.* Dunod.

Commission des Communautés Européennes 1995. *Utilisation rationnelle et conservation des zones humides.* Communication de la Commission au Conseil et au Parlement Européen. 29 Mai 1995. Office des publications officielles des Communautés Européennes. Luxembourg.

Cornaert, M.H., V. Mariette, C. Steenmans & R. Henriques 1987. *The EC CORINE land cover data base: an aid for European and national environmental planning policies.* Capri.

Cowardin, L.M., V. Carter, F.C. Golet & E.T. Laroe 1979. *Classification of wetlands and deep water habitats of the United States.* US Fish and Wildlife Service, Washington DC.

Crespí-Ramis, F. & R. Mathevet 1995. *Test of MedWet inventory methodology: application of the methodology to the reserve of Marais du Vigueirat, France.* IWRB/ICN/Tour du Valat. (unpublished report).

Dakki, M. 1987. Ecosystèmes d'eau courante du haut Sebou (Moyen Atlas). *Trav. Int. Sci., Rabat (serie Zoologie)* 42: 1-99.

Dakki, M. & M. El Agbani 1995. The Moroccan wetlands: diversity and human impact. In Montes, C. *et al. Bases ecologicas para la restauración de humedales en la cuenca mediterranea.* Consejería de Medio Ambiente, Junta de Andalucia: 299-307.

Davies, J. & C.F. Claridge (editors) 1993. *Wetland Benefits. The Potential for Wetlands to Support and Maintain Development.* Asian Wetland Bureau Publication 87/IWRB Special Publication 27/Wetlands for Americas Publication 11.

Davis, T.J. 1994. *The Ramsar Convention Manual. A guide to the convention on wetlands of international importance especially as waterfowl habitat.* Ramsar Convention Bureau, Gland.

De Beaufort, F. & A.-M. Czajkowski 1986. *Zones Humides d'Afrique septentrionale, centrale et occidentale, II: inventaire préliminaire et methodologie.* Secretariat de la Faune et de la Flore, Museum National d'Histoire Naturelle, Paris.

De Klemm, C. & I. Creteaux 1995. *The legal development of the Ramsar Convention on wetlands of international importance especially as waterfowl habitat (2 February 1971).* Ramsar Convention Bureau, Gland.

De Maria, G. (Editor) 1992. *Inventorio delle zone umide del territorio Italiano.* Ministero dell' Ambiente, Servizio Conservazione della Natura. Instituto Poligrafico e Zecca dello Stato, Roma.

Derenne, P. 1979. *Atlas des réserves d'avifaune aquatique*. Ministère de l'Environnement/DPN., Arpège Ed.

Derruau, M. 1974. *Précis de géomorphologie*, 6th edition. Masson.

DGXI-CEC-EEA/TF 1992. CORINE land cover brochure. Brussels.

Dugan, P.J. (editor) 1990. *Wetland conservation: a review of current issues and required action.* IUCN, Gland.

Dugan, P.J. & T. Jones 1993. Ecological changes in wetlands: a global overview. *In Moser, M.*, R.C. Prentice & J. van Vessem (editors). *Waterfowl and Wetland Conservation in the 1990s - a global perspective*. Proc. IWRB Symposium St Petersburgh Beach, Florida, USA, IWRB Special Publication 26, Slimbridge.

Dussart, B. 1966. *Limnologie. L'étude des eaux continentales*. Gauthier-Villars.

Emberger, L. 1952. *Sur le quocient pluviothermique.* C. R. Ac. Sci 234: 2508-2511.

European Commission 1993. *CORINE land cover Technical guide*. Luxembourg.

European Commission 1994. *Special Protection Areas under article 4 of Council Directive 79/409/EEC (situation as of 31 July 1994)*. DG XI, Luxembourg.

European Communities 1979. *Council Directive 79/409/EEC of 2 April 1979 on the Conservation of Wild Birds*. Official Journal of the European Communities L 103.

European Communities 1991. *CORINE Biotopes: the design, compilation and use of an inventory of sites of major importance for nature conservation in the European Community.* Report and Manual (3 volumes). Office for Official Publications of the European Communities, Luxembourg.

European Communities 1992. *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora*. Official Journal of the European Communities L 206: 7-50.

European Communities - Commision. 1992. *Corine Land Cover. European Environment Agency Task-Force.*

EUROSTAT 1995. *GISCO Data base manual*. Luxembourg.

Evans, M.I. 1994. *Important Bird Areas in the Middle East*. BirdLife International, Cambridge.

Farinha, J.C. & Trindade, A. 1994. *Contribuição para o inventário e caracterização nacional de Zonas Húmidas*. Publicação MedWet/Instituto da Conservação da Natureza, Lisboa.

Farinha, J.C., L. Costa, E. Fitoka, A. Mantzavelas, G. Zalidis, N. Hecker & P. Tomàs Vives 1996. *Mediterranean Wetland Inventory. Habitat Description System*. MedWet /Instituto da Conservação da Natureza /Wetlands International / EKBY. *Publication, Volume III.*

Federal Geographic Data Committee 1992. *Application of satellite data for mapping and monitoring wetlands - fact finding report*. Technical report 1. Wetlands Subcommittee, FGDC, Washington DC.

Federal Interagency Committee for Wetland Delineation. 1989. *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, DC.

Finlayson, M. 1994. Monitoring ecological changes in wetlands. In Aubrecht, G., G. Dick & R.C. Prentice (editors) *Monitoring of ecological changes in wetlands of Middle Europe*. Proc. International Workshop, Linz Austria, 26-30 Oct. 1993). Stapfia 31, Linz/IWRB

Publication 30. IWRB, Slimbridge: 163-180.

Finlayson, C.M., G.E. Hollis & T.J. Davis (editors) 1992. *Managing Mediterranean Wetlands and their Birds*. Proc. Symp., Grado, Italy 1991. IWRB Special Publication 20, Slimbridge.

Frécaut, R. & P. Pagney 1978. *Climatologie fluviale à la surface de la terre*. CDU, SEDES, Paris.

Géhu, J.M., J.L. Meriaux & P. Tombal 1981. *Inventaire des Tourbières de France*. Institut Européen d'Ecologie de Metz, Ministère de l'Environnement/DPN. (unpublished report)

Giudicelli, J., M. Dakki & A. Dia 1985. Caractéristiques abiotiques et hydrobiologiques des eaux courantes méditerranéennes. Verh. Internat. Verein. Limnol. 22: 2094-2101.

Grimmett, R.F.A. & T.A. Jones 1989. *Important Bird Areas in Europe*. ICBP Technical Publication No. 9. ICBP, Cambridge.

Guilhaudin, P. 1992. Le SDAGE et les SAGE: des outils de planification proposé par la nouvelle loi sur l'eau. Revue de l'Agence de l'eau Rhône-Méditerranée-Corse 43.

Hareuveni, I. 1994. *Nature reserves in Israe*l. Ministry of Defence, Tel Aviv.

Hecker, N. & P. Tomàs Vives (editors) 1995. *The Status of Wetland Inventories in the Mediterranean Region*. MedWet publication/IWRB Special Publication 38, Slimbridge.

Hecker, N., L.T. Costa, J.C. Farinha & P. Tomàs Vives 1996. Mediterranean Wetland Inventory. *Data Recording*. MedWet/Wetlands International /Instituto da Conservação da Natureza. *Publication, Volume III.*

Hess, L.L. & J.M. Melack 1993. *Mapping wetland hydrology and vegetation with synthetic aperture radar*. Proceedings of IV International Conference, 4/93.

Hughes, R.H. & J.S. Hughes 1992. *A Directory of African Wetlands*. IUCN, Gland.

Hughes, J.M.R., F. Maamouri, G.E. Hollis & C. Avis 1994. *A preliminary inventory of Tunisian wetlands*. Report to EEC (DG XII), Ramsar Bureau and US Fish and Wildlife Service. Wetland Research Unit, Department of Geography, University College, London.

IWRB 1992-95. *Ramsar database documentation*, IWRB, Slimbridge (unpublished series).

Jensen, J.R., K. Rutchey, M.S. Koch & S. Narumalani 1995. Inland wetland change detection in the Everglades Water Conservation Area 2A using a time series of normalised remotely sensed data. *Photogrammetric Engineering & Remote Sensing 61 (2): 199-209.*

Jones, T. (compiler) 1993. *A Directory of Wetlands of International Importance*. Part I, Africa, Part II, Asia and Oceania, Part III, Europe. Ramsar Convention Bureau, Gland.

Karathanasis, A.D. 1992. *Wetland delineation and hydrology monitoring in Western Kentucky.* University of Kentucky.

Lenco, M., Balland & Garry, 1990. Etude par télédétection au 1:50 000 des zones inondables et du drainage dans le bassin de débordement de la Saône. Symposium International de Cartographie Thématique Dérivée des Images Satellitaires, Saint Mandé 2-4 oct. 1990. *Comité Français de Cartographie. Bull. No 127-128*: 182-185, Instaprint, Tours.

Luther, H. & J. Rzóska 1971. *Project Aqua: a source book of inland waters proposed for conservation*. IBP Handbook No.21. Blackwell Scientific Publications, Oxford.

Macbeth Division of Kollmoggen Instruments Corporation, 1992. *Munsell Soil Color Charts*. Macbeth Division of Kollmoggen Instruments Corporation, Newburgh, New York.

Mantzavelas, A., G. Zalidis, P.A. Gerakis & S. Dafis (editors) 1995. Criteria for wetland identification. EKBY, Thessaloniki.

Matthews, G.V.T. 1993. *The Ramsar Convention on wetlands. Its history and developmen*t. Ramsar Convention Bureau, Gland.

Melack, J.M., L.L. Hess & S. Sippel 1993. Remote sensing of lakes and floodplains in the

Amazon Basin. Submitted to Remote Sensing Reviews, 3/93.

Merot, Ph. & A. Chanzy 1991. *Mesure de l'humidité d'un sol nu par radar dans des conditions d'excès d'eau*. Proceedings of the 5th International Colloquium, Physical Measurements and signatures in remote sensing, Courchevel, France

Misopolinos, N. 1992. *Observations related to soils existing inside and outside the boundaries of wetlands*. Aristotelian University of Thessaloniki, Thessaloniki.

Mitsch, W.J. & J.G. Gosselink 1993. *Wetland*s, 2nd edition. Van Nostrand Reinhold, New York.

Montes, C. (coordinator) 1991. *Estudio de las Zonas Húmedas de la España Peninsular. Inventario y tipificación*. INITEC. Dirrección General de Obras Hidráulicas. Ministerio de Obras Pública y Urbanismo, Madrid.

MOPT 1993. *Plan Hidrológico Nacional - Memoria*. Abril 1993. Ministerio de Obras Públicas y Transportes, Dirección General de Obras Hidráulicas. Madrid, Spain. (unpublished report)

Moss, D. & B.K. Wyatt 1994. The CORINE Biotopes Project: a database for conservation of nature and wildlife in the European Community. *Applied Geography* 14: 327-349.

National Research Council 1995. *Wetlands: Characteristics and boundaries*. National Academy Press. Washington D.C.

Nisbet, M. & J. Verneaux 1970. Composants chimiques des eaux courantes: discussion et proposition de classes en tant que bases d'interprétation des analyses chimiques. Annals *Limnol.* 6 (2): 161-190.

Normand, M. 1991. *Perspectives offertes par la télédétection radar dans le domaine de l'état hydrique des sols*. Caractérisation et suivi des milieux terrestres en régions arides et tropicales (Deuxièmes journées de télédétection): 191-205. ORSTOM, Blondy.

Olney, P. (editor) 1965. Project MAR. *List of European and North African Wetlands of International Importance*. IUCN New Series, Morges.

O'Sullivan, G. 1992. CORINE land cover Project Ireland. Survey Ireland: 37-44.

Ottman, F. 1965. *Introduction à la géologie marine et littorale*. Masson.

Pearce, F. & A.J. Crivelli 1994. *Characteristics of Mediterranean Wetlands*. Station Biologique de la Tour du Valat, Arles.

Quezel 1980. L'Homme et le dégradation récente des forêts au Maghreb et au Proche-Orient. *Naturalia Monspeliencia*, H.S.: 147-152.

Ramsar Convention Bureau 1990. *Proceedings of the fourth meeting of the conference of contracting parties. Montreux, Switzerland, 27 June-4 July 1990, Vol. I.* Ramsar Convention Bureau, Gland.

Ramsar Convention Bureau 1991. *The Ramsar Database Programme profile no.2.* Ramsar Convention Bureau, Gland.

Ramsar Convention Bureau 1993. *Proceedings of the fifth meeting of the conference of contracting parties. Kushiro, Japan, 9 June-16 June 1993*, Vol. I. Ramsar Convention Bureau, Gland.

Raveneau 1992. L'atlas environnemental du Saint-Laurent: un outil de connaissance systématique au service d'une gestion globale. *Rev. Géog. Lyon*. 67 (4): 319-327.

Redaud, J.L. 1995. *Mise en place du Plan d'action gouvernemental pour la protection et la reconquête des zones humides*. Ministère de l'Environment, Paris.

Reed, P.B. 1988. National list of plant species that occur in wetlands: national summary. *Biol. Report* 88(24). Washington, DC: US Fish and Wildlife Service.

Reeves, R.G., A. Anson & D. Landen 1975. *Manual of remote sensing*. American Society of

Photogrammetry.

Roller, E.G. Norman 1977. *Remote sensing of wetlands*. Environmental Research Institute of Michigan.

Rose, P.M. 1990. *Manual for International Waterfowl Census Coordinators*. IWRB/ONC, Slimbridge.

Sandoz, A. 1996. *Proposition d'une méthodologie adaptée au suivi de l'occupation du sol d'une zone humide aménagée: application au bassin versant du Fumemorte (Grande Camargue, France)*. Thèse de Doctorat, Université d'Aix-Marseille I.

Schoeller, H. 1962. *Les eaux souterraines*. Masson.

Scott, D.A. 1980. *A Preliminary Inventory of Wetlands of International Importance for Waterfowl in West Europe and Northwest Africa*. IWRB Special Publication No. 2. IWRB, Slimbridge.

Scott, D.A. 1989. *Design of wetland data sheet for database on Ramsar sites* (unpublished report).

Scott, D.A. 1993. Wetlands of West Asia - a regional overview. In Moser, M. & J. van Vessem (eds) *Wetlands and Waterfowl Conservation in South and West Asia*. Proceedings Int. Symp., Karachi, 14-20 December 1991. IWRB Special Publication No.25: 9-22.

Scott, D.A. 1995. *A Directory of Wetlands in the Middle East*. IUCN, Gland/IWRB, Slimbridge.

Skinner, J. & S. Zalewski 1995. *Functions and values of Mediterranean wetlands*. MedWet/Tour du Valat 2, Arles.

Stumm, W. & J.J. Morgan 1981. *Aquatic chemistry: an introduction emphasizing chemical equilibria in natural waters*. J. Wiley & Sons.

Suyatno, N., S. Frazier & S. Dacey 1994. *Wetland Data Base (WDB). a User Manual.* Asia Wetland Bureau, Bogor.

Tomàs Vives, P. 1993. *Medwet subproject on inventory and monitoring. 1st Advisory Group Meeting*, Alcochete, Portugal, 8-10 July 1993. Conclusions of the Meeting. ICN, Lisboa/IWRB, Slimbridge (unpublished report).

Tomàs Vives, P. 1994. *Medwet subproject on inventory and monitoring. 2nd Advisory Group Meeting*, Bizerte, Tunisia, 18-21 April 1994. Meeting Report and Conclusions. ICN, Lisboa/IWRB, Slimbridge (unpublished report).

Welch, P.S. 1952. *Limnology*. McGraw-Hill.

UNEP/IUCN 1989. Directory of Marine and Coastal Protected Areas in the Mediterranean region. Part 1. Sites of biological and ecological value. MAP Technical Reports No. 26, UNEP, Athens.

Vogt, T. & H. Vogt 1990. Utilisation de la télédétection pour la cartographie des comportements hydriques de surface. Symposium International de Cartographie Thématique Dérivée des Images Satellitaires, Saint Mandé 2-4 oct. 1990. *Comité Français de Cartographie. Bull.* No 127-128: 146-153, Instaprint, Tours.

Yésou, P. 1983. Anatidés et zones humides de France métropolitaine. Bull. mens. O.N.C., numéro scientifique et technique, décembre.

Zalidis, G. & A. Mantzavelas (editors) 1995. Inventory of Greek wetlands as natural resources (first approximation). EKBY, Thessaloniki.

Zalidis, G.C., A.L. Mantzavelas & E.N. Fitoka 1996. *Mediterranean Wetland Inventory. Photointerpretation and Cartography Conventions*. MedWet/EKBY/Instituto da Conservação da Natureza /Wetlands International. *Publication volume IV*.

12 Appendices

Addresses of the secretariats of relevant conventions and programmes

Some major wetlands are designated under regional, national or international legislation and agreements. For those sites, information is usually greater, as it served as a basis for the designation of the site. Many international designations, under several programmes, can be considered as source of information for the inventory (see Chapter 3), like the Ramsar Convention, the World Heritage Convention, the Barcelona Convention, the UNESCO Man and Biosphere Reserves, the Council of Europe Network of Biogenetic Reserves, the European Union Special Protection Areas under the Birds Directive, and soon sites under Habitat Directive, which will contribute to constitute the Natura 2000 network. In this Appendix addresses of the secretariats of these are listed.

Ramsar Convention Bureau
Rue de Mauverney, 28
CH-1196 Gland
SUISSE
telephone: +41.22.9990170
fax: +41.22.9990169
e-mail: ramsar@hq.iucn.ch
N.B. the Ramsar database is managed on behalf of the Convention by Wetlans International

European Union
for
Special Protection Areas under the Birds Directive
Habitats Directive
Natura 2000 Network
EUROPEAN COMMISSION
Directorate - General XI
Environment, Nuclear Safety and Civil Protection
Nature Protection, coastal zones and tourism
Rue de la Loi 200, B - 1049 Brussel - Office: TRMF 02/03
BELGIUM
telephone: +32.2.2968711 (direct line) and +32.2.2961111 (exchange)
fax: +32.2.2969556

Barcelona Convention
UNEP/Coordinating Unit for the Mediterranean Action Plan (MAP)
P.O. Box 18019
48 Vassileos Konstandinou Avenue
11610 Athens
GREECE
telephone: +30.1.7253190-5
fax: +30.1.7253196-7

Council of Europe Network of Biogenetic Reserves
COUNCIL OF EUROPE
Environment Conservation and Management Division
F-67075 Strasbourg Cedex
FRANCE
telephone: +33.88412000
fax: +33.88412751

Flora representative of Greek wetlands

(Taken from Mantzavelas *et al.* 1995)

The knowledge of plant species is often crucial for wetland identification (see Chapter 5). One of the main steps is to record the dominant species ocurring in vegetation units within the area examined. Based on the information collected by field observations, the vegetation units whose flora composition indicates the presence of wetlands conditions on the substrate are allocated.

SPECIES FOR EACH VEGETATION UNIT	MOISTURE INDICES	SALINITY INDICES
AQUATIC BED		
Azolla filiculoides	11	-
Callitriche obtusangula	11	-
Ceratophyllum demersum	12	-
Ceratophylum submersum	12	-
Groelandia densa	12	-
Hydrocharis morsus-ranae	11	-
Lemna giba	11	-
Lemna minor	11	-
Lemna trisulca	12	-
Myriophyllum spicatum	12	-
Myriophyllum erticillatum	12	-
Najas graccilima	12	-
Najas marina	12	-
Najas minor	12	-
Nymphaea alba	11	-
Nuphar lutea	11	-
Nymphoides peltata	11	-
Polygonum amphibium	11	-
Posidonia oceanica	12	-
Potamogeton crispus	12	-
Potamogeton filiformis	12	-
Potamogeton gramineus	12	-
Potamogeton lucens	12	-
Potamogeton natans	12	-
Potamogeton nodosus	12	-
Potamogeton pectinatus	12	-
Potamogeton perfoliatus	12	-
Potamogeton pussilus	12	-
Potamogeton trichoides	12	-

Ranunculus aquatilis	*11*	-
Ranunculus fluitans	*11*	-
Ranunculus trichophyllus	*11*	-
Riccia fluitans	*11*	-
Ricciocarpos natans	*11*	-
Ruppia maritima	*12*	-
Sal inia natans	*11*	-
Spirodella polyrhiza	*11*	-
Trapa natans	*11*	-
Urticularia minor	*10*	-
Vallisneria spiralis	*11*	-
Wolffia arrhiza	*11*	-
Zannichelia palustris	*12*	-
Zostera nolti (nana)	*12*	-

EMERGENT VEGETATION

Aeluropus litoralis	*X*	-
Agropyrum junceum	*7*	*II*
Agrostis alba	*5*	-
Alisma gramineum	*10*	-
Alisma plantago-aquatica	*10*	-
Apium gra eolens	*10*	-
Arthrocnemum fruticosum	*X*	*III*
Arthrocnemum glaucum	*X*	*III*
Arundo donax	*8*	-
Aster tripolium	*9*	*II*
Atriplex hastata	*6*	*I*
Atriplex rosea	*5*	*I*
Bassia hirsuta	*8*	*II*
Bupleurum tenuissium	*5*	*I*
Bupleurum tricopodum	*5*	*I*
Butomus umbellatus	*10*	-
Cacile maritima	*6=*	-
Calamagrostis epigeios	*X~*	-
Calystegia soldanella	*6*	-
Carex distans	*7~*	*II*
Carex di isa	*7*	*II*
Carex ulpina	*9~*	-
Centaurea diffusa	*5*	-
Cirisium creticum	*8*	-
Crypsis aculeata	*X*	*II*
Cuscuta australis	*5*	-
Cyperus fuscus	*9*	-

Cyperus longus	*10*	-
Cyperus rotundus	*9*	-
Eleocharis palustris	*10*	-
Elymus arenarius	*6*	-
Elymus giganteus	*6*	-
Epilobium hirsutum	*8=*	-
Equisetum ar ense	*6~*	-
Equisetum maximum	*8*	-
Euphorbia paralias	*5*	-
Geranium dissectum	*5*	-
Glyceria plicata	*10*	-
Halimione portulacoides	*7*	*III*
Halocnemum strobilaceum	*6*	*II*
Holcus lanatus	*6*	-
Holoschoenus ulgaris	*10*	-
Hordeum maritimum	*4*	-
Hypochoeris radicata	*5*	-
Juncus acutus	*8-*	-
Juncus articulatus	*8~*	-
Juncus bufonius	*7*	*I*
Juncus gerardii	*7*	*I*
Juncus heldreichianus	*7*	*I*
Juncus maritimus	*7*	*I*
Juncus subulatus	*8*	*I*
Limonium bellidiflorum	*6=*	*III*
Limonium gmelinii	*6=*	*III*
Limonium ulgare	*6=*	*III*
Lycopus europaeus	*9=*	-
Lythrum salicaria	*8*	-
Lythrum irgatum	*8*	-
Menta pulegium	*7=*	-
Montia erna	*9*	-
Narcissus tazetta	*X*	-
Nastirtium officinale	*11*	-
Oenanthe aquatica	*10*	-
Oenanthe fistulosa	*9*	-
Phragmites australis	*10~*	-
Picreus badius	*X*	-
Picreus longus	*X*	-
Plantago major	*7~*	-
Polygonum maritimum	*8~*	-
Polygonum monspeliensis	*8~*	-
Psylurus aristatus		*III*

Puccinelia distans	6~	III
Puccinelia festuciformis	8	III
Ranunculus muricatus	8=	-
Ranunculus sardous	8=	-
Ranunculus elutinus	8=	-
Rumex conglomeratus	7	-
Rumex crispus	6	-
Rumex hydrolapathum	10	-
Salicornia europaea	9=	III
Salicornia fruticosa	9=	III
Salicornia herbacea	9=	III
Salicornia radicans	9=	III
Scirpus lacustris	8	-
Scirpus litoralis	8	-
Scirpus maritimus	9	-
Scirpus tabernaemontani	8	-
Sparganium erectum	10	-
Spergularia marina	6=	III
Spergularia media	7~	II
Spergularia salina	6=	III
Statice angustifolia	6~	III
Statice sinuata	6=	III
Suaeda maritima	8=	III
Suaeda splendens	8=	III
Tragus racemosus	X	-
Trifolium fragiferum	7	-
Typha angustifolia	10	-
Typha domigensis	10	-
Typha latifolia	10	-
Veronica anagalis-aquatica	9=	-
Veronica anagalloides	9	-
Xanthium spinosum	5	-

SHRUBS

Aristolochia clematis	4~	-
Nerium oleander	4~	-
Periploca graeca	7=	-
Tamarix hampeana	X	I
Tamarix par iflora	X	II
Tamarix smyrnensis	X	II
Vitex agnus-castus	5	-

TREES

Alnus glutinosa	9=	-
Clematis italba	5	-
Fraxinus angustifolia	7=	-
Phoenix theophrastii	7=	I
Platanus orientalis	7=	-
Populus alba	5~	-
Populus nigra	8=	-
Salix alba	8=	-
Salix fragilis	8=	-
Salix triandra	8=	-
Ulmus minor	X~	-
Ulmus lae is (efusa)	8=	-

Moisture index varies between 1 and 12 and includes the following categories:

X	Unknown diagnostic value
1	Index of very dry soil. Plants capable of surviving in dry sites and restricted only to dry soils
2	Between 1 and 3
3	Index of dry soils. Plants more commonly present in dry than in moist soils, usually absent from saturated soils
4	Between 3 and 5
5	Index of moist soil. Plants mainly present in moist soils, but absent from saturated or frequently dry soils.
6	Between 5 and 7
7	Index of saturated soil. Plants mainly present in saturated but not in oversaturated soils
8	Between 7 and 9
9	Index of oversaturated soil. Plants mainly present in frequently oversaturated soil which are poorly ventilated
10	Index of alternating humid conditions, hydrophytes which can tolerate long periods without being covered by water
11	Hydrophytes which are rooted in soil under the water or floating plants which are floating on the surface of the water
12	Hydrophytes living under the water surface which are always or almost always submerged
~	Index of alternating humid conditions (e.g. 3~ is the index of alternating dry soil conditions)
=	Index of flooding conditions. Plants present in soils which are more or less regularly flooded

Salinity index reflects the tolerance of plant species to water salinity, and includes the following categories:

-	Plants avoiding saline soils
I	Plants tolerant to salt but more commonly present in non-saline than in saline soils
II	Plants which are usually indicative of saline soils but also present in less saline soils (facultative halophytes)
III	Plants always present in saline soils (obligatory halophytes)

APPENDIX 3 **Simplified Data sheet**

MedWet

WETLAND SITE

Country:

Compiler's name:

Address:

1. IDENTIFICATION

Site code | | | | | | | | | | |

Usual name of the wetland:

2. LOCATION

Geographical coordinates ° ′ ″ N ° ′ ″ **UTM** | | | | | | | |

(10X10 km)

Administrative division code:

Location remarks (nearest town, major river, etc.):

(add separate sheets if necessary)

Catchment area code (or sub-catchment) | | | | |
C C S S

Name of the catchment/sub-catchment area:

Part of a complex? (Y/N) | |

If yes, name of the complex:

3. DESCRIPTION

Wetland area (ha):

General site description:

(add separate sheets if necessary)

CORINE Biotopes habitats		Other CORINE Biotopes habitats		**Habitat Directive Annex I** habitat types		**Ramsar** wetland types	
code	**cover(%)**	**code**	**code**	**code**	**cover(%)**	**code**	**cover(%)**

Special remarks (*unique or extraordinary information about the site, e. g. flag particular habitats and species about the site):*

4. VALUES

Ramsar criteria

code	*Remarks*

Wetland values

code	*Criteria scale* [1]				*Remarks*
	I	N	R	L	

5. STATUS

Conservation information

code	Designation	Legislation	cover (%)

Site tenure

(Pri ate, public/communal, local authority, municipality, etc.)

(add separate sheets if necessary)

Management

(Name of the management authorities, management acti ities,etc.)

(add separate sheets if necessary)

Additional information

(Proposed status, constraints on de elopment, research/educational facilities)

(add separate sheets if necessary)

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