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

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MedWet

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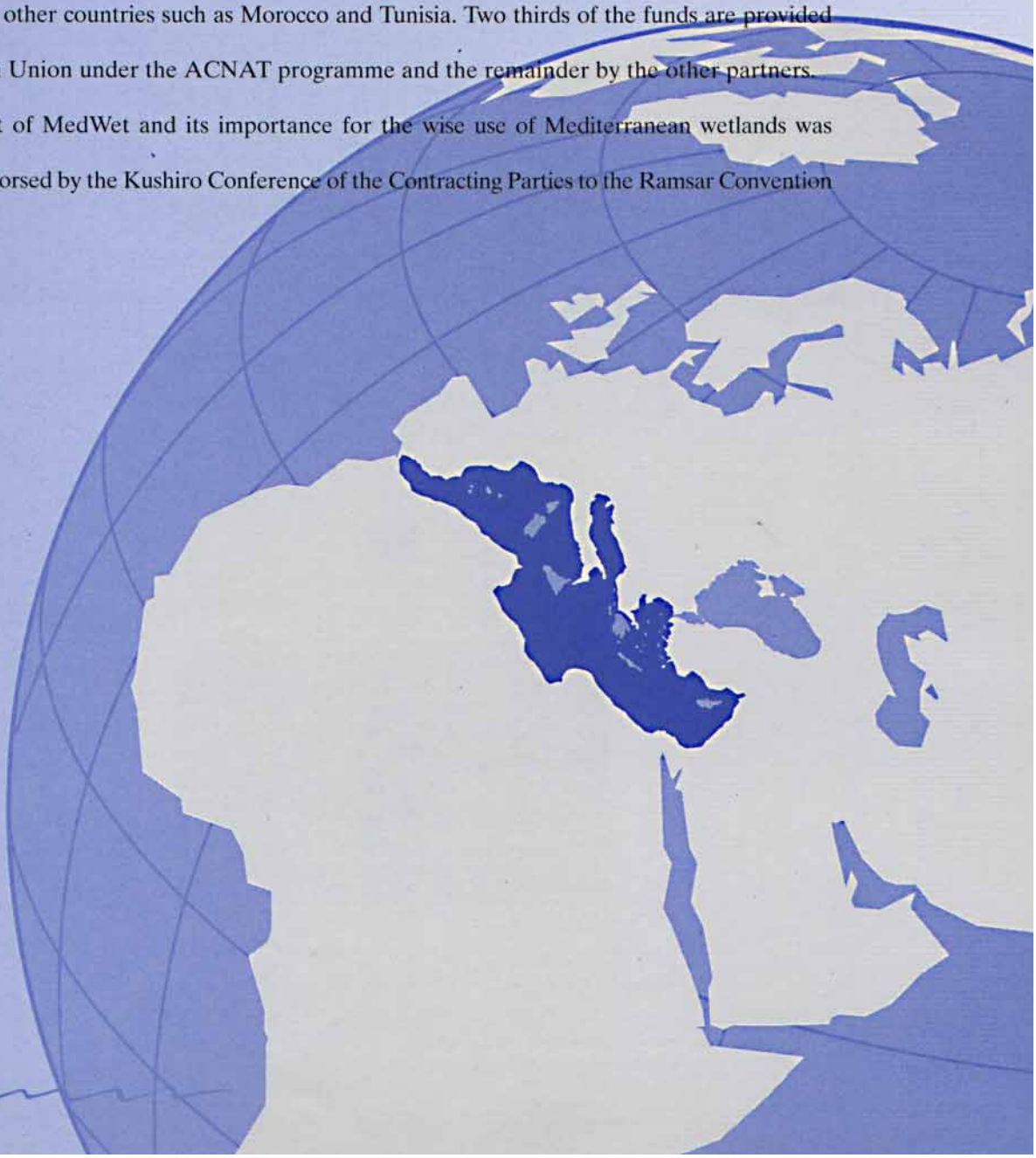
The Medwet Action

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
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Michael Moser
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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.

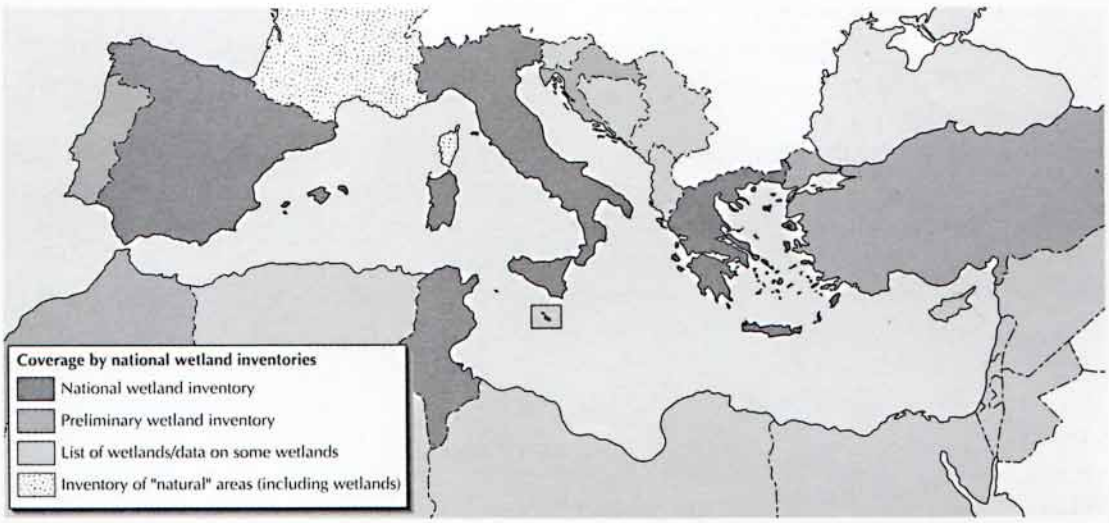
A presentation of the main inventories has recently been published (Hecker & Tomàs Vives 1995) and gives an update on their status throughout the region and an analysis of the various existing methodologies. The first section of the present chapter is extracted from this report and gives an overview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

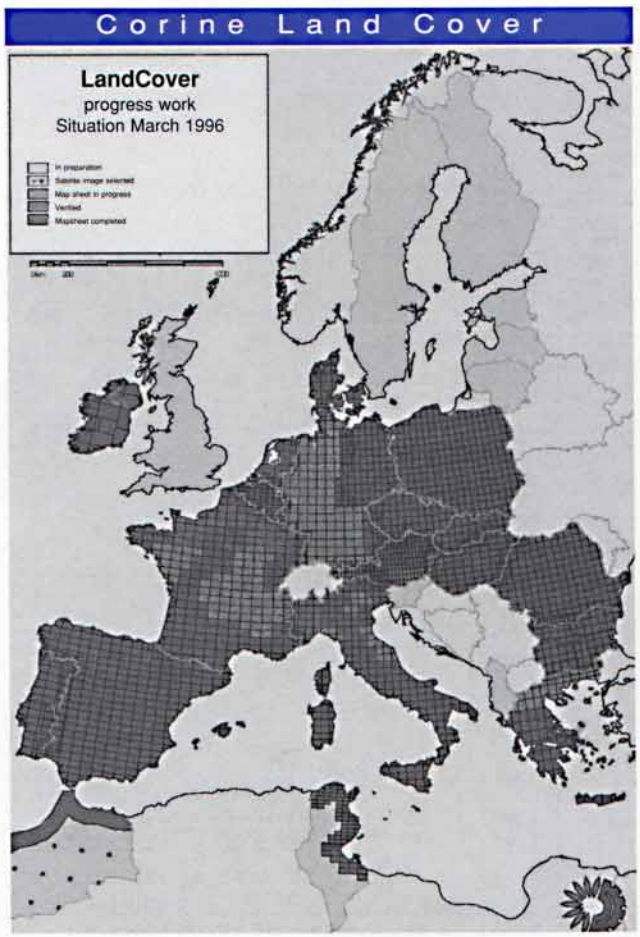
The LandCover database compilation

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

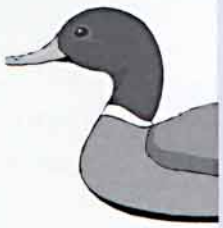
a wetland should be considered internationally important if:

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.



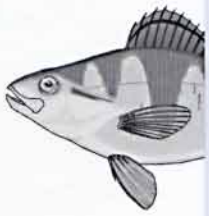
3. Specific criteria based on waterfowl

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.

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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 .

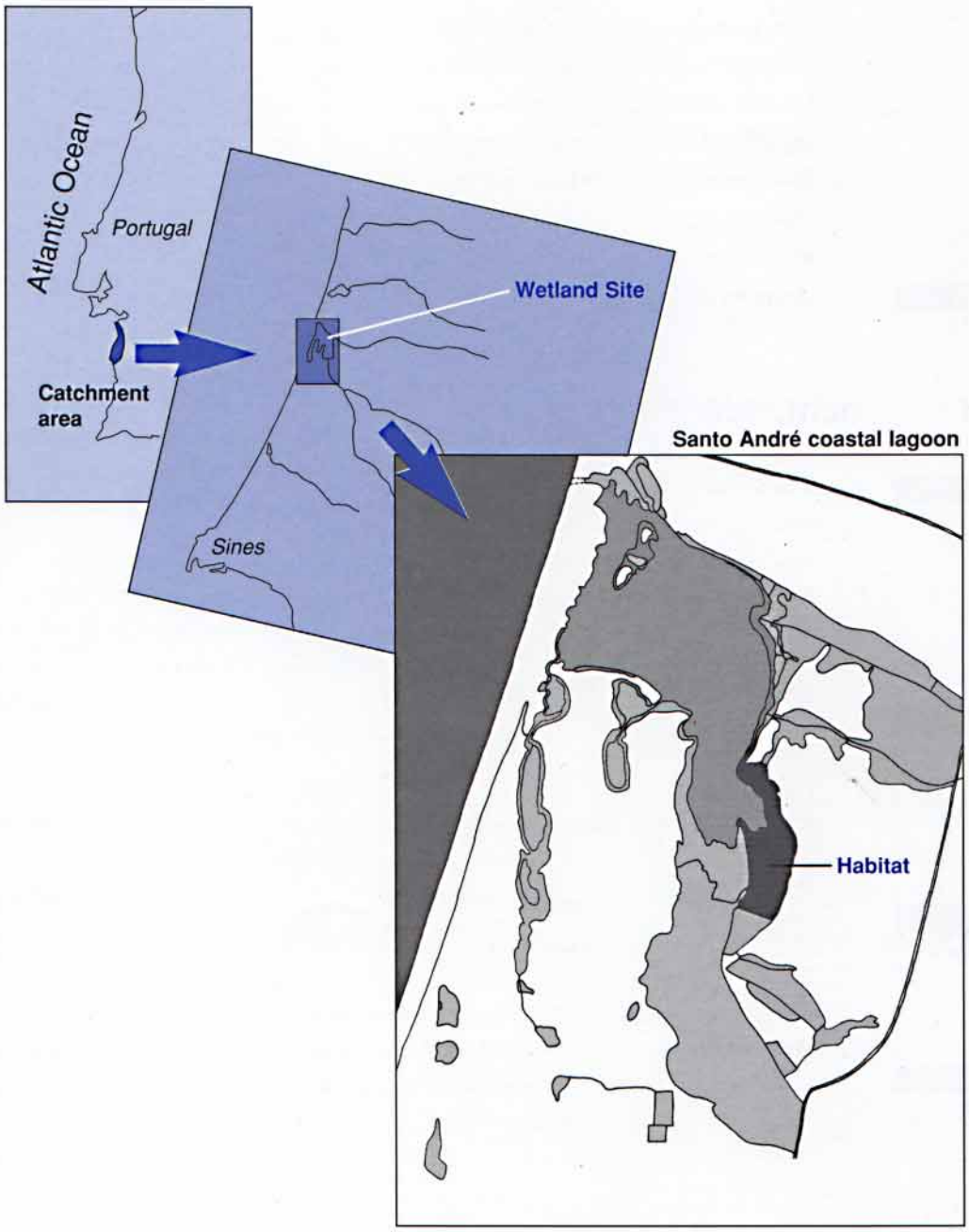
see Chapter 4

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

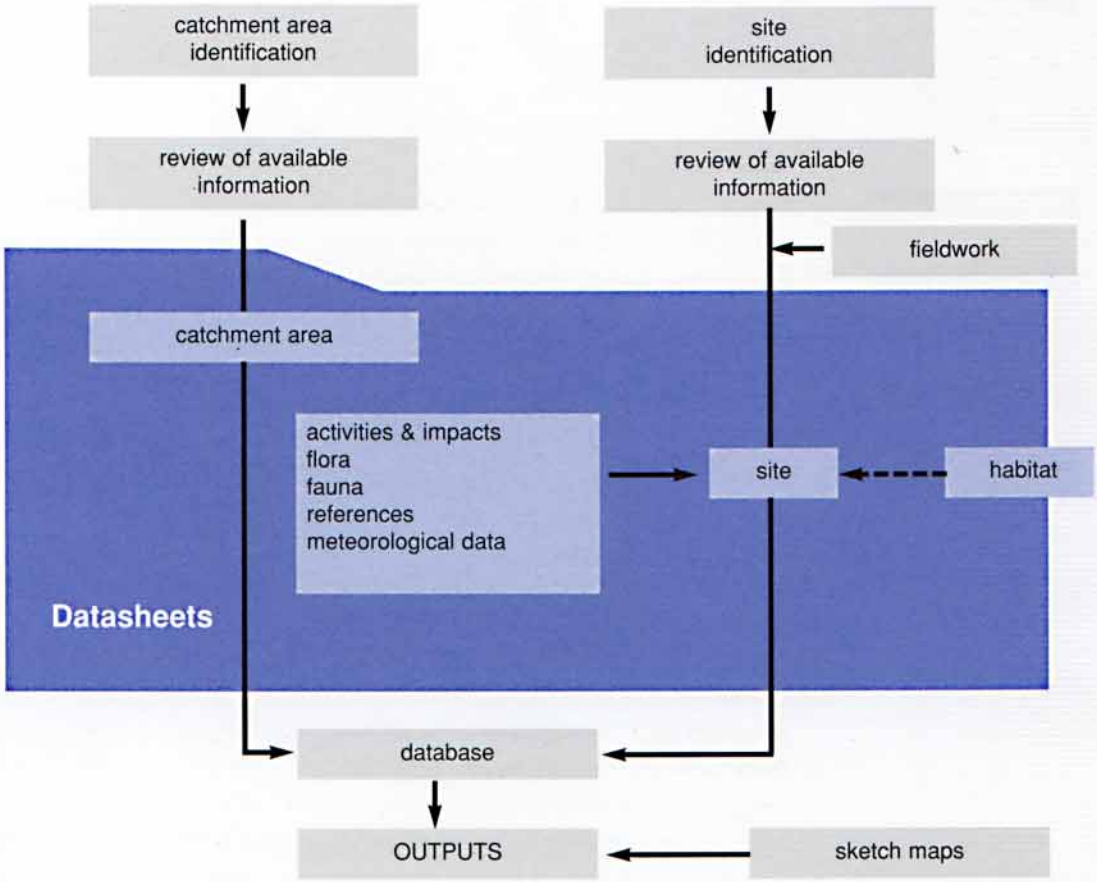
Only the datasheets concerning catchment area and wetland site information need to be used for a simple inventory. Habitat datasheets can also be completed as well, if desired. The complementary datasheets for fauna, flora, human activities, meteorological data and references can also be completed and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

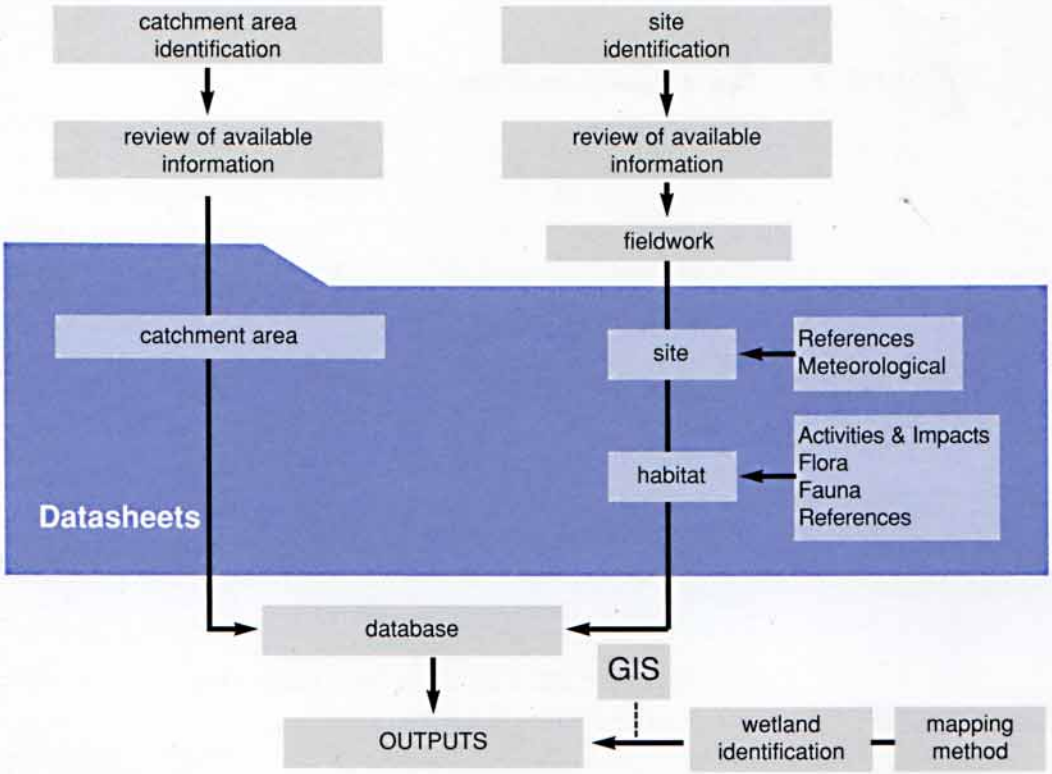
- Photointerpretation and Cartographic Conventions to provide standard interpretation effort and outputs.

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.

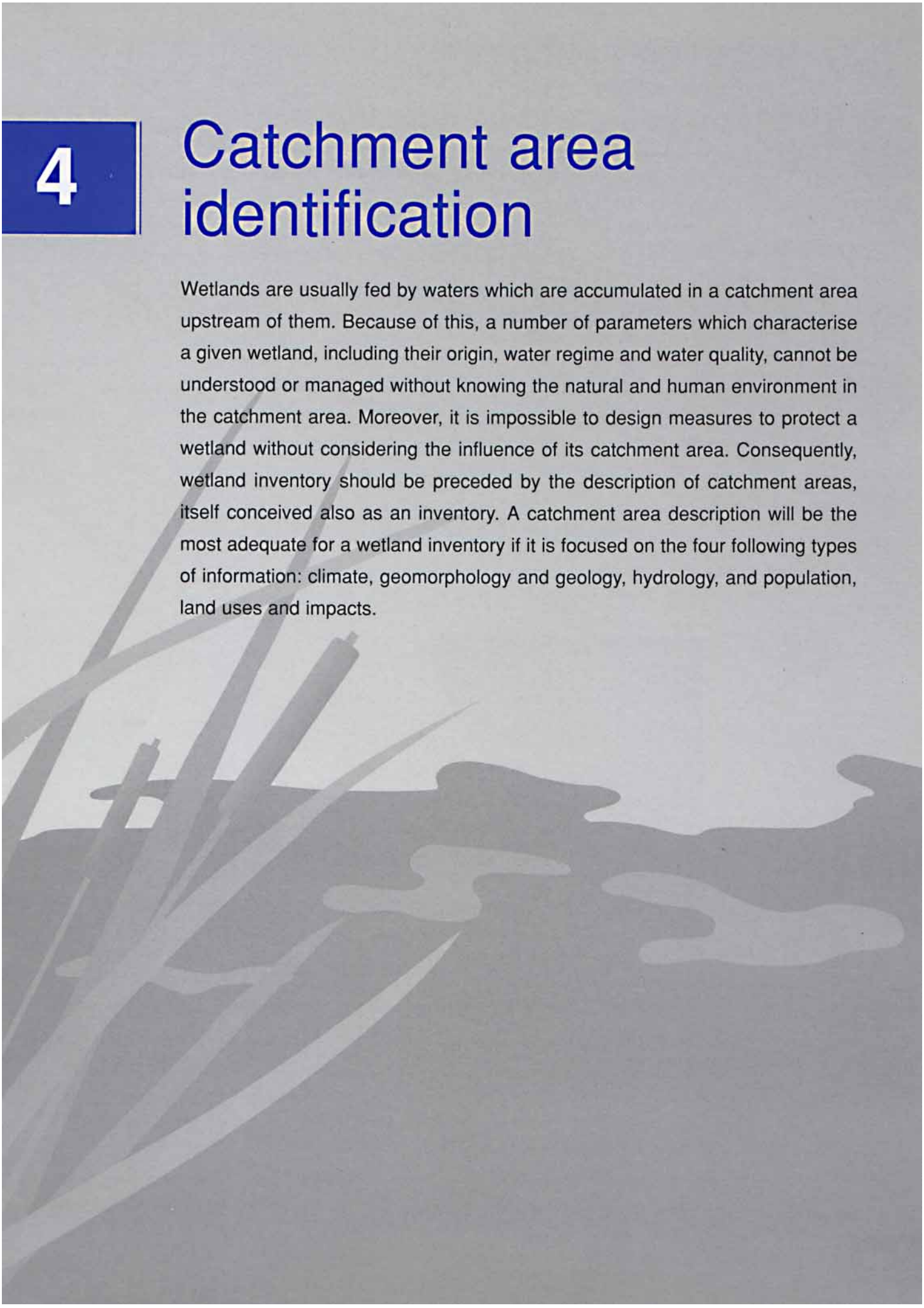
All the information collected with the datasheets is entered in the MedWet Database. Ideally, the maps should be linked to the information stored in the database and datasheets, through a Geographic Information System (GIS).

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.

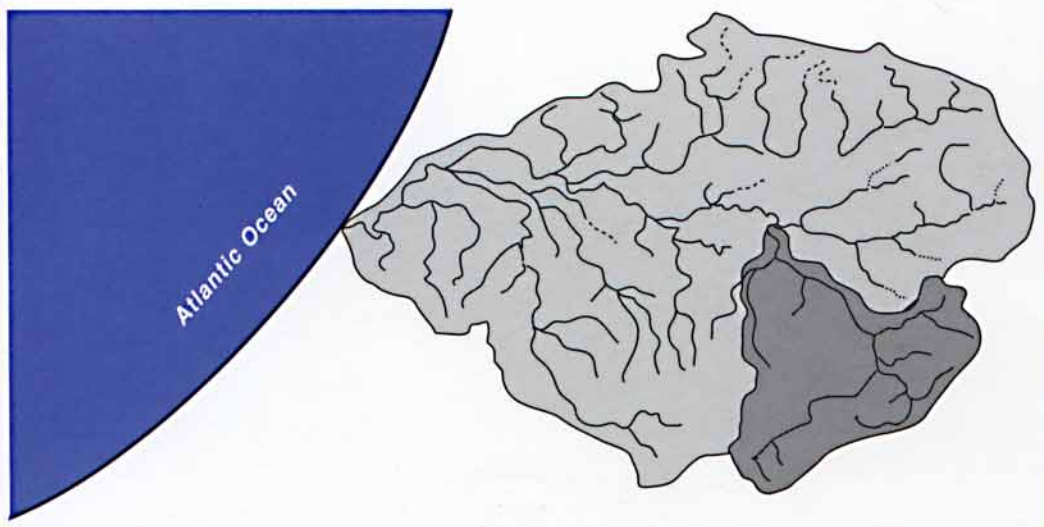
Consequently, wetland inventory should includes the description of catchment areas.

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



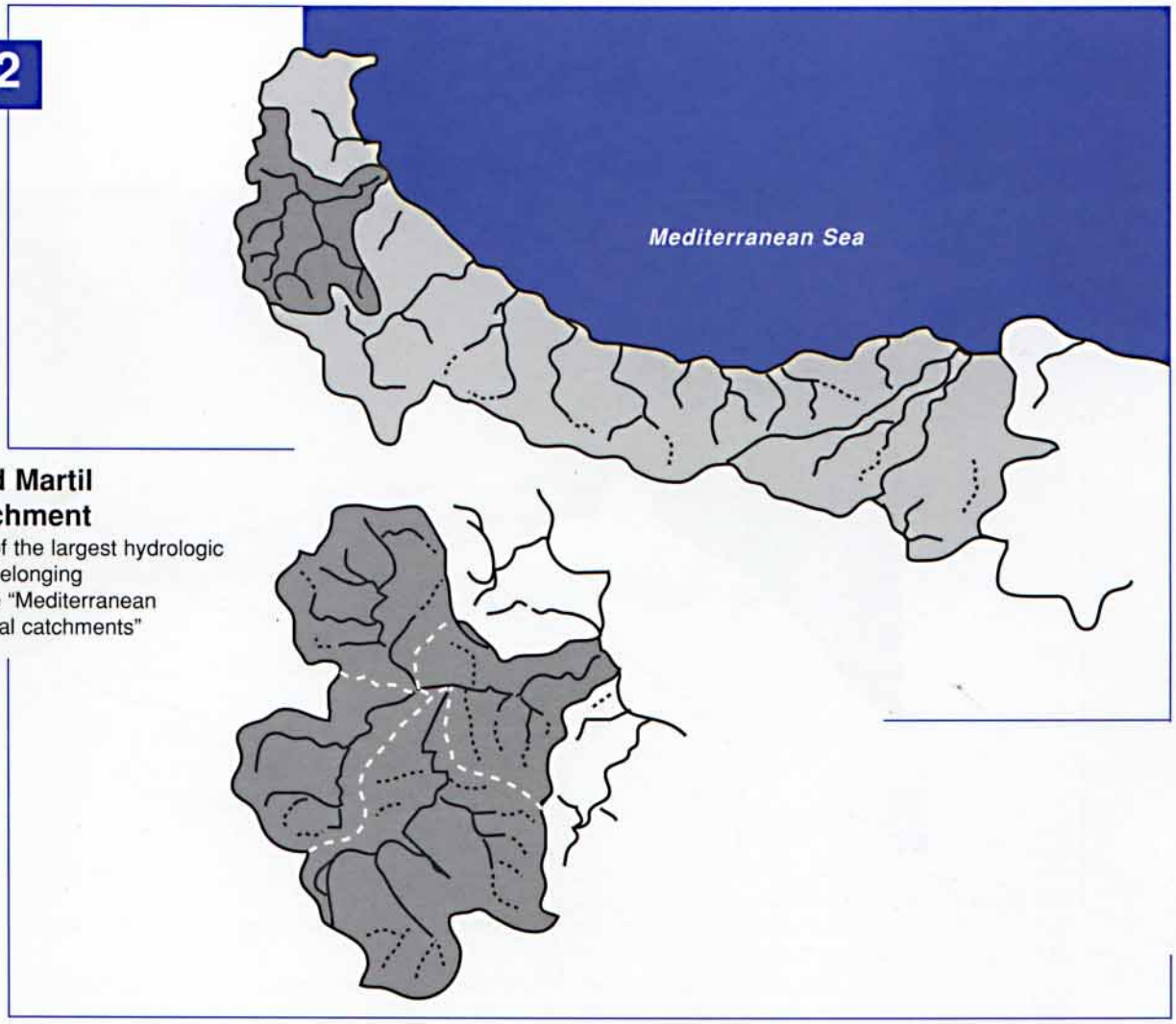
- *An entire river system discharching directly in the sea is the most adequate unit in a national hydrological subdivision*
- *the Sebou catchment may be subdivided into 5 or 6 sub-catchments (or more) corresponding to its main tributaries:*

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)

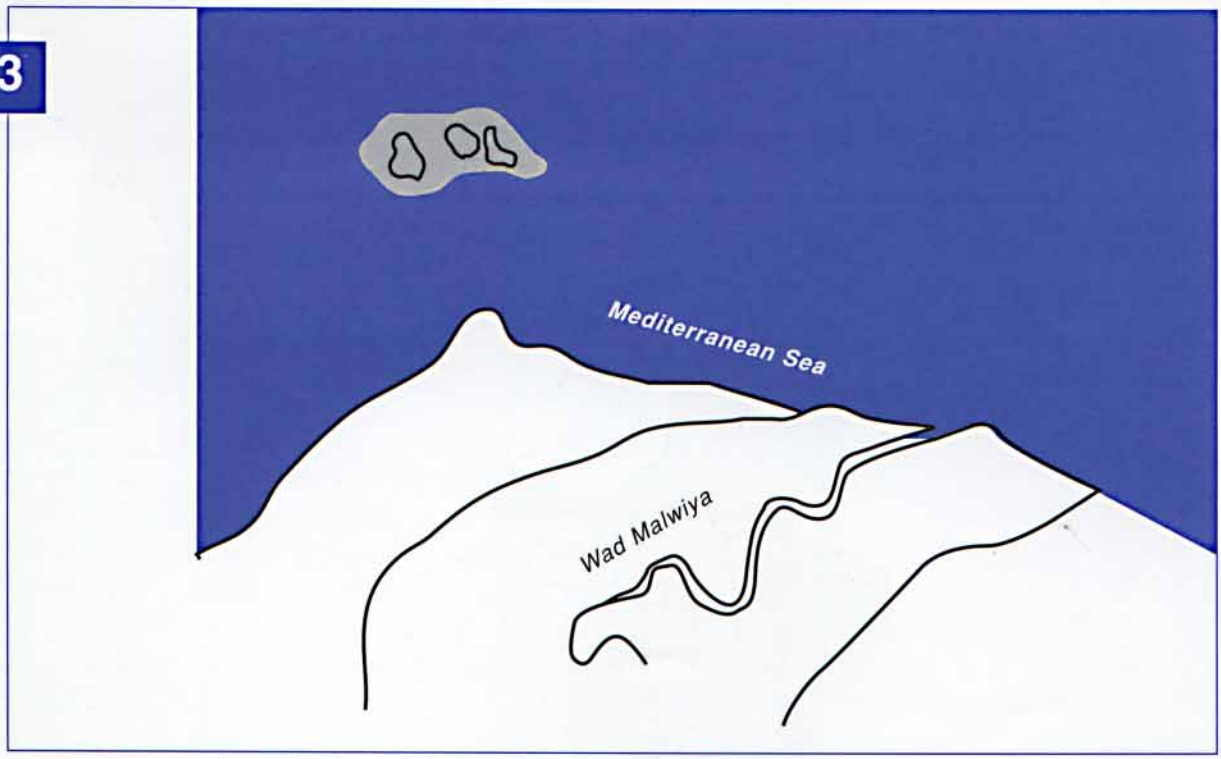


- *On the Northern watershed of the Rif Mountains severall small rivers discharge directly into the same Mediterranean sea sector. In the hydrological subdivision scheme of Morocco, they have been grouped into a "hydrological region" which is considered as a first level national subdivision, equivalent 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.

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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.

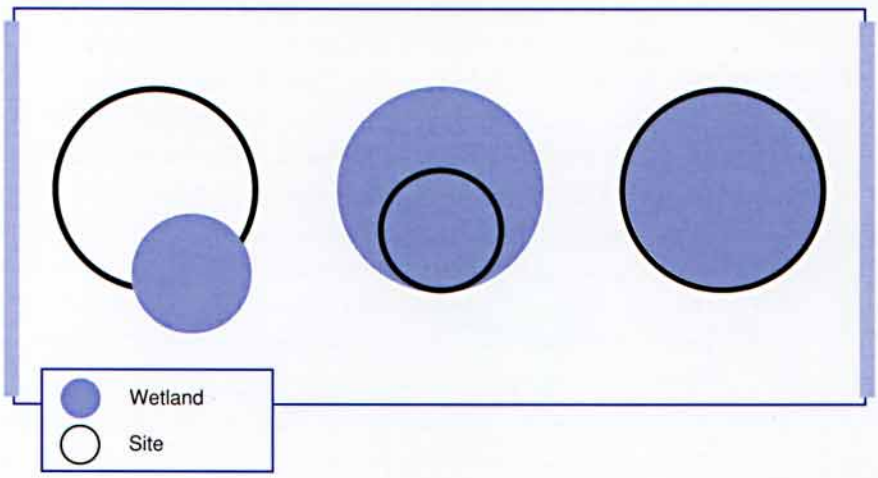
see **Chapter 3**

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