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

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

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

see
Chapter 2

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

**However, field work will be needed in order to:**

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

## Wetland identification

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

**These attributes are:**

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

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

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

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

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

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

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

## Hydrology

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

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

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

**What needs to be defined before using the hydrology criteria ?**

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

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

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

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

## Vegetation

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

- *A list of flora species* indicative of wetlands should be established for each country or region to be covered by the inventory. This list will include hydrophytes which are "species that have demonstrated an ability (because of morphological and/or physiological adaptation and/or reproductive strategies) to achieve maturity and reproduce in an environment where all or portions of the soils within the root zone become, periodically or continuously, saturated or inundated during the growing season" (Reed 1988). Amongst this list will be selected the indicator species which are restricted to wetlands. These indicator species can vary from one region to another because of ecotypic variation within species (National Research Council 1995).

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

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

### *What needs to be defined before using the vegetation criterion ?*

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

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

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

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

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

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

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

**b)** recording of dominant plant species for each vegetation unit

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

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

## Soil

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

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

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

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

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

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

*Organic soils:*

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

*Mineral soils:*

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

# 6 Wetland habitats

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

# 6.Wetland habitats

## The importance of considering wetland habitats

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

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

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

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

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

## Systems for habitat description

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

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

see
VOLUME III
Mediterranean Wetland Inventory.
Habitat Description System

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

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

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

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

see
Chapter 2

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

see
Chapter 2

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

see
VOLUME III
Mediterranean Wetland Inventory.
Habitat Description System

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

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

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

# 7 Data recording

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

# 7. Data recording

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

- **Compatibility:**

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

- **Uniformity:**

  see VOLUME V Mediterranean Wetland Inventory: Database Manual

  see Chapter 8

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

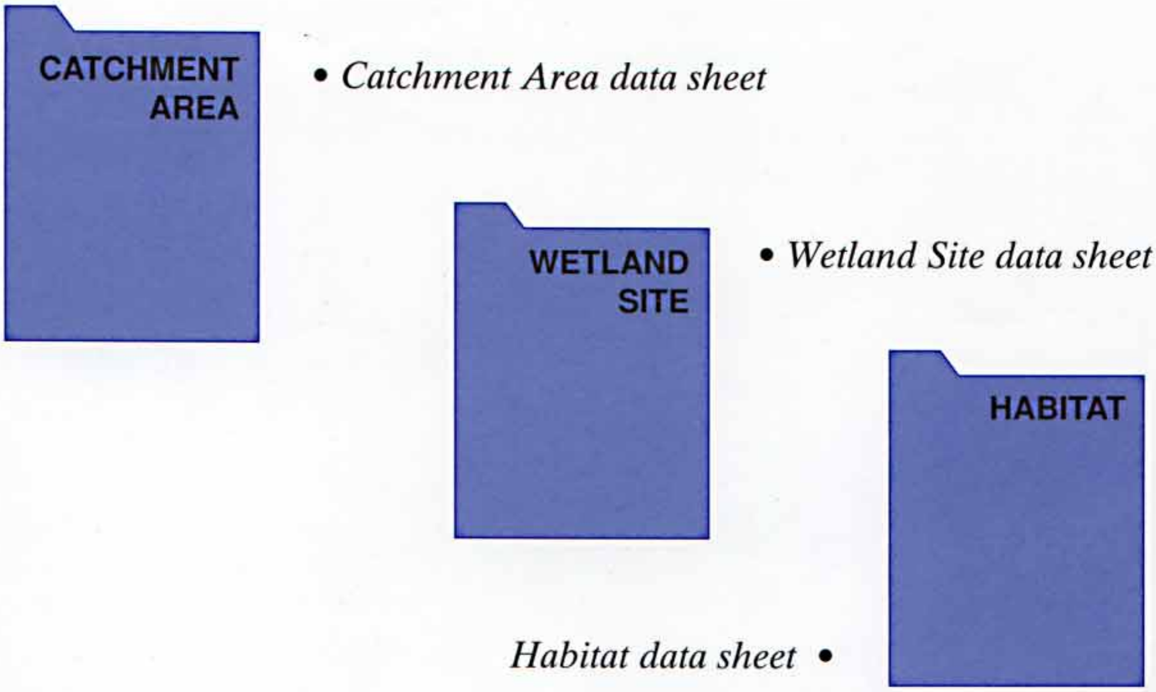
- **Flexibility:**

  see Chapter 3

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

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

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




see Chapter 3

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

see Chapter 8

see Volume V Mediterranean Wetland Inventory: Database Manual

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

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

see Chapter 3

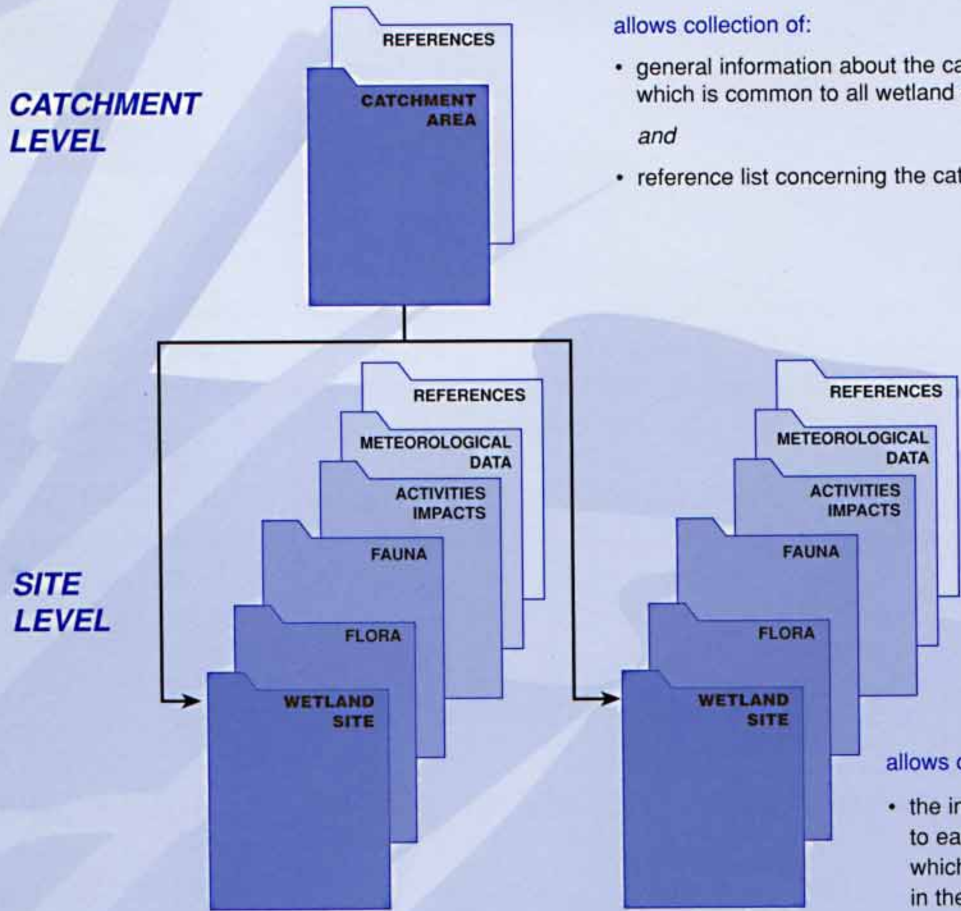
According to the resources and the time and information available, the inventory can be carried out at different levels: research of existing information, the simple inventory or the detailed inventory. This set of data sheets should be used as a flexible tool which can be adapted to any special needs.

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

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

## EXAMPLE OF A SIMPLE WETLAND INVENTORY

*In this example, the catchment area contains two wetland sites*




allows collection of:

- general information about the catchment area which is common to all wetland sites;

*and*

- reference list concerning the catchment area.

allows collection of:

- the information specific to each of the two sites which are situated in the catchment area;

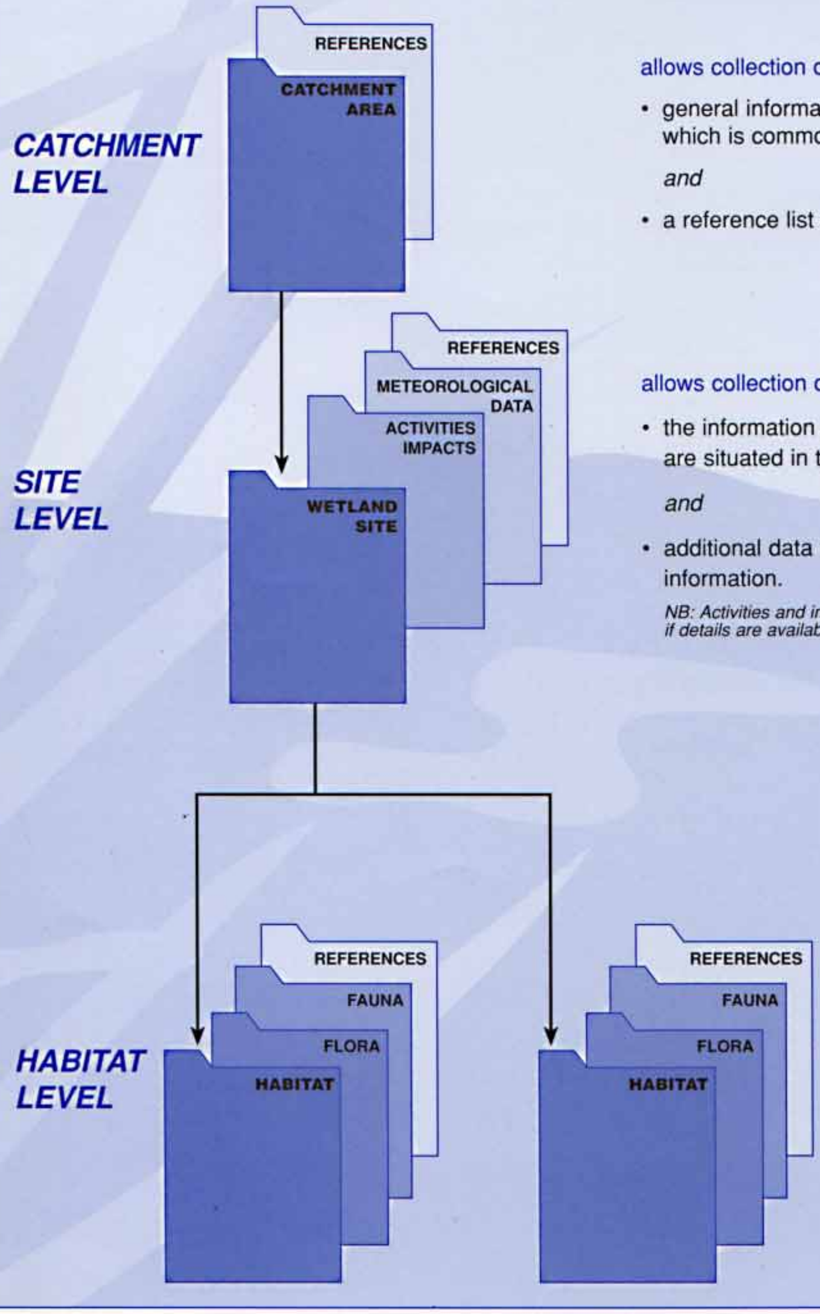
*and*

- additional information referring to each wetland site.

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

## EXAMPLE OF A DETAILED WETLAND INVENTORY

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




allows collection of:

- general information about the catchment area which is common to all wetland sites;

*and*

- a reference list concerning the catchment area.

allows collection of:

- the information specific to the wetland sites which are situated in the catchment area;

*and*

- additional data to complement the wetland site information.

*NB: Activities and impacts data can refer to the habitats if details are available*

allows collection of:

- the information specific to each of the two habitats situated in the wetland site;

*and*

additional data to complement the habitat information.

*NB: Flora and Fauna data can refer to the site if details are not available for the habitat.*

## Which data can be collected with these data sheets?

CATCHMENT AREA

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

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

The Catchement Area data sheet includes:

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

WETLAND SITE

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

The Site Data Sheet includes:

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

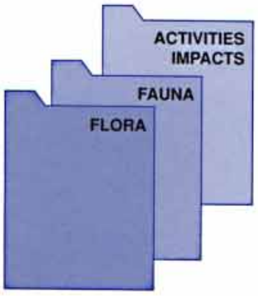
HABITAT

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

The Habitat data sheet includes:

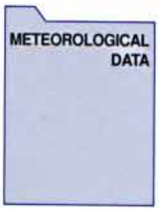
- Coding of the Habitat;
- Water permanency and Salinity if Ramsar or CORINE biotopes classifications are used;
- Area;
- Maximum depth;
- Condition of the habitat concerning human-induced changes;
- Artificiality of the water regime;
- pH range of the water;
- Description of the habitat.

## Additional data



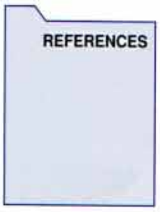

***Activities and impacts*** are listed with their trend and importance at various levels. ***Flora*** species are listed with the cover and height of each one. ***Fauna*** species are recorded with their abundance and their status (breeding, wintering, etc.).

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




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

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




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

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

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

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

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

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

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

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

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

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

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

# 8 Data storage: the Medwet database

# 8. Data storage: the MedWet database

## Why a MedWet Database?

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

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

## Background

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

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

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

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

## Specification and computer requirements

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

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

see
Chapter 9

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

### *Computer specifications*

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

80486 (the minimum is 80386)

DOS 6.0 (the minimum is DOS 4.0)[1]
2 Mb of RAM memory
approx. 12 Mb of space in the hard disk2
Colour VGA screen is recommended (not necessary)
Mouse (not necessary)
Printer (dot matrix, deskjet, inkjet, laser...)

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

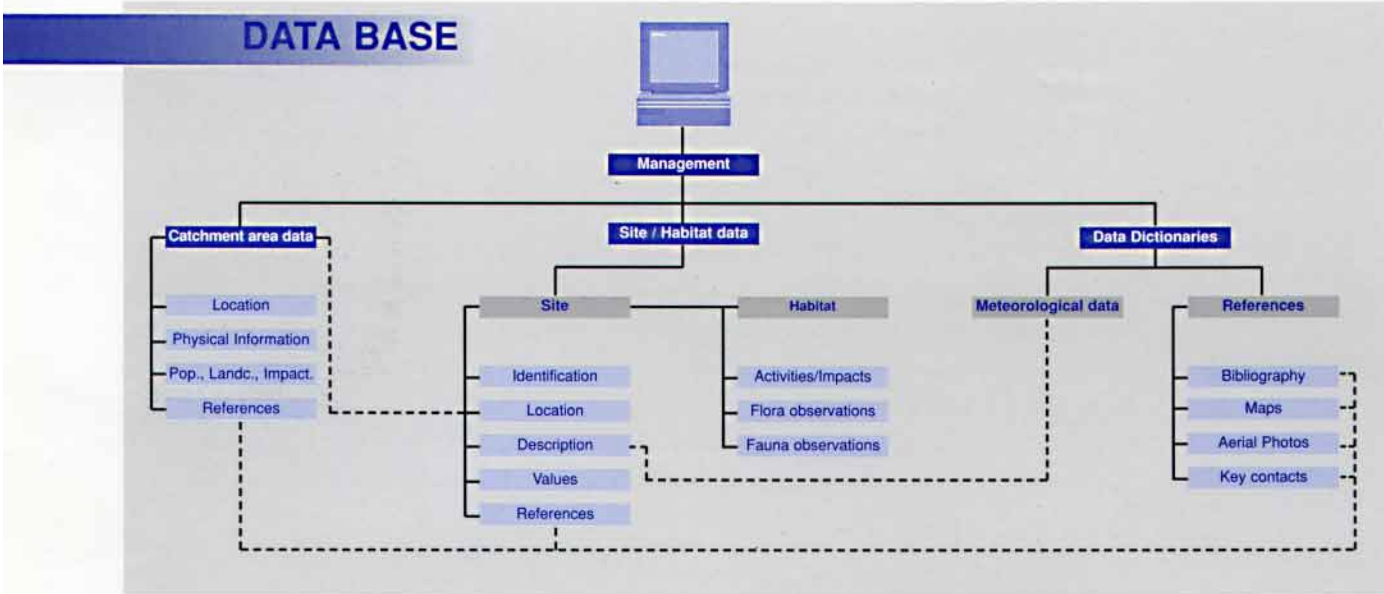
## The main MedWet Database program

### Input of Data

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

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

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




## Dictionaries

### What are data dictionaries?

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

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

### Species dictionaries

There are Species Dictionaries for all the following taxa:

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

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

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

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

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

### Habitat dictionaries

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

## Outputs

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

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

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

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

# 9 Mapping wetlands

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

# 9. Mapping wetlands

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

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

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

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Mediterranean Wetland Inventory. Photointerpretation and Carthographic Conventions

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

see
Chapter 5

## The mapping method and its different phases

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

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

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

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

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

**Phase 2** Fieldwork

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

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

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

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

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

### Sources of information

*Aerial photographs*

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

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

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

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

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

*Collateral data*

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

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

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

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

*Preliminary Photointerpretation*

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

In this step all the photographs are thoroughly examined and only a sample part of the entire area is photointerpreted. Actually it is not practical to do a significant amount of photointerpretation before the fieldwork. The area to be interpreted represent the entire range of wetland habitat types and covers about the 10% of the project area. By this preliminary photointerpretation, habitat identification and descriptions are made and relevant problems appear.

Specifically, the preliminary photointerpretation includes:

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

## Phase Two Fieldwork

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

### Pre-fieldwork preparation

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

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

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

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

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

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

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

## Fieldwork

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

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

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

The objectives of the fieldwork are:

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

Simple Stereocopes
Photo of Wild Heerbrugg Inc.

Zoom Stereoscope
Photo of M. karteris

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

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

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

## Phase Three
## Photointerpretation and production of the final map

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

### Final Photointerpretation

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

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

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

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

Zoom Transfer Stereoscope
Photo of Belfetop Eurosense

Digitizer
Photo of ALTEK Corp.

## Transferring the interpreted information to a base map

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

## Quality control

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

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

## Cartographic presentation of the map

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

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

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

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

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

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

## Phase Four
## Digital wetland habitat description map production using GIS

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

### Data input to the Geographical Information System

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

The information to be digitised comes from the final wetland habitat map. In order to accurately and rapidly transform the analogue wetland habitat map into digital form the data are traced on clear separate transparencies. For the wetland habitats two transparencies are used, one for their spatial distribution and the other for their description codes. Base map elements are grouped and traced on different transparencies according to their intensity and complexity.

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

## Geographic database development

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

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

## Outputs

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

# 10 Use of the inventory

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

# 10. Use of the inventory

## Identification of priority wetlands

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

### Identification of threatened sites

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

### Identification of sites with high intrinsic values

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

#### Ecological importance

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

#### Functional importance

The inventory should provide information about the main natural functions of each wetland. These functions such as groundwater recharge and discharge, flood control, sediment and toxicant retention, nutrient retention and recycling, shoreline stabilisation, storm protection and food chain support are essential to maintain natural processes in the general environment and benefit the human communities (Dugan 1990, Skinner & Zalewski 1995). Their assessment provides strong arguments to select sites as priority wetlands.

### Importance for human communities

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

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

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

## Planning, Management and Monitoring

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

### Planning and Management

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

## Planning

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

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## Management

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

## Monitoring

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

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

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

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

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

## Dissemination of knowledge

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

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

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

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

## Use of the National Wetland Inventory in Tunisia:

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

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

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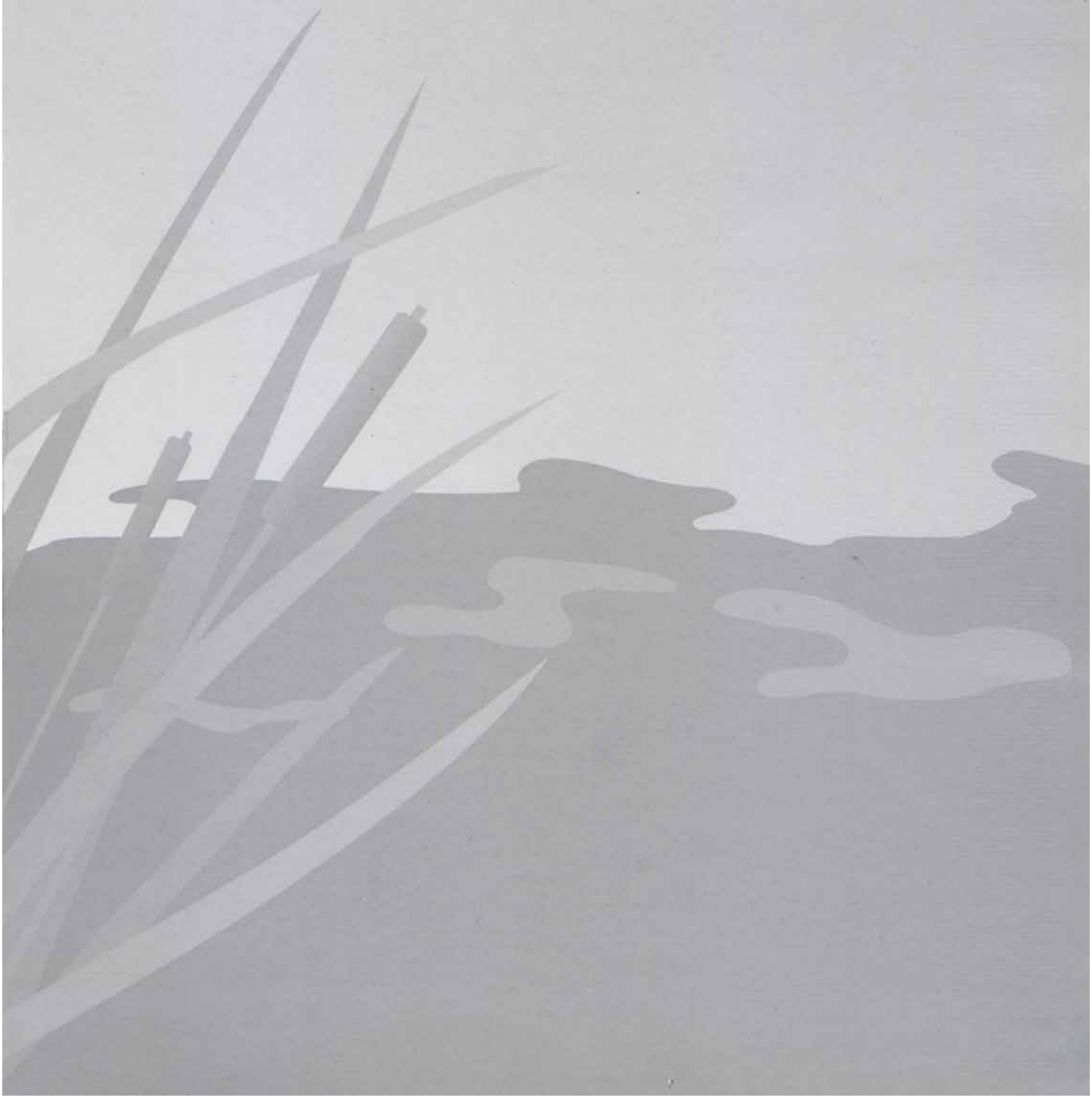

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# 12 Appendices

## Addresses of the secretariats of relevant conventions and programmes

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

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

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

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

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

## Flora representative of Greek wetlands

(Taken from Mantzavelas *et al.* 1995)

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

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

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

## EMERGENT VEGETATION

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

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

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

**SHRUBS**

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

## TREES

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

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

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

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

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

MedWet

# WETLAND SITE

**Country:**

**Compiler's name:**

**Address:**

## 1. IDENTIFICATION

**Site code**

**Usual name of the wetland:**

## 2. LOCATION

**Geographical coordinates** ° ' " N ° ' "

**UTM** (10X10 km)

**Administrative division code:**

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

*(add separate sheets if necessary)*

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

**Name** of the catchment/sub-catchment area:

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

If yes, name of the complex:

## 3. DESCRIPTION

Wetland area (ha):

**General site description:**

*(add separate sheets if necessary)*

**CORINE Biotopes habitats**

| code | cover(%) |
|---|---|
| | |
| | |
| | |
| | |

Other CORINE Biotopes habitats

| code | code |
|---|---|
| | |
| | |
| | |
| | |

**Habitat Directive Annex I** habitat types

| code | cover(%) |
|---|---|
| | |
| | |
| | |
| | |

**Ramsar** wetland types

| code | cover(%) |
|---|---|
| | |
| | |
| | |
| | |

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

## 4. VALUES

### Ramsar criteria

| code | | *Remarks* |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

### Wetland values

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

## 5. STATUS

### Conservation information

| code | | Designation | Legislation | cover (%) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

### Site tenure

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

*(add separate sheets if necessary)*

### Management

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

*(add separate sheets if necessary)*

### Additional information

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

*(add separate sheets if necessary)*

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