Ramsar
Handbooks
4th edition

Handbook 15

Wetland inventory

About the Convention on Wetlands

The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". As of October 2010, 160 nations have joined the Convention as Contracting Parties, and more than 1900 wetlands around the world, covering over 186 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance.

What are wetlands?

As defined by the Convention, wetlands include a wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as saltmarshes, mangroves, and seagrass beds, but also coral reefs and other marine areas no deeper than six metres at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs.

About this series of handbooks

This series has been prepared by the Secretariat of the Convention following the 7th, 8th 9th, and 10th meetings of the Conference of the Contracting Parties (COP7, COP8, COP9 and COP10) held, respectively, in San José, Costa Rica, in May 1999, Valencia, Spain, in November 2002, Kampala, Uganda, in November 2005, and Changwon, Republic of Korea, October-November 2008. The guidelines on various matters adopted by the Parties at those and earlier COPs have been prepared as a series of handbooks to assist those with an interest in, or directly involved with, implementation of the Convention at the international, regional, national, subnational or local levels. Each handbook brings together, subject by subject, the various relevant guidances adopted by Parties, supplemented by additional material from COP information papers, case studies and other relevant publications so as to illustrate key aspects of the guidelines. The handbooks are available in the three working languages of the Convention (English, French, and Spanish).

The table on the inside back cover lists the full scope of the subjects covered by this handbook series at present. Additional handbooks will be prepared to include any further guidance adopted by future meetings of the Conference of the Contracting Parties. The Ramsar Convention promotes an integrated package of actions to ensure the conservation and wise use of wetlands. In recognition of these integrated approaches, the reader will find that within each handbook there are numerous cross-references to others in the series.

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Ramsar handbooks for the wise use of wetlands
4th edition, 2010

Handbook 15

Wetland inventory

A Ramsar framework for wetland inventory and ecological character description

This 4th edition of the Ramsar Handbooks replaces the series published in 2007. It includes relevant guidance adopted by several meetings of the Conference of the Parties, in particular COP7 (1999), COP8 (2002), COP9 (2005), and COP10 (2008), as well as selected background documents presented at these COPs.

Acknowledgements

The *Framework for Wetland Inventory* which forms the basis for this Handbook was prepared by the Scientific and Technical Review Panel's Expert Working Group on Wetland Inventory, led by Max Finlayson (Australia). The "Recommended standard metadata record for the documentation of wetland inventories" provided in Appendix V of the Framework was developed for the Ramsar Convention by John Lowry and Max Finlayson, then of the Environmental Research Institute of the Supervising Scientist (eriss), Australia, with the financial support of the government of the United Kingdom, as support for the development of a second phase of the *Global Review of Wetland Resources and Priorities for Wetland Inventory (GRoWI 2).*

The framework and guidance on harmonized data and information for core inventory, wetland ecological character description, Ramsar Site designation, and Article 3.2 reporting was developed by Dave Pritchard, then of BirdLife International, during a period of secondment to the Ramsar Secretariat.

All Resolutions of the Ramsar COPs are available from the Convention's Web site at www.ramsar.org/resolutions. Background documents referred to in these handbooks are available at www.ramsar.org/cop7-docs, www.ramsar.org/cop8-docs, www.ramsar.org/cop9-docs, and www.ramsar.org/cop10-docs.

Table of Contents

Acknowledgements 2

Getting the most out of this Handbook 4

Foreword 5

A Framework for wetland inventory and ecological character description 7

Background and context 8

A Framework for wetland inventory 10

1. State the purpose and objective 11
2. Review existing knowledge and information 12
3. Review existing inventory methods 12
4. Determine the scale and resolution 13
5. Establish a core or minimum data set 13
6. Establish a habitat classification 15
7. Choose an appropriate method 15
8. Establish a data management system 16
9. Establish a time schedule and the level of resources that are required 17
10. Assess the feasibility & cost effectiveness 17
11. Establish a reporting procedure 17
12. Review and evaluate the inventory 18
13. Plan a pilot study 18

Implementation of the inventory 19

Describing the ecological character of individual wetlands 19

Appendix I: Inventory methods 29
Appendix II: Determining the most appropriate remotely sensed data for a wetland inventory 40
Appendix III: Summary of remotely sensed data sets applicable to wetland inventory 44
Appendix IV: Wetland classifications 51
Appendix V: Recommended standard metadata record for the documentation of wetland inventories 53
Appendix VI: Reading list 57

Additional Appendix

Ramsar COP7 DOC. 19.3: *Global Review of Wetland Resources and Priorities for Wetland Inventory - Summary Report* 59

Relevant Resolutions

Resolution VIII.6: *A Ramsar Framework for Wetland Inventory* 71
Resolution VI.12: *National Wetland Inventories and candidate sites for listing* 73
Resolution VII.20: *Priorities for wetland inventory* 74
Resolution X.15: *Describing the ecological character of wetlands, and data needs and formats for core inventory: harmonized scientific and technical guidance* 76

Getting the most out of this Handbook

The Handbooks in general

The purpose of the Ramsar Handbooks is to organize guidance material from relevant decisions adopted by the Contracting Parties over the years, according to subject themes. This helps practitioners to implement the internationally-agreed best practice in a way that is convenient to handle and more naturally matches their own everyday working environment.

The intended readership includes national and local staff of the government departments, ministries and agencies that act as Administrative Authorities for the Ramsar Convention in each country. Equally important users in many cases are managers of individual wetland areas, as some aspects of the guidance relate specifically to site management.

The Ramsar guidance has been adopted by member governments as a whole, and increasingly it addresses itself to the crucial roles of other sectors beyond the "environment" or "water" sectors. It is thus very important that these Handbooks should be used by **all** whose actions may benefit from or impact upon the wise use of wetlands.

A vital first step in each country therefore is to ensure adequate **dissemination** of these Handbooks to all who need or can benefit from them. Copies are freely available in PDF format from the Ramsar Secretariat in three languages on CD-ROM or by download from the Convention website (www.ramsar.org).

Other early steps would be, in each particular context, to **clarify** lines of responsibility and **actively check** how to align the terms used and approaches described with the reader's own jurisdiction, operating circumstances, and organizational structures.

Much of the text can be used in a **proactive sense**, as a basis for framing policies, plans and activities, sometimes by simply importing relevant sections into national and local materials. It can also be used in a **reactive sense** as a source of help and ideas for responding to problems and opportunities, navigating subjects by the need of the user.

Cross-references, original sources, and further reading are liberally cited: the Handbooks will often not be the "last word", but they provide a helpful "route-map" to further sources of information and support.

Strategic direction in the Ramsar Convention is provided by the Strategic Plan, the latest version of which was adopted by COP10 in 2008 for the period 2009-2015. All thematic implementation frameworks, including the Handbooks, sit within the context of the goals and strategies of this Plan and the priorities it highlights for the period covered.

In this fourth edition of the Handbooks, additions to and omissions from the text of the original guidelines, required by the results of COP8, COP9 and COP10, are shown in square brackets […].

The Handbook series is updated after each meeting of the Conference of the Parties, and feedback on user experience is always appreciated in helping to refine each new edition.

This Handbook (Wetland inventory)

Strategy 1.1 of the Strategic Plan on "Wetland inventory and assessment" includes Key Result Area 1.1.i (to be achieved by 2015) as follows: "All Parties to have completed national wetland inventories in line with the Ramsar Framework for Wetland Inventory and as far as possible to have disseminated comprehensive national wetland inventories, including information on wetland importance, potential Ramsar Sites, wetlands for restoration, location of under-represented wetland types, and the ecosystem services provided by wetlands".

Concerning description of ecological character, Strategy 2.4 on Ramsar Site ecological character includes Key Result Area 2.4.v (to be achieved by 2015): "Statements of ecological character finalized for all Ramsar Sites and used as a basis for implementing Article 3.2 of the Convention".

The text in this Handbook is based on Resolutions VIII.6 and X.15 and their Annexes. The substance of it thus reflects formal decisions adopted by the Conference of Contracting Parties. The Handbook also brings together additional information relevant to this issue. The views expressed in this additional information do not necessarily reflect the views of the Ramsar Secretariat or the Contracting Parties, and such materials have not been endorsed by the Conference of the Contracting Parties.

Foreword

The Ramsar Convention on Wetlands has always recognized the importance of national wetland inventories as a key tool for informing policies and other actions to achieve the conservation and wise use of wetlands. As early as the 1st meeting of the Conference of the Contracting Parties (COP1, Cagliari, 1980), Parties were convinced that national wetland policies should be based on a nationwide inventory of wetlands and of their resources (Recommendation 1.5). This recognition of the value of national wetland inventories has been regularly reiterated by subsequent COPs, including in the Annex to Recommendation 2.3 (COP2, Groningen, 1984), Recommendation 4.6 (COP4, Montreux, 1990), Resolution 5.3 (COP5, Kushiro, 1993), and Resolution VI.12 (COP6, Brisbane, 1996).

The Convention has also recognized that national wetland inventories, as well as being an essential basis for the formulation of national wetland policy, are equally important for *inter alia* identifying sites suitable for inclusion in the List of Wetlands of International Importance (the Ramsar List), for quantifying the global wetland resource as the basis for assessment of its status and trends, for identifying wetlands suitable for restoration, and for risk and vulnerability assessments.

In 1998, in response to Action 6.1.3 of the Convention's Strategic Plan 1997-2002, Wetlands International and the Environmental Research Institute of the Supervising Scientist, Australia, undertook for the Ramsar Convention a *Global Review of Wetland Resources and Priorities for Wetland Inventory (GRoWI)* project. This reviewed the extent and status of national wetland inventories. The findings of this analysis were presented to a Technical Session of COP7 in San José in 1999 and are summarised in a COP7 Background Paper (Ramsar COP7 DOC. 19.3) available at www.ramsar.org/cda/en/ramsar-documents-cops-cop7-ramsar-cop7-doc-19-3/main/ramsar/1-31-58-83%5E18751_4000_0__ and as an Additional Appendix to this Handbook. The project's recommendations were incorporated in Resolution VII.20 on Priorities for wetland inventory, and the full set of global and regional GRoWI reports are available for download in Word format from http://www.wetlands.org/RSIS/WKBASE/GRoWI/welcome.html.

To provide the further guidance to Contracting Parties on inventory methodologies called for in Resolution VII.20, the Convention's Scientific and Technical Review Panel (STRP) prepared *A Framework for Wetland Inventory* for COP8, which was adopted as the Annex to Resolution VIII.6

and forms the main part of this Handbook. The framework provides guidance for planning and designing an appropriate wetland inventory, recognizing that the actual inventory approach adopted will depend on its purpose and objectives, as well as the capacity and resourcing for undertaking the inventory. Appendices to the Framework provide further information on a number of standardised inventory methods which have been successfully applied in different parts of the world, additional guidance on determining appropriate use of remotely sensed data in inventory, information on a range of different wetland classifications which have been applied to wetland inventory, and a summary of a recommended standard metadata record for documenting wetland inventories.

Contracting Parties at COP8 requested the STRP, through Resolution VIII.6, to undertake further work in preparing guidance on certain aspects of wetland inventory, including on remote sensing data, low-cost geographical information systems, and classification systems in wetland inventory, and, through Resolution VIII.7, to undertake further work to address recognized gaps and disharmonies in guidance on ecological character, inventory, assessment, monitoring and management of Ramsar Sites and other wetlands. This latter Resolution also requested the STRP to consider consolidation of the Framework for Wetland Inventory into an Integrated Framework for Wetland Inventory, Assessment and Monitoring (IF-WIAM), which was duly approved by COP9 in 2005 (Resolution IX.1 Annex E) and is now available as Handbook 13 in this fourth edition of the Handbook series.

Contracting Parties at COP9 then requested the STRP to prepare guidance for the description of the "ecological character" of wetlands, which is a key concept under the Convention and a basis for some of its requirements. Since the elements of ecological character description are closely related to elements addressed by wetland inventory, the guidance duly adopted in the Annex to Resolution X.15 took the opportunity to harmonize the two, resulting in some rationalisation of the core fields for wetland inventory adopted in Resolution VIII.6. Key parts of the Resolution X.15 guidance, which also addresses the relationship between core inventory, ecological character description and data fields in the Information Sheet for Ramsar Sites, have now been integrated into the present Handbook.

A Framework for wetland inventory and ecological character description

(based on the Annexes to Resolutions VIII.6 and X.15 of the 8th and 10th meetings of the Conference of the Contracting Parties, Spain, 2002 and Republic of Korea, 2008)

Relevant implementation commitments made by Contracting Parties in COP Resolutions

Resolution VI.12: National Wetland Inventories and candidate sites for listing

THE CONFERENCE OF THE CONTRACTING PARTIES

4. ENCOURAGES Contracting Parties, in establishing and maintaining national scientific inventories of wetlands, to include all wetlands; and

5. URGES each Contracting Party to recognize officially its identified sites meeting the criteria approved by the Conference of the Contracting Parties.

Resolution VII.20: Priorities for wetland inventory

THE CONFERENCE OF THE CONTRACTING PARTIES

11. URGES all Contracting Parties yet to complete comprehensive national inventories of their wetland resources, including, where possible, wetland losses and wetlands with potential for restoration (Resolution VII.17), to give highest priority in the next triennium to the compilation of comprehensive national inventories, in order for related actions such as policy development and Ramsar Site designations to be carried out with the best information possible;

12. FURTHER URGES that in undertaking inventory activities Contracting Parties give consideration to affording highest priority to those wetland types identified as at greatest risk or with poorest information in the *Global review of wetland resources and priorities for wetland inventory* report;

Resolution VIII.6: A Ramsar framework for wetland inventory

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15. RECOGNIZES that it is appropriate to apply different wetland inventory approaches, methods and wetland classifications for different purposes and objectives, but that common standards can be achieved by ensuring consistency in the collection of a core (minimum) dataset, as provided in the Framework;

16. URGES all Contracting Parties that have yet to complete comprehensive national wetland inventories to continue to give a high priority in the next triennium to the compilation of such inventories, utilizing the *Framework for Wetland Inventory* to ensure that their inventory design appropriately addresses their purpose and objectives, in order that their activities that require the sound basis of wetland inventory, such as policy development and Ramsar Site designations, can be carried out on the basis of the best possible information;

18. CALLS UPON Contracting Parties that have undertaken wetland inventories to ensure that they have appropriate arrangements in place for housing and maintaining their wetland inventory data, […] and, where appropriate, to make this data and information available […] to all decision-makers, stakeholders, and other interested parties;

Resolution X.15: Describing the ecological character of wetlands, and data needs and formats for core inventory: harmonized scientific and technical guidance

THE CONFERENCE OF THE CONTRACTING PARTIES

4. WELCOMES the guidance on "Describing the ecological character of wetlands, and harmonized data formats for core inventory" provided in the annex to this Resolution, and URGES Contracting Parties to make good use of it as appropriate, adapting it as necessary to suit national conditions and circumstances, within the frameworks of existing regional initiatives and commitments and in the context of sustainable development;

7. INVITES Contracting Parties and those responsible for the management of Ramsar Sites to apply these guidelines in the preparation of ecological character descriptions of Ramsar Sites, and as part of their management planning processes, so that these descriptions constitute a complementary basis to the Information Sheets on Ramsar Wetlands (RIS) for detecting and notifying changes in ecological character, as established through Article 3.2 of the Convention text, and RECOMMENDS that Contracting Parties provide any completed descriptions of the ecological character of Ramsar Sites to the Secretariat as a supplement to the information provided in the RIS.

Background and context

1. In Resolution VII.20 (1999) the Contracting Parties recognized the importance of comprehensive national inventory as the vital basis for many activities necessary for achieving the wise use of wetlands, including policy development, identification and designation of Ramsar Sites, documentation of wetland losses, and identification of wetlands with potential for restoration (see also Resolutions VII.16 and VIII.17). It also encouraged the collection of information for the management of shared wetlands, including those within river basins and/or coastal zones (see also Resolutions VII.18 and VIII.4) as appropriate. Furthermore, Operational Objective 1 of the Convention's Strategic Plan 2003-2008 [was] devoted to wetland inventory and assessment, with a series of concrete actions to achieve this Operational Objective.

2. The *Global Review of Wetland Resources and Priorities for Wetland Inventory* (GRoWI), prepared in 1999 for the Ramsar Convention by Wetlands International and the Environmental Research Institute of the Supervising Scientist, Australia, indicated that few countries have comprehensive national inventories of their wetland resources, and lack this essential baseline information on their wetlands. In addition, the National Reports submitted to Ramsar COP8 indicated that insufficient progress has been made in wetland inventory.

3. The GRoWI review concluded that a clear identification and statement of purpose and objectives is fundamental to the design and implementation of effective and cost-efficient inventory, but found that the purpose and objectives for many existing inventories were poorly, if at all, stated.

4. In Resolution VII.20 the COP urged Contracting Parties which had yet to complete national inventories of their wetland resources to give the highest priority to the compilation of comprehensive wetland inventories, and requested the Convention's Scientific and Technical Review Panel (STRP) to review and further develop existing models for wetland inventory and data management, including the use of remote sensing and low-cost and user-friendly geographic information systems.

5. This *Framework for Wetland Inventory* has been developed by the STRP, working with the Ramsar [Secretariat], Wetlands International, the Environmental Research Institute of the Supervising Scientist (Australia) and others, in response to Resolution VII.20. The Framework provides guidance on a standard approach to designing a wetland inventory program. It includes information on determining appropriate remote sensing techniques to apply, wetland classifications and existing standardised inventory methods, and recommends standards for core data fields and data and metadata recording.

6. The Framework provides guidance for designing wetland inventory at multiple scales from site-based to provincial, national and regional. The extent of detail that can be compiled in the inventory will generally decrease as the geographical area of coverage increases, unless large resources can be allocated for the program.

7. The data fields included in any particular inventory will be based on the specific purpose and scale of the inventory. A core data set is recommended as a minimum, but with the option of adding further data fields as required.

8. The Framework uses the definition of "inventory" agreed in Workshop 4 on *Wetland Inventory, Assessment and Monitoring – Practical Techniques and Identification of Major Issues* held during the 2nd International Conference on Wetlands and Development, Dakar, Senegal, 8-14 November 1998 (Finlayson *et al.* 2001). The definition is provided below along with those for the inter-connected concepts of assessment and monitoring:

   Wetland inventory: The collection and/or collation of core information for wetland management, including the provision of an information base for specific assessment and monitoring activities.

   Wetland assessment: The identification of the status of, and threats to, wetlands as a basis for the collection of more specific information through monitoring activities.

   Wetland monitoring: Collection of specific information for management purposes in response to hypotheses derived from assessment activities, and the use of these monitoring results for implementing management. (Note that the collection of time-series information that is not hypothesis-driven from wetland assessment should be termed *surveillance* rather than monitoring, as outlined in Resolution VI.1.)

9. It is important to distinguish between inventory, assessment and monitoring when designing data gathering exercises, as they require different categories of information. Wetland inventory provides the basis for guiding the development of appropriate assessment and monitoring, but wetland inventories repeated at given time intervals do not constitute 'monitoring'.

See also Handbook 13, Inventory, assessment and monitoring; and Handbook 18, Managing wetlands

A framework for wetland inventory

10. A structured framework for planning and designing a wetland inventory is summarized in Table 1. The framework comprises 13 steps that provide the basis for making decisions in relation to the purpose (and objectives), and the available resources, for an inventory.

11. All steps in the Framework are applicable to the planning and implementation of any wetland inventory, and all steps should therefore be followed during the design and planning process. The framework does not provide prescriptive guidance on particular inventory methods; rather it provides guidance to the Contracting Parties and others who are planning to undertake wetland inventory by drawing attention to different methods and wetland classifications already in use and of proven utility under different circumstances.

12. The framework should be used as a basis for making decisions for undertaking a wetland inventory under the circumstances particular to each inventory program. Guidance on the application of each step is provided.

Table 1. A structured framework for planning a wetland inventory

Step	Guidance
1. State the purpose and objective	State the reason(s) for undertaking the inventory and why the information is required, as the basis for choosing a spatial scale and minimum data set.
2. Review existing knowledge and information	Review the published and unpublished literature and determine the extent of knowledge and information available for wetlands in the region being considered.
3. Review existing inventory methods	Review available methods and seek expert technical advice to: a) choose the methods that can supply the required information; and b) ensure that suitable data management processes are established.
4. Determine the scale and resolution	Determine the scale and resolution required to achieve the purpose and objective defined in Step 1.
5. Establish a core or minimum data set	Identify the core, or minimum, data set sufficient to describe the location and size of the wetland(s) and any special features. This can be complemented by additional information on factors affecting the ecological character of the wetland(s) and other management issues, if required.
6. Establish a habitat classification	Choose a habitat classification that suits the purpose of the inventory, since there is no single classification that has been globally accepted.
7. Choose an appropriate method	Choose a method that is appropriate for a specific inventory based on an assessment of the advantages and disadvantages, and costs and benefits, of the alternatives.

8. Establish a data management system	Establish clear protocols for collecting, recording and storing data, including archiving in electronic or hardcopy formats. This should enable future users to determine the source of the data, and its accuracy and reliability. At this stage it is also necessary to identify suitable data analysis methods. All data analysis should be done by rigorous and tested methods and all information documented. The data management system should support, rather than constrain, the data analysis. A meta-database should be used to: a) record information about the inventory datasets; and b) outline details of data custodianship and access by other users.
9. Establish a time schedule and the level of resources that are required	Establish a time schedule for: a) planning the inventory; b) collecting, processing and interpreting the data collected; c) reporting the results; and d) regular review of the program. Establish the extent and reliability of the resources available for the inventory. If necessary make contingency plans to ensure that data is not lost due to insufficiency of resources.
10. Assess the feasibility & cost effectiveness	Assess whether or not the program, including reporting of the results, can be undertaken within under the current institutional, financial and staff situation. Determine whether the costs of data acquisition and analysis are within budget and that a budget is available for the program to be completed.
11. Establish a reporting procedure	Establish a procedure for interpreting and reporting all results in a timely and cost effective manner. The report should be succinct and concise, indicate whether or not the objective has been achieved, and contain recommendations for management action, including whether further data or information is required.
12. Establish a review and evaluation process	Establish a formal and open review process to ensure the effectiveness of all procedures, including reporting and, when required, supply information to adjust or even terminate the program.
13. Plan a pilot study	Test and adjust the method and specialist equipment being used, assess the training needs for staff involved, and confirm the means of collating, collecting, entering, analysing and interpreting the data. In particular, ensure that any remote sensing can be supported by appropriate "ground-truth" survey.

Step 1 State the purpose and objective

13. Wetland inventory has multiple purposes. These include:

    a) listing particular types, or even all, wetlands in an area;
    b) listing wetlands of local, national and/or international importance;
    c) describing the occurrence and distribution of wetland taxa;
    d) describing the occurrence of natural resources such as peat, fish or water;
    e) establishing a baseline for measuring change in the ecological character of wetlands;

f) assessing the extent and rate of wetland loss or degradation;
g) promoting awareness of the value of wetlands;
h) providing a tool for conservation planning and management; and
i) developing networks of experts and cooperation for wetland conservation and management.

14. An inventory should contain a clear statement of its purpose and objective. This should identify the habitats that will be considered, the range of information that is required, the time schedule, and who will make use of the information.

15. A clear statement of the purpose(s) will assist in making decisions about the methods and resources needed to undertake the inventory.

Step 2 Review existing knowledge and information

16. Past investigations have resulted in the provision of broad-scale wetland inventory information for many parts of the world. Other, more detailed, but localized inventory may have been undertaken, restricted either geographically or to particular wetland habitats or ecosystems in the region under consideration.

17. Valuable information may be held in many different formats and/or by many different organizations (e.g., waterbird, fisheries, water quality and agricultural information bases, and local people's information and knowledge).

18. A comprehensive review of existing data sources may be necessary and its relevance to the proposed inventory work ascertained.

Step 3 Review existing inventory methods

19. A number of established methods for wetland inventory exist. The characteristics of five examples […] are summarized in Appendix I. Further sources of information are listed in Appendix VI. The techniques and habitat classifications used in these methods have been successfully adapted for use in a number of locations.

20. The review should determine whether or not existing established inventory methods are suitable for the specific purpose and objectives of the inventory being planned.

21. Some inventory methods use a linked hierarchical approach, in which inventory may be designed at different spatial scales for different purposes.

22. Many inventories have been based on ground-survey, often with the support of aerial photography and topographical maps and, more recently, satellite imagery. The development of Geographic Information Systems (GIS) and the enhanced resolution of satellite imagery have resulted in greater use of spatial data.

23. A procedure for determining which remotely sensed datasets are the most appropriate for particular purposes, including their use in GIS, is given in Appendix II. A summary of [some] remote sensing data sets that can be applicable to wetland inventory is provided in Appendix III.

Step 4 Determine the scale and resolution

24. The spatial scale used for wetland inventory is inseparable from its objective and greatly influences the selection of the method to be used.

25. Wetland inventory has been carried out at a number of spatial scales, with specific objectives at each scale. When choosing the scale it is necessary first to determine the objective and then assess how this can be achieved through a chosen scale.

26. Suitable scales for wetland inventory within a hierarchical approach are:

    a) wetland regions within a continent, with maps at a scale of 1:1,000,000 – 250,000
    b) wetland aggregations within each region, with maps at a scale of 1:250,000 – 50,000
    c) wetland sites within each aggregation, with maps at a scale of 1:50,000 – 25,000.

27. The choice of scale is also related to the size of the geographic area involved and to the accuracy required and achievable with available resources.

28. Each of the scales needs a minimum mapping unit that reflects the minimum acceptable accuracy for that scale. This is done by first determining what is the minimum size of feature that can be clearly delineated at that scale, to acceptable standards, and by then determining what measures are required to describe the accuracy/confidence of defining the unit. For example, a land systems map compiled to a scale of 1:250,000 typically involves taking one on-the-ground site observation for every 600 ha surveyed.

Step 5 Establish a core or minimum data set

29. A core or minimum data set sufficient to describe the wetland(s) should be determined. The specific details of this data set are inseparable from the level of complexity and the spatial scale of the inventory.

30. It is recommended that sufficient information (the core, or minimum, data set) should be collected so as to enable the major wetland habitats to be delineated and characterized for at least one point in time.

31. [Analyses undertaken by the Scientific and Technical Review Panel prior to COP10 identified a number of aspects of the core data fields originally described in the Annex to Resolution VIII.6 where harmonization of terminologies and structure and content descriptions of data and information fields could be made, in order to facilitate the sharing of data and information between inventory and ecological character description processes. Accordingly in Resolution X.15 (2008) the Parties agreed a revised set of core fields to replace those in Resolution VIII.6].

32. The decision whether to undertake an inventory based only upon core biophysical data or also to include data on management features will be based on individual priorities, needs, and resources. The [management features] component is likely to provide information that can immediately be used for assessment purposes, but it may require more extensive data collection and analyses. Care should be exercised to ensure that the inclusion

of this information does not detract from the primary purpose of obtaining sufficient information to enable the delineation and characterization of the wetland(s).

33. [A summary description and structure of recommended core data fields for wetland inventory, as identified in the Annex to Resolution X.15, is given in Table 2. The relationship of these fields to the description of the ecological character of wetlands is shown in Table 3].

Table 2. Core (minimum) data fields for [wetland inventory]

Revised core wetland inventory fields **(Harmonized with Ramsar ecological character description sheet)**
Site name: Official name of site and catchment/other identifier(s) (e.g., reference number)
Area, boundary and dimensions: Site shape (cross-section and plan view), boundaries, area, area of water/wet area (seasonal max/min where relevant), length, width, depth (seasonal max/min where relevant)
Location: Projection system, map coordinates, map centroid, elevation
Geomorphic setting: Setting in the landscape/catchment/river basin - including altitude, upper/lower zone of catchment, distance to coast where relevant, etc.
Biogeographical region:
Climate: Overview of prevailing climate type, zone and major features (precipitation, temperature, wind)
Soil: Geology, soils and substrates; and soil biology
Water regime: Water source (surface and groundwater), inflow/outflow, evaporation, flooding frequency, seasonality and duration; magnitude of flow and/or tidal regime, links with groundwater
Water chemistry: Temperature; turbidity; pH; colour; salinity; dissolved gases; dissolved or suspended nutrients; dissolved organic carbon; conductivity
Biota: Plant communities, vegetation zones and structure (including comments on particular rarity, etc.); Animal communities (including comments on particular rarity, etc.); Main species present (including comments on particular rare/endangered species, etc.); population size and proportion where known, seasonality of occurrence, and approximate position in distribution range (e.g., whether near centre or edge of range)
Land use: Local, and in the river basin and/or coastal zone
Pressures and trends: Concerning any of the features listed above, and/or concerning ecosystem integrity
Land tenure and administrative authority: For the wetland, and for critical parts of the river basin and/or coastal zone

Conservation and management status of the wetland: Including legal instruments and social or cultural traditions that influence the management of the wetland; and including protected area categories according to the IUCN system and/or any national system
Ecosystem services: (for a list of relevant ecosystem services, see the Ramsar ecological character description sheet)
Management plans and monitoring programs: In place and planned within the wetland and in the river basin and/or coastal zone (see Resolutions 5.7, VI.1, VII.17, and VIII.14)

Step 6 Establish a habitat classification

34. Many national wetland definitions and classifications are in use (Appendix IV). These have been developed in response to different national needs and take into account the main biophysical features (generally vegetation, landform and water regime, sometimes also water chemistry such as salinity) and the variety and size of wetlands in the locality or region being considered.

35. The Ramsar Classification System for Wetland Type (Resolution VI.5) is increasingly being used as a classification basis for national wetland inventories. However, when it was first developed it was not anticipated that the Ramsar classification would be used for this inventory purpose, so its usefulness as a habitat classification for any specific wetland inventory should be carefully assessed. Whilst the Ramsar Classification System has value as a basic habitat description for sites designated for the Ramsar List of Wetlands of International Importance, it does not readily accommodate description of all wetland habitats in the form and level of description that are now commonly included in many wetland inventories.

36. A classification based upon the fundamental features that define a wetland – the landform and water regime – is considered to be superior to those based on other features (Resolution VII.20). The basic landform and water regime categories within such a classification can be complemented with modifiers that describe other features of the wetland, for example, for vegetation, soils, water quality, and size.

37. As it is unlikely that a single classification can be globally acceptable, not least because different classification systems are required by some national legislations, a classification should be chosen that suits the purpose of the inventory. The core biophysical data recommended to be collected in an inventory (Table 2) may be used to derive a classification that suits individual needs.

Step 7 Choose an appropriate method

38. Many inventory methods are available (see Appendices I and IV for examples). When assessing which method (or methods) is appropriate for an inventory, it is necessary to be aware of the advantages and disadvantages of the alternatives in relation to the purpose and objective of the proposed inventory work. This applies particularly to the use of remotely sensed data (as listed in Appendix III).

39. To assist in determining which remote sensing data is most useful for a particular inventory, a simple decision-tree is provided in Appendix II. The decision-tree is also presented pictorially and contains six steps to assist in determining which data are most suitable. Importantly, the extent of "ground-truth" survey required to validate the remote sense data should be assessed when considering such techniques.

40. Physico-chemical and biological sampling should be undertaken whenever possible by standard laboratory and field methods that are well documented and readily available in published formats. There is a variety of acceptable methods in use. The bibliographical details of those used should be recorded and any departures from standard procedures clearly justified and documented.

41. As a general rule, the inventory method chosen should be sufficiently robust to ensure that the required data can be obtained within the constraints imposed by the terrain, resources, and time period available. Where adequate methods do not exist, well-directed research is needed to develop or identify specific techniques.

See also Ramsar Technical Report No. 2

42. The use of Geographic Information Systems (GIS) for managing spatial data, in particular, is encouraged, noting that low-cost GIS platforms are increasingly available and widely-used.

Step 8 Establish a data management system

43. Increasing use of databases and Geographic Information Systems ensure that a large amount of data can be stored and displayed, but these capabilities will be undermined if the data are not well managed and stored in formats that are readily accessible.

44. Potential data management problems can be overcome by establishing clear protocols for collecting, recording and storing data, including archiving data in electronic and/or hardcopy formats. The protocols should enable future users to determine the source of the data, as well as its accuracy and reliability. The protocols should also ensure effective recording and reporting of data and information.

45. The data management system should support analysis of the data. Details of all analytical methods should be recorded along with the data and made available to all users. This includes details of statistical techniques and any assumptions about the data.

46. In addition, a meta-database should be used to record basic information about individual inventory data sets. These metadata records should include a description of the type of data and details of custodianship and access. A standard metadata format has been developed specifically for recording wetland inventory (Appendix V), and further guidance on the use of this inventory metadata standard will be issued by the Ramsar [Secretariat].

47. General good practice guidance on metadata and data custodianship, ownership and access is also available in a handbook produced for the Biodiversity Conservation Information System (BCIS) (Biodiversity Conservation Information System 2000).

48. The metadata records should be an integral part of the data management system and not treated as a separate entity from the data files, even if these have been archived.

Step 9 Establish a time schedule and the level of resources that are required

49. It is necessary to determine the time schedule for planning the inventory, as well as for collecting, processing and interpreting the data collected during an inventory. This is particularly important if field sampling is required, in which case a sampling schedule that takes into account any special features of the terrain and sampling techniques will be necessary.

50. The schedule should be realistic and based on firm decisions about funding and resources. This will determine the extent and duration of the inventory. The schedule should also include time to prepare for the inventory, especially if a team of experts needs to be gathered, and extensive background investigation and review has to be undertaken.

51. The extent and reliability of the resources available for the inventory will eventually determine the nature and duration of the inventory. The funding to secure and train suitable personnel and obtain appropriate technical resources, such as field equipment and remote sensing data, should be confirmed and steps taken to ensure that these are available when required.

Step 10 Assess the feasibility and cost effectiveness of the project

52. Once a method has been chosen and a time schedule determined, it is necessary to assess whether or not it is feasible and cost effective to undertake the project. This assessment is essentially a review of the entire inventory method, including the time schedule and costs.

53. Factors that influence the feasibility and cost effectiveness of the project include:

- availability of trained personnel;
- access to sampling sites;
- availability and reliability of specialized equipment for sample collection or analysis of samples;
- means of analyzing and interpreting the data;
- usefulness of the data and information derived from it;
- means of reporting in a timely manner; and
- financial and material support for any continuation of the project.

Step 11 Establish a reporting procedure

54. The results obtained in the inventory should be recorded and reported in a timely and cost effective manner. The records should be concise and readily understood by others involved in the program or similar investigations. Where necessary the records should be cross-referenced to other documentation from the inventory.

55. It is important to keep in mind that the data may be useful for further analyses in the future – the analysts involved should be able to readily access and interpret the data records and be aware of any constraints on their

usefulness for such purposes. In this respect the reporting procedure should incorporate reference to the meta-database and archived data.

56. A report on the inventory should be prepared at pre-determined intervals. It should be succinct and concise and indicate whether or not the purpose and objective of the inventory is being achieved, and whether there are any constraints on using the data (e.g., changes to the sampling regime such as lack of replication or concerns about its accuracy).

57. The core data should be made available to interest groups in appropriate formats along with details of the methods used. Reports may present the data collected and/or contain specific recommendations for further inventory and data collection, or for management action.

58. At the same time, a metadata record of the inventory should be made and added to a centralized file using a standardized format.

59. All reports should be made available to interested parties and other agencies in the shortest possible time through appropriate electronic and hardcopy formats.

Step 12 Review and evaluate the inventory

60. Throughout the inventory it may be necessary to review progress and make adjustments to the sampling regime, data management, and program implementation. The review and evaluation process should be developed and agreed as part of the planning and design phase of the inventory. The review procedures should establish that when changes are made they should be recorded and made known to all involved in the inventory.

61. The review procedures should also establish that at the end of the inventory, or after a predetermined time period, the entire process should be re-examined and necessary modifications made and recorded. The evaluation procedures should be designed to illustrate both the strengths and the weaknesses of the inventory, including necessary reference to the sampling regime and/or the data quality.

62. The evaluation can also be used to justify a request for ongoing funding. If the inventory has been a success and achieved its purpose and objective, this should be clearly stated and the program brought to an end. Conversely, if the inventory has not achieved its purpose and objective, this also should be clearly stated along with a recommendation as to whether it should continue, possibly in a revised form, or halted.

Step 13 Plan a pilot study

63. Before launching an inventory a pilot study is essential. The pilot study provides the mechanism through which to confirm or alter the time schedule and the individual steps within the chosen method. It also provides the opportunity to develop individual workplans for all personnel.

64. The pilot study phase is the time to fine-tune the overall method and individual steps and test the basic assumptions behind the method and sampling regime. Specialist field equipment should be tested and, if necessary, modified, based on practical experience. It is also the opportunity

to assess training needs. The amount of time and effort required to conduct the pilot study will vary considerably – its importance will be shown by the improvements made to the schedule and design of the inventory.

65. The pilot study provides the final step before commencing the wetland inventory itself. Lessons learnt during the pilot study should be incorporated into the inventory method.

Implementation of the inventory

66. Once the method has been agreed by following all steps in the above Framework the inventory can be implemented with some confidence. Importantly, that confidence is dependent upon a suitable pilot study being undertaken and confirmation of all individual sampling and data management protocols. Any further changes to the agreed protocols should be recorded and, where necessary, discussed and formalized.

67. It should be expected that collection of the data for the full inventory will consume most of the time and resources available for the inventory. The steps in the Framework are designed to guide development of an overall method and ensure that the inventory can be competently implemented.

68. All data collected during the inventory should be contained within the agreed data management system, which may include both hardcopy and electronic files and records. Steps should be taken to ensure that the data records are secure and duplicate copies kept in safe locations.

69. Whilst the steps in the Framework provide the basis for designing an inventory project for specific purposes and with specified resources available, it does not ensure that an inventory will be effective. This can only be done by the personnel engaged to undertake the inventory – the Framework provides an outline of the method, including necessary training and contingency in support of the method.

70. It must be stressed that all steps in the Framework are necessary, with the pilot study step providing an important feedback and an opportunity to refine the inventory before the main sampling effort commences. Similarly, the review and evaluation step provides an important check on progress and a formal opportunity to adjust or even halt the inventory.

Describing the ecological character of individual wetlands[1]

The ecological character concept and the need for methods for describing ecological character

71. The text of the Ramsar Convention includes in Article 3.2 the requirement that "each Contracting Party shall arrange to be informed at the earliest

1 [Note to 4th edition: The text in this section is an addition in the 4th edition of this Handbook. It is derived from the Annex to Resolution X.15 (2008) on *Describing the ecological character of wetlands, and data needs and formats for core inventory: harmonized scientific and technical guidance*. What was Table 2 in the Resolution Annex now appears as Table 2 earlier in this Handbook. What was Table 1 is incorporated here into Table 3. Some introductory passages and a section on the historical development of the work have been omitted, the paragraphs are re-numbered and in a few cases re-positioned, otherwise the text is unchanged except where square-bracketed].

possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change". Through a series of COP decisions (principally the Strategic Plan adopted in 1996 and Resolution VIII.8 in 2002), the requirement in Article 3.1 to "promote the conservation" of Ramsar Sites has been equated to "maintenance of the ecological character" of these sites.

72. Furthermore, the current description of "wise use" (paragraph 22 of Resolution IX.1 Annex A) makes explicit the link between maintenance of ecological character and wise use, such that the concept of maintaining ecological character can and should be applied to all wetlands, rather than only designated Ramsar Sites:

> "Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development."

73. The current definition of "ecological character" (paragraph 15 of Resolution IX.1 Annex A) is:

> "Ecological character is the combination of the ecosystem components, processes and benefits*/services that characterise the wetland at a given point in time."
>
> *Within this context, ecosystem benefits are defined in accordance with the MA [Millennium Ecosystem Assessment] definition of ecosystem services as "the benefits that people receive from ecosystems".

74. Whilst a definition of "ecological character" is helpful, it is also important to be able to describe the particular ecological character of a wetland as a key element of an effective management planning process, including monitoring, as is set out in the wetland management planning guidance in Ramsar Wise Use Handbook [18 (4th ed.)]. It also follows that if human-induced adverse change in the ecological character of a designated Ramsar Site is to be detected and reported under Article 3.2 of the Convention text, a baseline description of ecological character is needed against which to assess change.

75. The lack of guidance to Contracting Parties and wetland site managers on methods for describing ecological character was recognized in annex 2 to Resolution IX.2 (paragraph 52), which requested the Scientific and Technical Review Panel (STRP) to prepare "guidance for the description of the ecological character of wetlands".

76. The guidance developed in response and provided here therefore moves beyond the *definition* of the concept to a treatment of the constituent parts of *what goes to make up* ecological character, and this can be applicable to any wetland in the context of documenting core aspects of an inventory of wetlands (see Resolution VIII.6) and to completing the Information Sheet on Ramsar Wetlands (RIS) for any given Ramsar Site.

77. The preparation of the guidance on describing ecological character has […] permitted some reflection on the Convention's definition of ecological character […], referred to above. While it is certainly correct that the concept should embrace ecosystem components, processes and services, the definition makes clear that ecological character consists not simply of

a *list* of these, but includes the additional idea of what they represent *in combination*. The dividing-line between what is counted as a component, or a process, or a service, may not always be sharply distinguished. For example, "water regime" is included in "components" in the scheme provided below, but might also be regarded as a "process". Long debate on this would not be fruitful, however, since these categorizations are pragmatic expedients, and the key principle is that ecological character is a holistic rather than a reductionist concept.

78. In any guidance on ecological character description, there will be a need to map out the various different purposes for, and uses of, this description and how these differ from the purposes of core wetland inventory, as well as RIS and Article 3.2 reporting. […].

A summary framework of data and information for core inventory, ecological character description, Ramsar Site designation and Article 3.2 reporting

79. There are close relationships between the types of data and information which are, and need to be, collected for the purposes of core inventory, ecological character description, Ramsar Site designation, and Article 3.2 reporting.

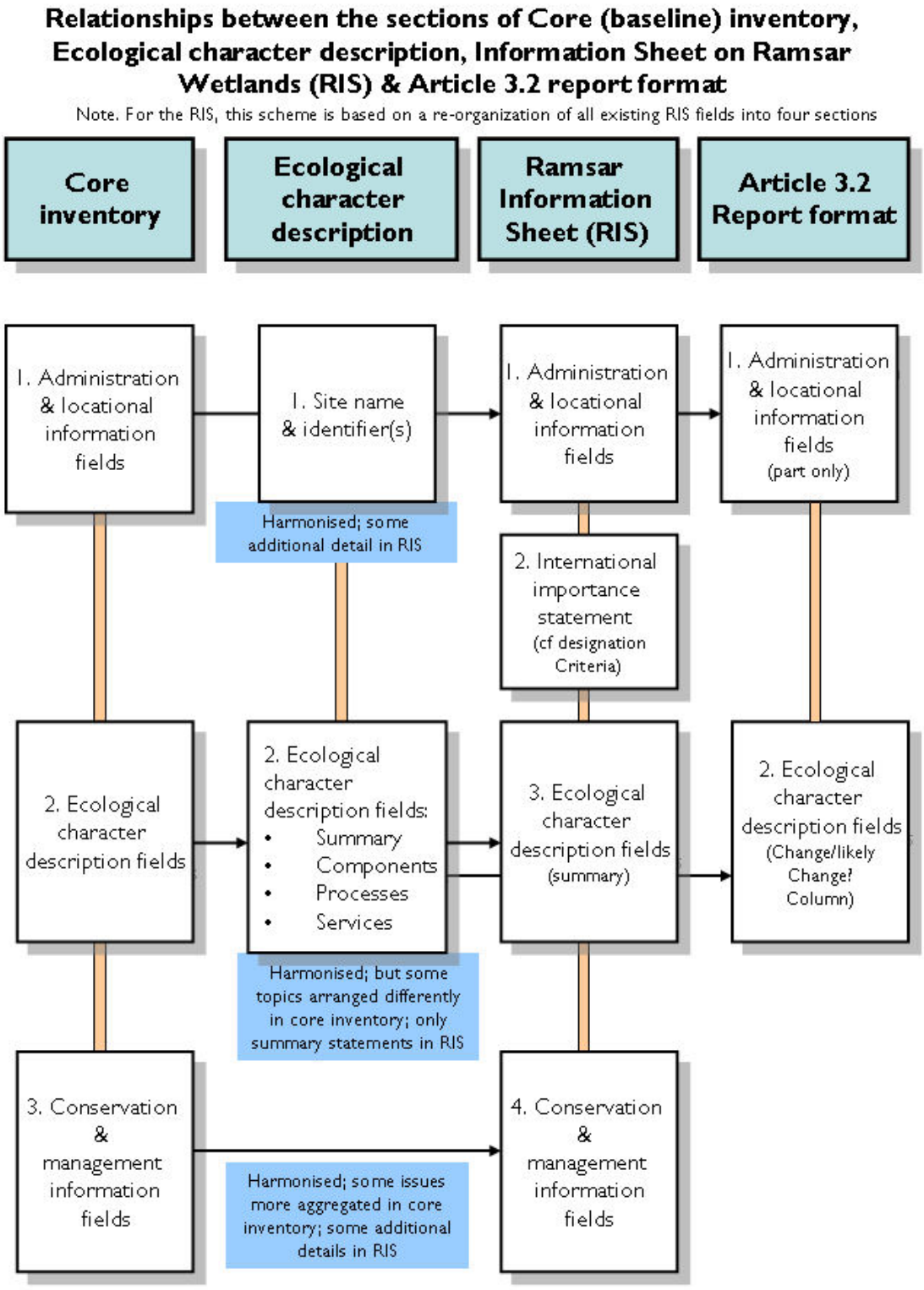
80. Figure 1 provides a comparative framework of the major types of data and information required for each of these purposes. To this could be added a column for data and information needed for management plans, and the STRP anticipates reviewing this aspect in its future work.

81. All four of these purposes require a description of ecological character for the site, and through harmonization of these data and information fields this would then need to be done only once for all four purposes, hence avoiding a significant duplication of effort that may otherwise occur at present. Three of the purposes need similar administrative and locational details. Core inventory and the RIS need some conservation activity information, and although the level of detail might be different, again the same structure of data fields can be used.

82. The unique section of data and information needed for the RIS is its statement of the international importance of the wetland, made against each of the Criteria applied in the designation of the site, and the data and information provided to justify the application of these Criteria (Ramsar Wise Use Handbook [17 *Designating Ramsar Sites*, 4th edition]). This distinction between the description of the international importance of a Ramsar Site and the description of its overall ecological character has not always been kept clear.

83. […] Any differences in the data and information needs for these various purposes can often be more a matter of the level of detail required. Actual needs will vary according to the individual circumstances of the sites and situations concerned. The tables in this guidance identify the full list of fields that may apply, but whether any of them does apply, or whether there is capacity to provide a full description, will vary from site to site. It is not expected that all the specific data fields will necessarily have to be filled out for all sites.

Figure 1. A summary framework for data and information needs for core inventory, ecological character description, Ramsar Site designation, and Article 3.2 reporting



84. It is largely dependent on each Contracting Party's priorities and chosen purposes whether the relevant data and information is collected first for core wetland inventory, for ecological character description (e.g., for management planning purposes), or for the preparation of an RIS for Ramsar Site designation. As indicated above, whichever the first purpose applied, much of the data and information collected can be used for the other purposes. Thus, for example, completion of the ecological character description should directly provide the information (in summarized form) for core inventory and the RIS. Reports made under Article 3.2 would also be drawn directly from the data and information in the ecological character description.

A framework for describing the ecological character of wetlands

85. […] A global scheme for describing wetland ecological character in the context of the Ramsar Convention is provided in tabular format below. […] [Editor's note: the original table in the Annex to Resolution X.15 listed ecological character description fields which were then repeated in a table comparing those fields with the fields for core inventory. The latter comparison table is reproduced below as Table 3, which is therefore used in this Handbook as the sole way of presenting the ecological character description fields, to avoid repetition]. Some guidance on implementing the approach is provided below in paragraphs [86-89].

86. **Start with available data and information.** In developing a description of the ecological character of a wetland, it is important to start with whatever data and information are currently available, even if information is not comprehensively available for all fields in the description sheet. Starting with compiling what is currently available also helps to identify gaps and priorities for further data and information collection to enhance the description.

87. **Start with qualitative description if quantitative data are not available.** Even if detailed quantitative data are not available, begin by compiling qualitative data and information and do not underestimate the value of expert and local knowledge as a source of such information. Often, bringing together those who know the wetland to share their knowledge can be an important and effective start to compiling the ecological character description.

88. **Simple 'conceptual models' can be a powerful tool.** Developing simple two- or three-dimensional 'conceptual models' accompanied by summary descriptions of key features, processes and functioning can be a powerful tool supporting the ecological character description. Further guidance on approaches to developing such conceptual models will be developed by the Scientific and Technical Review Panel. For one example of this approach for a Ramsar Site, see Davis, J. & Brock, M. (2008) "Detecting unacceptable change in the ecological character of Ramsar Wetlands," *Ecological Management & Restoration*, vol. 9 (1): 26-32 (downloadable from http://www.blackwell-synergy.com/doi/pdf/10.1111/j.1442-8903.2008.00384.x).

89. **Separate descriptions for different parts of large or complex wetlands can be a helpful start.** For large wetlands or wetland complexes where different parts of the system function differently or have very different characteristics, it may prove practically helpful to prepare separate descriptions initially

for any distinctly different parts, supplemented by an overall summary ecological character description and conceptual models.

Harmonizing the ecological character description and the core fields for wetland inventory

90. Core fields for wetland inventory were [initially] agreed by the Parties in 2002, in the Annex to Resolution VIII.6. A further aspect of the STRP's work on data and information needs for wetlands, including Ramsar Sites (2006-2008 STRP work plan task 52), concerned "harmonization of the layout and information fields of the RIS with the core data fields of the Framework for wetland inventory and the description of ecological character".

91. […] Further work by the STRP will address the RIS-related aspects of this task. This section of guidance provides advice only on the harmonization of core inventory and ecological character description fields.

92. Table 2 [given earlier] provides the revised core inventory fields, [which have now] supersede[d] those in the Annex to Resolution VIII.6. Table 3 provides [the ecological character description fields, and shows how they relate to the revised fields for core inventory].

Table 3. [Information fields in the Ramsar wetland ecological character description sheet, and their relationship with the revised fields for core wetland inventory]

Ramsar ecological character description sheet	Core inventory fields (revised)
Site name: Official name of site and catchment)/other identifier(s) (e.g., reference number)	
	Administrative and locational details
	Site name: Official name of site and catchment/other identifier(s) (e.g., reference number)
	Area, boundary and dimensions: Site shape (cross-section and plan view), boundaries, area, area of water/wet area (seasonal max/min where relevant), length, width, depth (seasonal max/min where relevant)
	Location: Projection system, map coordinates, map centroid, elevation
	Biogeographical region
	Land tenure and administrative authority: For the wetland, and for critical parts of the river basin and/or coastal zone
	Ecological character
1. Summary statement	

Two or three narrative sentences giving a statement of what is ecologically *distinctive* (not necessarily *important*) about the site, based on the details below. (With reference to the COP 9 definition, this concerns *the combination of* the components, processes and services that *characterise* the wetland (emphasis added)).	(Not part of core inventory)
2. Ecological components	
2.1 Geomorphic setting: Setting in the landscape/catchment/river basin - including altitude, upper/lower zone of catchment, distance to coast where relevant, etc.	**Geomorphic setting:** Setting in the landscape/catchment/river basin -including altitude, upper/lower zone of catchment, distance to coast where relevant, etc.
2.2 Climate: Overview of prevailing climate type, zone and major features (precipitation, temperature, wind)	**Climate:** Overview of prevailing climate type, zone and major features
2.3 Habitat types (including comments on particular rarity, etc.), and Ramsar wetland types	Part of section on **biota:** Plant communities, vegetation zones and structure (including comments on particular rarity, etc.)
2.4 Habitat connectivity	
2.5 Area, boundary and dimensions: Site shape (cross-section and plan view), boundaries, area, area of water/wet area (seasonal max/min where relevant), length, width, depth (seasonal max/min where relevant)	[In administrative and locational details section above.]
2.6 Plant communities, vegetation zones and structure (including comments on particular rarity, etc.)	Part of section on **biota:** Plant communities, vegetation zones and structure (including comments on particular rarity, etc.); (See under administrative and locational details above)
2.7 Animal communities (including comments on particular rarity, etc.)	Part of section on **biota:** Animal communities (including comments on particular rarity, etc.);
2.8 Main species present (including comments on particular rare/endangered species etc); population size and proportion where known, seasonality of occurrence, and approximate position in distribution range (e.g., whether near centre or edge of range)	Part of section on **biota:** Main species present (including comments on particular rare/endangered species etc); population size and proportion where known, seasonality of occurrence, and approximate position in distribution range (e.g., whether near centre or edge of range) Part of section on **biota:** Animal communities (including comments on particular rarity, etc.);
2.9 Soil: Geology, soils and substrates; and soil biology	**Soil:** Geology, soils and substrates

2.10 Water regime: Water source (surface and groundwater), inflow/ outflow, evaporation, flooding frequency, seasonality and duration; magnitude of flow and/or tidal regime, links with groundwater	**Water regime**: Water source (surface and groundwater), inflow/ outflow, evaporation, flooding frequency, seasonality and duration; magnitude of flow and/ or tidal regime, links with groundwater
2.11 Connectivity of surface waters and of groundwater	(Incorporated in "Water regime" above)
2.12 Stratification and mixing regime	
2.13 Sediment regime (erosion, accretion, transport and deposition of sediments)	
2.14 Water turbidity and colour	Part of section on **Water chemistry:** Turbidity; colour
2.15 Light - reaching the wetland (openness or shading) and attenuation in water	(Incorporate as appropriate in vegetation and chemistry sections above)
2.16 Water temperature	Part of section on **Water chemistry:** Temperature
2.17 Water pH	Part of section on **Water chemistry:** pH
2.18 Water salinity	Part of section on **Water chemistry:** Salinity
2.19 Dissolved gases in water	Part of section on **Water chemistry:** Dissolved gases
2.20 Dissolved or suspended nutrients in water	Part of section on **Water chemistry:** Dissolved or suspended nutrients
2.21 Dissolved organic carbon	Part of section on **Water chemistry:** Dissolved organic carbon
2.22 Redox potential of water and sediments	(Incorporate in chemistry section if appropriate)
2.23 Water conductivity	(Incorporate in chemistry section if appropriate)
3. Ecological processes	
3.1 Primary production (S)*	(Not included)
3.2 Nutrient cycling (S)*	
3.3 Carbon cycling	
3.4 Animal reproductive productivity	(Incorporate as necessary in section on **biota**)
3.5 Vegetational productivity, pollination, regeneration processes, succession, role of fire, etc.	
3.6 Notable species interactions, including grazing, predation, competition, diseases and pathogens	
3.7 Notable aspects concerning animal and plant dispersal	
3.8 Notable aspects concerning migration	
3.9 Pressures and trends concerning any of the above, and/or concerning ecosystem integrity	**Pressures and trends:** Concerning any of the features listed above, and/or concerning ecosystem integrity

4. Ecosystem services	
4.1 Drinking water for humans and/or livestock (P)*	Ecosystem services: (Derive summary, to length appropriate, of the aspects documented in the character description sheet as listed in fields 4.1 - 4.27 on the left)
4.2 Water for irrigated agriculture (P)*	
4.3 Water for industry (P)*	
4.4 Groundwater replenishment (R)*	
4.5 Water purification/waste treatment or dilution (R)*	
4.6 Food for humans (P)*	
4.7 Food for livestock (P)*	
4.8 Wood, reed, fibre and peat (P)*	
4.9 Medicinal products (P)*	
4.10 Biological control agents for pests/diseases (R)*	
4.11 Other products and resources, including genetic material (P)*	
4.12 Flood control, flood storage (R)*	
4.13 Soil, sediment and nutrient retention (R)*	
4.14 Coastal shoreline and river bank stabilization and storm protection (R)*	
4.15 Other hydrological services (R)*	
4.16 Local climate regulation/buffering of change (R)*	
4.17 Carbon storage/sequestration (R)*	
4.18 Recreational hunting and fishing (C)*	
4.19 Water sports (C)*	
4.20 Nature study pursuits (C)*	
4.21 Other recreation and tourism (C)*	
4.22 Educational values (C)*	
4.23 Cultural heritage (C)*	
4.24 Contemporary cultural significance, including for arts and creative inspiration, and including existence values (C)*	
4.25 Aesthetic and "sense of place" values (C)*	
4.26 Spiritual and religious values (C)*	
4.27 Important knowledge systems, and importance for research (C)*	
(For nature conservation value as an ecosystem 'service' (S)*, see items under 'components' and 'processes' above)	

	Conservation and management
	Conservation and management status of the wetland: Including legal instruments and social or cultural traditions that influence the management of the wetland; and including protected area categories according to the IUCN system and/or any national system
	Management plans and monitoring programs: In place and planned within the wetland and in the river basin and/or coastal zone (see Resolutions 5.7, VI.1, VII.17, and VIII.14)
	Land use : Local, and in the river basin and/or coastal zone

* Ecosystem Services are categorised as "provisioning" (P), "regulating" (R), cultural (C) or "supporting" (S) according to the categorization in the Millennium Ecosystem Assessment. Some may appear in the "processes" section as well as the "services" section above.

Change in ecological character and Article 3.2 reporting

93. [In Resolution VIII.8 (2002), the Conference of the Parties directed the Secretariat to prepare a simple format for reporting human-induced change or likely change in ecological character of Ramsar Sites as required under Article 3.2 of the Convention. This issue was subsequently addressed in the STRP's work on the subject]. […]

94. Since it follows that identifying such a change is based on its detection by comparison with the description of the ecological character of the wetlands, and with any established limits of unacceptable change in ecological character, the approach [which was] developed [and reflected in the Annex to Resolution X.15] is to use the ecological character description format [with an] additional column for describing "Change/likely change", to make such Article 3.2 reports.

95. Thus using a copy of the completed ecological character format for a given site, with relevant details entered into this column, can act as the simple alert mechanism required to trigger the processes (see Resolution X.16) for implementing Article 3.2 requirements and for submitting the Article 3.2 report to the Ramsar Secretariat.

See also Handbook 19, Addressing change in wetland ecological character

96. In addition to the "Change/likely change?" column in [the ecological character description sheet], a further refinement that Contracting Parties and wetland managers may wish to add, where appropriate and possible, is a further column identifying "Limits of acceptable change, where defined" […]. This speaks to the role of the ecological character description in management planning, including monitoring, and also to determining when an Article 3.2 report of non-trivial change in ecological character would be needed. Further discussion on limits of acceptable change and trivial/non-trivial change in ecological character is provided in [Information document] COP10 DOC.27.

Appendix I

Inventory methods

Standardized inventory methods are available and have been successfully used in different circumstances, countries or regions. Notable amongst these are the Mediterranean Wetlands Initiative (MedWet) inventory, the United States Fish and Wildlife Service national wetland inventory, the Ugandan national wetland inventory, the Asian wetland inventory, and the Ecuador national wetland inventory.

The characteristics of these examples are summarised below in terms of each of the 13 Framework steps. These examples have been chosen principally as they were considered comprehensive examples of existing methods, but also because they illustrate differences in approaches that could be used in different locations, for different purposes, and at different scales. The need for different methods and wetland classifications (see also Appendix IV) that enable local and national needs to be met must be stressed: this is illustrated by the range of examples below.

Mediterranean Wetlands Initiative (MedWet) inventory

This is a set of standard but flexible methods and tools, including a database for data management, for inventory in the Mediterranean region. Although not intended as a pan-Mediterranean wetland inventory, it has provided a common approach that has been adopted, and adapted, for use in several Mediterranean countries and elsewhere.

1. Purpose and objective	To identify where wetlands occur in Mediterranean countries and ascertain which are priority sites for conservation; to identify the values and functions for each wetland and provide a baseline for measuring future change; and to provide a tool for planning and management and permit comparisons between sites.
2. Information review	A process of consultation with an advisory group of experts from the Mediterranean and elsewhere. This group considered the experience and knowledge gained from other inventory and various Ramsar guidelines on managing wetlands.
3. Review methods	Considered database methods used elsewhere in Europe, United States and Asia. Compatibility with wetland databases being used in Europe was a key consideration, e.g. the CORINE Biotopes program. The method was designed to include both a simple and a complex data format.
4. Scale and resolution	Multiple scales for river basins, wetland sites and habitats have been adopted.
5. Core data set	Standard data sheets have been established for river basins, wetland sites (identification, location, description, values, status), habitat, flora, fauna, activities and impacts, meteorological data, and references.
6. Habitat classification	Ramsar classification can be used at a broad scale. For detailed information on sites the United States National Wetland Inventory classification has been adapted.
7. Method	Five steps: i) site selection; ii) Site identification through cartographic means or remote sensing with field assessment; iii) habitat classification; iv) data collection and management through standard data sheets and database; and v) map production using standard conventions.

8. Data management	Based on a standard database, initially developed in FoxPro in MS-DOS, and updated in 2000 in Microsoft Access. [Note. A further updated database, using PHP software, and including mapping/GIS capability, is available on the internet (http://medwetnet.icn.pt) in English, French, Spanish and Portuguese].
9. Time schedule and resources	Dependent on the complexity of the inventory. A simple inventory can be done with minor resources while a detailed inventory requires greater human and financial resources.
10. Feasibility & cost effectiveness	Assessed in France before being made available for on-ground pilot studies. The feasibility of the program is built around having a flexible approach that reflects the resources that are available for the inventory.
11. Reporting	Standardized data sheets provided for storing information and a database for ease of reporting. Specific formats for reports can be determined and included.
12. Review and evaluation	An inventory working group has been established to assess progress with undertaking and using the information from inventories using this approach, and to update the information and methods as necessary.
13. Pilot study	Undertaken in Portugal, Morocco, Greece, Spain and France.
Further information	Costa, Farinha, Tomas Vives & Hecker 1996 & 2001; Hecker, Costa, Farinha & Tomas Vives 1996. http://www.medwet.org/category/medwet-projects/

United States national wetland inventory

A long running national program that has developed a classification and methodology for producing a map-based inventory.

1. Purpose and objective	To conduct a natural resource inventory of wetlands for use in wetland planning, regulation, management and conservation.
2. Information review	Reviewed the extent of wetland survey and inventory to determine the status of wetland protection and the availability of maps of wetlands.
3. Review methods	Reviewed existing wetland inventory and consulted with state and federal agencies to determine what inventory techniques were being used.
4. Scale and resolution	Maps produced at a scale of 1:80 000 or 1:40 000.
5. Core data set	Standardized data collection is undertaken in line with the information required for the habitat classification and production of standard maps for each state.
6. Habitat classification	Hierarchical classification developed as an integral part of the inventory to describe ecological units and provide uniformity in concepts and terms.
7. Method	Based on interpretation of color infrared aerial photographs, initially at 1:24 000 and more recently at 1:40 000 to 1:80 000 scale. The mapping unit varies according to the region and ease of identifying wetlands. The method includes field checking and stereoscopic analysis of photographs. Other remote sensing techniques are being tested.

8. Data management	Maps and digital data are made available online at http://www.fws.gov/wetlands/. Data is analyzed through GIS using ARC-INFO.
9. Time schedule and resources	Ongoing program since 1974. Maps are updated as needed and when funding is available.
10. Feasibility & cost effectiveness	Large scale program was extensively funded and a large proportion of the country is now mapped. A statistical design was incorporated to provide valid representative figures for selected areas.
11. Reporting	National wetland trends are produced periodically, based on statistical sampling. Mapping targets have been set through legislation that has periodically been revised.
12. Review and evaluation	The inventory has been under regular review and its outputs evaluated and new targets and priorities established.
13. Pilot study	An extensive phase of method development was undertaken before the inventory was considered operational. The classification system which underpins the inventory was extensively tested in the field.
Further information	Cowardin, Carter, Golet & LaRoe 1979; Cowardin & Golet 1995; Wilen & Bates 1995. National Wetlands Inventory website: http://www.fws.gov/wetlands/

Uganda National Wetlands Programme

The inventory is a component of an ongoing National Wetlands Program. It is largely carried out at the local level, using standard formats, and includes a training component.

1. Purpose and objective	To survey, describe, quantify and map all wetlands and provide decision-makers and planners, especially at district level, with information for management planning; to support policy implementation; to support economic valuation; and to support overall natural resource management planning.
2. Information review	Undertook literature review prior to the onset of the inventory.
3. Review methods	Carried out a review prior to the onset of the inventory process.
4. Scale and resolution	Uses SPOT imagery at 1:50 000 to cover the country.
5. Core data set	Bio-physical data encompassing site name, area, location, general description, seasonality, biota (vegetation types and animals present) and management data covering land-use, land tenure, conservation status, values, threats.
6. Habitat classification	Derived from landform, water regime and vegetation.
7. Method	GIS-based map analyses based on remotely sensed data alongside topographic maps of similar scale (1:50 000) as well as ground surveys. Uses standard data sheets. All wetlands are coded. Methods are documented in a wetland inventory guide. Activity is carried out on district basis with personnel from the district being designated to carry out the fieldwork and compile reports.
8. Data management	A computerized database using Microsoft Access was based on the standardized field data sheets. This database will be linked to the ArcView map database using wetland codes. The linkage between the two databases forms the National Wetland Information System (NWIS) which is already developed with ongoing data entry.

9. Time schedule and resources	An ongoing process with regular updates. The inventory is one of the main activities of a donor-funded National Wetlands Program with a number of partners.
10. Feasibility & cost effectiveness	Feasibility assessed through pilot studies. Cost effectiveness related to the complexity of the wetland systems, extent of areas being assessed, availability of remotely sensed images and capacity.
11. Reporting	Standardized data sheets used for storing information in a database for ease of reporting. Individual reports prepared at district level. These will be consolidated into a National Wetland Inventory.
12. Review and evaluation	Done within the project in consultation with a few external experts.
13. Pilot study	Undertaken in a few wetlands and then districts..
Further information	National Wetlands Programme 1999; Pabari, Churie & Howard 2000.

Asian Wetland Inventory (AWI)

This approach has been developed in response to the recommendations contained in the *Global Review of Wetland Resources and Priorities for Wetland Inventory* report and presented in Resolution VII.20. The method is a hierarchy that can be implemented at four spatial scales. The method is based largely on a draft protocol developed in Australia, and has been tested in a pilot study in Japan. The pilot study has resulted in a manual being produced.

1. Purpose and objective	To provide a hierarchical database on coastal and inland wetlands in Asia
2. Information review	Undertaken in the extensive global review of wetland inventory conducted on behalf of the Ramsar Convention (see Resolution VII.20)
3. Review of methods	Undertaken in the extensive global review of wetland inventory conducted on behalf of the Ramsar Convention and refined through the development of a manual.
4. Scale and resolution	Hierarchical multi-scalar approach with four levels of analysis: level 1 at 1:10 000 000 to 1:5 000 000; level 2 at 1:1 000 000 to 1:250 000; level 3 at 1: 250 000 to 1:100 000; and level 4 at 1:50 000 to 1:25 000.
5. Core data set	Hierarchical multi-scalar minimum data at each level of analysis: level 1 – broad geology, land cover and climate for river basins; level 2 – geology, landforms, climate for wetland regions; level 3 – hydrological, climate, landform, physico-chemical, and biological detail for wetland complexes; and level 4 information on management issues and procedures included, in addition to site descriptions as per level 3
6. Habitat classification	Derived from minimum data on landform and water regimes and possibly supplemented with information on vegetation, areal size and water quality.
7. Method	GIS-based map analyses using remotely sensed imagery and maps augmented with ground surveys that are more intensive at levels 3 and 4. Prescribed data sheets and fields with agreed codes are available for each level of analysis.

Additional information

Inventory for Asian Wetlands

A Manual for an Inventory of Asian Wetlands is a product of the Asian Wetland Inventory programme (AWI) and represents a significant step forward in the development of standardised methods for wetland data collection, collation and storage for Asian wetlands. The AWI programme was developed in response to the findings of the *Global Review of Wetland Inventory* presented at a Technical Session at Ramsar COP7, and to Resolution VII.20 on wetland inventory adopted at COP7. The AWI Manual also complements and provides direct support to Resolution VIII.6, *A Ramsar Framework for Wetland Inventory*.

The 72-page Manual has been built on inventory protocols successfully developed in other parts of the world. It takes the reader through the basic recommended inventory methods:

a) identifying 13 categories of wetlands that should be used; these are mutually exclusive categories and provide a consistent basis for identifying wetlands that brings out the underlying similarity of wetlands across a wide range of climatic, geomorphic, soil, and vegetation settings;

b) using a hierarchy of four scales of mapping contained within a GIS format, including major river basins, coastal regions or islands (1:500,000 to 1:1,000,000 scale maps); sub-basins and coastal sub-regions (1:250,000 to 1:500,000 scale maps); wetland complexes (1:100,000 to 1:250,000 scale maps); and finally, wetland habitats (1:10,000 to 1:50,000). These scales provide different information for wetland management;

c) providing data collection sheets that indicate the core data considered necessary for each level of delineation and description of wetlands with a standardised format for recording and presenting the information.

To enable the extraction, analysis and management of information that has been collated or created for each level of inventory, an information system has been developed comprising three related but distinct elements:

- an interactive, user-friendly, relational database which stores the inventory information for each level;
- GIS software and datasets which store the spatial datasets and can be integrated and updated with information from the relational database; and
- a metadatabase, comprising records describing individual inventory datasets.

Initial funding support for the AWI programme came from the Ministry of Environment, Japan and the programme was endorsed by the Ramsar Convention's Standing Committee. Wetlands International, in collaboration with the Australian National Centre for Tropical Wetland Research (NCTWR), the Wetland Inventory Assessment and Monitoring Specialist Group (WIAMSG), and the Japanese National Institute for Environmental Studies (NIES-CGER), has been responsible for the initial development of the project.

A Manual for an Inventory of Asian Wetlands: Version 1.0, by Finlayson CM, Begg GW, Howes J, Tagi K. & Lowry J, Wetlands International Global Series 10, Kuala Lumpur, Malaysia, is available in hard copy from wiap@nasionet.net and includes a CD-ROM with the Manual, a brochure (in English, Chinese and Thai), and an information pack on AWI, all in PDF format. A special download page for AWI has been created on the Wetlands International website at http://www.wetlands.org/RSIS/WKBASE/awi/default.htm, where the manual as well as the brochure and information pack are available for download in PDF format.

8. Data management	The data management system is built on a computerized database engine with web, user/data interface and GIS capabilities. This serves as the primary data management/storage/retrieval component of the project. The system is based on the Windows platform using MS Visual Basic and Access 97 software. The website (http://www.wetlands.org/RSIS/WKBASE/awi/default.htm) serves as the main communication node for data collection, announcements and discussions[, though it has not been updated for some years].
9. Time schedule and resources	An ongoing process with regular updates of information obtained through national or local analyses. The program has been devolved through the regionalized structure of Wetlands International and its partners.
10. Feasibility & cost effectiveness	Feasibility assessed through project meetings and submission of funding applications that required targeted outputs etc. Cost effectiveness related to the extent of the areas being assessed and the extent of pre-existing inventory information, maps and remotely sensed images. The procedure was based on the Ramsar Convention's review of wetland inventory that found many inventories did not achieve their purpose through being over-ambitious and/or not applying tight data management and reporting procedures – all features that have been addressed.
11. Reporting	Standardized data sheets provided for storing information in a database for ease of reporting. Individual reports are provided through the devolved projects. […]
12. Review and evaluation	Provided at the Wetlands International seminar "Wetlands in a Changing World" held in Wageningen, The Netherlands, 30 November 2001.
13. Pilot study	Undertaken in Japan – Hokkaido and Kushiro Marsh with maps produced in a GIS format.
Further information	Finlayson, Howes, Begg & Tagi 2002; Finlayson, Howes, van Dam, Begg & Tagi 2002 http://www.wetlands.org/RSIS/WKBASE/awi/default.htm

Ecuador wetland inventory

This is a national wetland inventory […]that was developed by the Ministry of the Environment, the Ramsar Bureau, and the EcoCiencia Foundation, and is designed to support Ecuador's implementation of the Ramsar Convention and the wise use of wetlands.

1. Purpose and objective	To provide information to assist in the management of globally important biodiversity in Ecuadorian wetlands, supporting Ecuadorian wetlands conservation through the identification, characterization and prioritization of wetlands for management and conservation.
2. Information review	Published documents and material on the internet and held by universities, research organisations and from a national workshop on the identification and status of wetlands was assessed.

3. Review of methods	Inventory methods used in Canada, Venezuela, Brazil and parts of Argentina were reviewed. Each method was considered to have limitations for application in Ecuador, including too resource and capacity demanding, too little background information available in Ecuador, lacking an ecosystem (catchment)-scale approach, or only reliant on secondary information sources.
4. Scale and resolution	Information was collected at 1:50,000 scale. As some wetlands were too large to use maps at this scale, large individual sites are presented at different scales but information on them held in the database at 1:50,000 scale.
5. Core data set	The data was collected using a quadratical-based matrix that included five selected general criteria, each validated through a series of analysed variables. Information was gathered on social, economic, zoological, botanical, limnological, ecological (including aquatic and terrestrial) features.
6. Habitat classification	The habitat classification followed two existing systems being used in Ecuador.
7. Method	The method includes the following steps: information collected using remote sensing; validation and delineation of zones using a numerical matrix; information on socio-economical and ecological aspects of wetlands derived from interviews; published information reviewed; primary information on ecological and social aspects of wetlands generated. Data was entered into a GIS containing physiographic layers so as to permit the production of recommended land-use strategy and management proposals for the wetlands within their catchments.
8. Data management	Cartographic information is managed by the department of Geographical Information Systems (GIS). Other information is maintained in digital formats by individual researchers. A database of wetland photographs is also maintained.
9. Time schedule and resources	The project began in 1996 with pilot studies in two provinces.[…] The total project cost was US$ 1 million over the seven years of the project, with funding from the Ramsar Bureau, the World Bank, the Global Environment Fund, the MacArthur Foundation and the Ecuadorian Government.
10. Feasibility & cost effectiveness	Feasibility and cost effectiveness was assessed in the project development phase through the World Bank's incremental costs assessment procedures.
11. Reporting	Published reports will be produced, and data held electronically in the GIS database.
12. Review and evaluation	Six-monthly World Bank evaluation of the process and progress in achievements of targets. Final report will have pre-publication review by the Ramsar [Secretariat]. The Ecuador National Wetlands Working Group will consider the final publication.
13. Pilot study	A pilot study was undertaken in 1996 of the lentic wetlands, in the Provinces of Esmeraldas and Manabí.

Additional Information

HumedAndes:

An initiative for institutional coordination and cooperation on Andean wetland inventories

An institutional cooperation initiative to promote and carry out inventories on Andean wetlands was launched in Colombia in February 2003 with the goal of developing a conceptual framework for the inventory and ecological characterisation of the wetlands in the Andean region. This information would then serve to register the presence of all high Andean wetlands and their characteristics in a format that was standardised and readily available. Of special importance in this undertaking was the identification and location of those wetlands that, because of their size, geographical location and state of conservation, have not been assigned the degree of importance they deserve as biodiversity refuges and safety nets for the local communities that depend on them.

Several institutions were involved from the outset in developing inventories for their respective regions, including Fundación Humedales, The Alexander von Humboldt Institute for Research on Biodiversity and Biological Resources, the World Wildlife Fund - Colombia, Asociación Calidris, Fundación Fuerachoga, the Environmental Studies School of Javeriana University, Fundación Ecotrópico, and Fundación Ecopar. This provided an opportunity to join forces and develop a common conceptual framework to develop inventories throughout the high Andes.

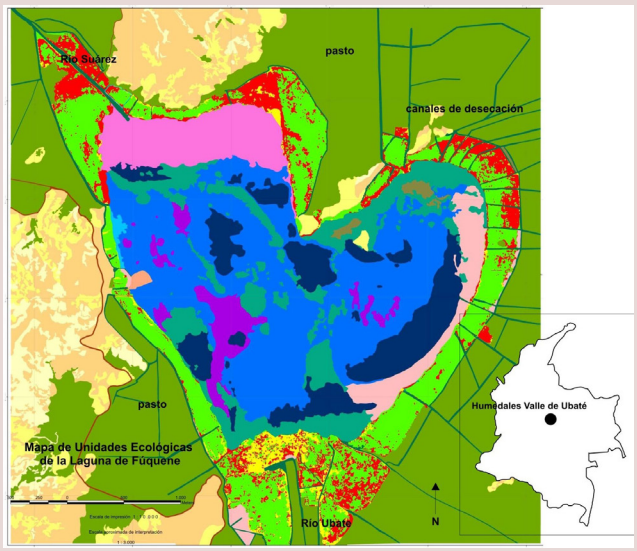
The conceptual framework advanced by HumedAndes has a hierarchical structure of five levels that assist in the location of the wetlands within their geographical range and provide additional information to identify potential threats and causes of degradation: Ecoregions; Biogeographical units for highland aquatic ecosystems; Catchments Areas; Wetland Site; and Habitat. The framework also built on several methodologies recommended by the Ramsar Convention: MedWet/Coast project, the Asian Wetland Inventory protocol, Ramsar guidelines, and the Cowardin System for the classification of wetlands and deepwater habitats.

Among the main contributions of HumedAndes to date are:

- **Successful application of the classification system** for the elaboration of detailed wetland cartography. This approach has allowed the identification of the characteristics specific to each wetland in order to recommend management options that address the particular ecological needs of each structural component in the ecosystem.
- **The development of a number of thesauruses** for standard treatment of thematic issues within the framework of the hierarchical levels. A thesaurus of human interventions and effects on Andean wetlands, and one on wetland values, functions and resources have already been prepared.
- **Fundación Humedales**, in a joint project with the **Alexander von Humboldt Institute**, applied the proposed system to the clasification of wetland habitats and the

development of detailed maps (1:5000) for the Fúquene, Cucunubá and Palacio wetland complex at an altitude of 2,600 masl.

- Under the overall coordination of the **Páramo Internacional** project (Ecuador), several partner institutions elaborated an inventory of Andean wetlands located above 2400 masl. For Colombia a total of 2,398 high Andean wetlands were recorded using the available literature, 86% of them with precise geographical coordinates. However, it is likely that many of these no longer exist.



Habitats of the Laguna de Fúquene wetland, Colombia. Map at 1:5000 scale based on an adaptation of the MedWet/Coast and Cowardin et al. (1979) systems by the HumedAndes Initiative.

- The **Javeriana University's Environmental School** has produced wetland maps using satellite imagery and basic cartographic information, covering the entire Cundinamarca and Boyacá plateau (750,000 ha) at an altitude of 2,600 masl. A total of 221 wetlands were identified and mapped, 52% of them natural and 48% artificial. This study evidenced the lack of information to support management, as no additional information was obtained in 80% of the cases. Fragmentation accounts for most of the degradation observed, and many of the wetlands identified in the literature no longer exist.

- The **Technological and Pedagogical University of Colombia** developed an inventory of the wetlands in Aquitania, an Andean region rich in aquatic ecosystems. A total of 55 wetlands in the altitude range between 1,800 and 3,700 masl were identified and mapped. The wetland area exceeds 6,000 ha, a large portion of which are "páramos". The project also had an important educational component.

- **Asociación Calidris** together with WWF and the Regional Autonomous Corporation of Cauca have been elaborating simple wetland inventories at the 1:25,000 scale. A total of 164 wetlands associated to the flat portion of the Cauca River have been identified at an altitude of 1,000 masl, while an additional 115 wetlands were identified in the Popayán plateau (south of Colombia) at an altitude of 1,800 masl. In the region of Puracé above 3,400 masl a wetland area of 207 ha was identified.

All wetland ecosystems identified and characterized share the common feature of being montane Andean wetlands, and the institutional collaboration and cooperation is contributing to the evaluation and adaptation of wetland inventory protocols proposed under the Ramsar Convention.

All interested persons and institutions are invited to contact: Lorena Franco Vidal (lfranco@fundacionhumedales.org), Coordinator, HumedAndes Initiative, Fundación Humedales (www.fundacionhumedales.org), Bogotá, Colombia.

Further information

Briones, E., Flachier, A., Gómez, J., Tirira, D., Medina, H., Jaramillo, I., & Chiriboga, C. 1997. Inventario de Humedales del Ecuador. Primera parte: Humedales Lénticos de las Provincias de Esmeraldas y Manabí. EcoCiencia/ INEFAN/ Convención de Ramsar. Quito, Ecuador.

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Additional information

MedWet Inventory Methodology

MedWet

The initial steps for the development of the MedWet Inventory Methodology were undertaken jointly in 1992 by the Portuguese *Instituto da Conservação da Natureza* (ICN) and *Wetlands International* (WI) on behalf of the MedWet initiative; subsequently the methodology has been updated and complemented with the work of the *Greek Wetland/ Biotope Centre (EKBY)* and other MedWet partners, including through the EU-funded SUDOE and CODDE projects. For further information on these inventory projects, see: http://www.medwet.org/2010/03/sudoe-inventory-assesment-and-monitoring-for-wetland-management/ and http://www.medwet.org/2010/03/codde/

The MedWet Inventory Methodology has been used or is currently in use for the preparation of national inventories in a number of countries (Albania, Croatia, France, Greece, Morocco, Portugal, Slovenia and Spain). Other countries (including Egypt, Italy and Tunisia) have used the MedWet Inventory methodology through their participation in the MedWet/Coast, MedWet/Regions and MedWet/SUDOE projects. In addition, Algeria, Libya and Turkey have expressed their interest in launching

The Methodology in brief

The MedWet Inventory Methodology was conceived not only as a means to register current knowledge on wetlands in a systematic way, but also as a powerful management tool, allowing in-depth understanding of the situation in each wetland and assessing the impact of management measures. This methodology includes a suite of separate but linked tools which allow the gathering of data at a number of different levels (catchment, site and habitat), namely data sheets, a database, a habitat description system, and photo-interpretation and cartographic conventions.

The *data sheets* allow the standardised collection of information on catchment, site, and habitats, as well as flora, fauna, activities and impacts, references, and meteorology.

The *database* is structured to allow direct entry of data from the data sheets for storing, analysing and presenting the data and reports.

The *MedWet Habitat Description System* is specific for wetlands and supports a detailed recording of the key characteristics (soil, vegetation, water regime and salinity) and structure of each habitat within a site. This system defines a number of categories that allows habitat delineation and the production of precise maps. These groups are organised in a hierarchical way into subsystems, classes and subclasses.

The *photo-interpretation and cartographic conventions* provide specific guidelines for mapping wetland habitats and a standard protocol to maintain consistency of outputs.

national inventories using the MedWet methodology. The long-term goal of MedWet is to achieve a comparable inventory of all Mediterranean wetlands.

Beyond the Mediterranean region, strong interest in the adaptation and use of the Medwet Inventory Methodology has been shown by several states in Africa (Benin, Botswana, Burkina Faso, Cameroon, Niger, South Africa and Togo) and South America (Argentina and Colombia), as well as by Belarus, Malaysia, and Ukraine.

In collaboration with the Regional Activity Centre for Specially Protected Areas (RAC/SPA) of the United Nations Mediterranean Action Plan, a comparative list of the habitat types of Mediterranean coastal wetlands has been developed and adopted by the Member States in an effort to provide them with a coherent, globally accepted tool.

The way forward for the MedWet Inventory Methodology is to enrich it with new components involving the use of remote sensing technologies, such as satellite imaging, in order to allow easier, quicker and less costly applications of the methodology. Such components will also permit the MedWet Inventory Methodology to develop into a dynamic monitoring tool, providing a powerful means for the planning of policy and action at a national or regional level.

The MedWet Inventory Working Group (IWG), chaired by ICN and including representatives from EKBY, Station Biologique de la Tour du Valat, Sede para los Humedales Mediterraneos (SEHUMED), Wetlands International, and the MedWet Coordination Unit of the Ramsar Secretariat, is responsible for developing activities that will lead to the further development and use of the MedWet Inventory Methodology, including the updating of the original suite of inventory manuals.

MedWet inventory manuals and other inventory publications are available at http://www.medwet.org/publications/

Appendix II

Determining the most appropriate remotely sensed data for a wetland inventory

1. The following steps provide an outline procedure for assessing which is the most appropriate remote sensing technique for a particular inventory. The procedure is summarized graphically in Figure 2. [Available remote sensing data sets applicable to wetland inventory are listed in Appendix III.]

2. Much of the information required for this specific determination concerning use of remote sensing can be acquired by following the inventory Framework steps that lead to the choice of an inventory method.

I. Define the purpose and objective

3. Explicitly define the purpose and objective for the inventory (e.g., distribution of specific plant species on a floodplain wetland, baseline data for areas inundated by floodwaters, type of habitats to be mapped, etc.).

II. Determine if remote sensing data is applicable

4. Assess whether remote sensing technology can be applied successfully as a tool to the wetland issues defined previously. This decision will be based on a combination of wetland habitat structure and sensor characteristics and explicitly relates to the spatial and spectral resolution of the remote-sensing device. Expert advice may be needed.

III. Define the wetland characteristics within a remote sensing context

5. Determine the spatial scale most suitable for the habitat structure, the season for data collection, the spectral characteristics and resolution that are critical to sensor choice, and what data and sensors are already available. If multiple surveys are required, determine at the outset the most appropriate temporal scale (e.g., annually or over much longer time periods).

IV. Choose appropriate sensor(s)

6. Assess the spatial and spectral resolution of likely sensors and ensure that they can obtain the environmental information that is required for the defined problem/issue. In some cases several sensors may be required (e.g., Landsat TM fused with polarimetric AirSAR for the identification of salt-affected areas on floodplains dominated by tree species).

7. For each sensor ascertain whether or not it can revisit the site at necessary intervals and whether its application is dependent on seasonal conditions (e.g. optical or radarsensors) and that the costs of the image and its analysis are within the allocated budget.

V. Ground data requirements

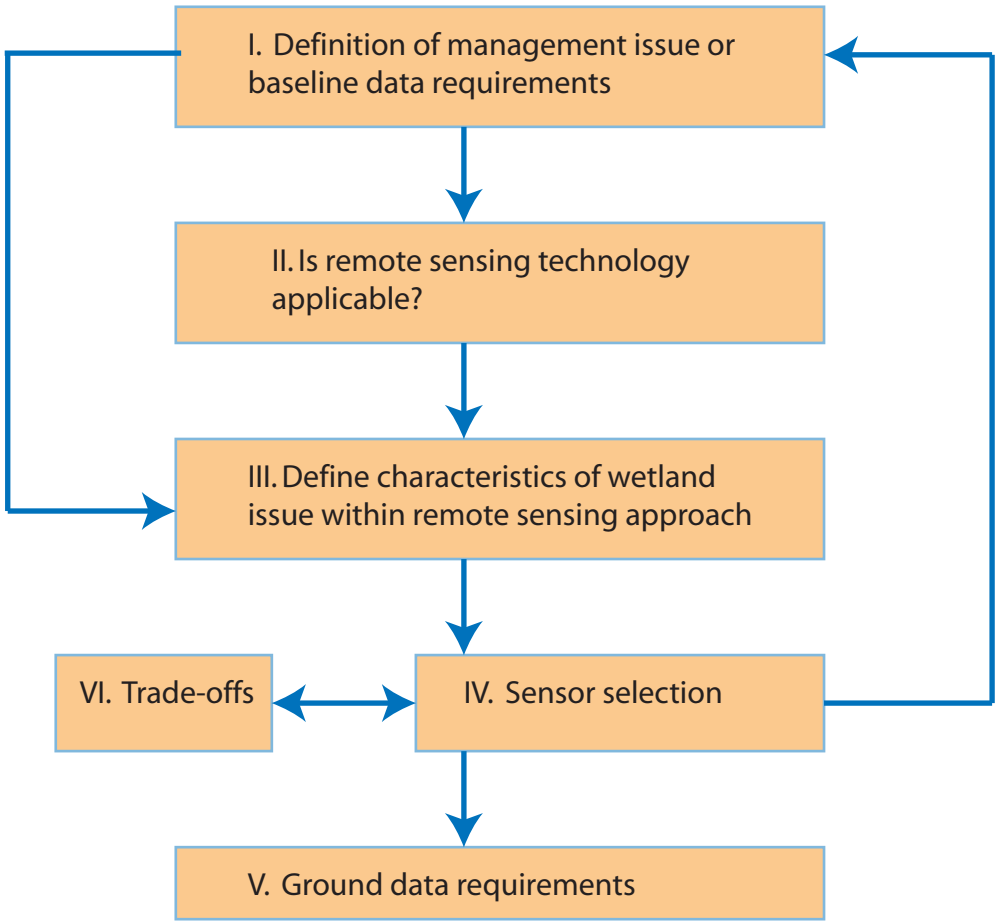
8. Determine a ground sampling strategy suitable for the sensor selected, including whether or not the collection of ground data should be done simultaneously with the acquisition of data from the sensor. Also determine

any potential issues that may influence extrapolation from the ground data, such as scaling-up.

VI. Trade-offs

9. Ascertain if there are any trade-offs when using particular sensors (e.g., what advantages and disadvantages does one data source offer?) and whether these will affect the study (as defined at step I above).

Figure 2. Recommended steps in determining the most appropriate remotely sensed data for use in a wetland inventory



Additional information

Earth Observation technology supporting wetland inventory, assessment and monitoring: the TESEO Project on wetlands

Over the past few decades, Earth Observation (EO) technology has proved to be an increasingly powerful tool to monitor and assess the Earth's surface and its atmosphere on a regular basis. EO satellites, with increasing capabilities, allow a more efficient, reliable and affordable monitoring of the environment over time at global, regional and local scales. In this context, the European Space Agency (ESA), initiated, in 2001, the Treaty Enforcement Services using Earth Observation (TESEO) project, aimed at exploring the capabilities of EO technology to support national and international bodies involved in the implementation of different international treaties of critical environmental importance such as the Ramsar Convention, the UN Framework Convention on Climate Change, the UN Convention to Combat Desertification, and the International Convention for the Prevention of Pollution from Ships (MARPOL).

The TESEO project on wetlands addressed the following questions:

- How can EO contribute to the achievement of the objectives of the Ramsar Convention?
- What are the information needs of the international and national bodies involved in the implementation of the Ramsar Convention?
- How can EO contribute to fulfill those needs?

To answer these questions, ESA contracted an international team led by the Canadian company Atlantis Scientific, after an open tender competition. In addition, a number of key end-user organizations were actively involved in the project to specify their main needs in terms of geo-information products and services, to support the TESEO team in defining key EO-based geo-information products, and to validate and assess the final results. The end-user group included the:

- National Capital Commission of Canada, managers of Mer Bleue, a Ramsar Site in Ottawa, Canada.
- Estación Biológica de Doñana, managers of Parque Nacional de Doñana, a Ramsar Site in southern Spain.
- Centre du Suivi Écologique, managers of Djoudj, a Ramsar Site in Senegal.
- World Resources Institute, an international non-governmental organization.

The project was carried out in three main phases:

1. **Preliminary analysis:** an extensive analysis of the end-user requirements was carried out by directly interviewing end users and conducting an international web-based user survey. As a result of this analysis, three main categories of information requirements were identified:

    - **Identification and physical description of wetlands.** This inventory and assessment information typology involves several physical, biological and chemical features ranging from topography and geology of the wetland site to water quality and vegetation cover. EO technology may provide a significant contribution to fulfill these information needs.

    - **Change analysis for monitoring purposes: land cover, land use, vegetation, water table, or water quality.** The frequent acquisition of EO data allows the regular monitoring of wetland areas. In addition, the existing archive facilities include EO data from the early 1970s, representing a unique source of information for assessing and monitoring the temporal evolution of wetlands.

- **Prevention of, and reaction to, natural and human-made hazards**. This involves the identification and monitoring of potential threats upstream in the basin or the catchment area that may affect the wetland site. For instance, urban expansion, industrial pollution, urban waste and increasing irrigation may represent some threats to the ecological status of a wetland that can be identified and monitored from space. In addition, users identified the need for a rapid mapping capability for assessing natural or human-made hazards such as floods or pollution. EO technology may play a key role in the fast provision of maps of the affected areas.

2. Product and service definition: based on the information requirements collected during the preliminary phase, the project explored the capabilities of existing and future EO technology to respond to the above needs. Different EO-based information products (around 48) were identified in collaboration with the user organisations.

Detail of the land use map generated for Mer Bleue. The different gray levels correspond to different land use types ranging from urban areas and transportation to croplands and farmlands. ***Photo: Atlantis Scientific/ESA.***

3. Product and service implementation: these products were evaluated according to different criteria, ranging from their priority for the user to their technological constraints. From this evaluation three products were selected and prototyped for the Mer Bleue, Doñana and Djoudj test sites:

   - seasonal changes in open water and flooded vegetation;
   - land cover and land-cover change;
   - land use.

The final products were validated and assessed by the users involved in the project. Their feedback confirms the effectiveness of EO technology to provide valuable, synoptic, reliable and continuous information to wetland managers.

As a result of the promising outcomes of the TESEO project and the interest of the user community, ESA is devoting increasing resources to support the development of efficient user-oriented information services for wetland managers based on space technology. To this end, ESA funded a further larger project, GlobWetland, completed in 2008 under which the results of the TESEO project have been consolidated, extended and tested in a large number of Ramsar Sites of different wetland types in Africa, Europe and elsewhere; and in a second phase these approaches are being applied to practical purposes in the Mediterranean region. A further project, GobWetland-II was initiated in 2010 with a focus on wetlands in the coastal zone of the southern and eastern coastas of the Mediterranean, For further information, visit the GlobWetland web site: http://www.globwetland.org/

For further information on the TESEO project, readers are referred to Ramsar COP8 DOC. 35 *The use of Earth Observation technology to support the implementation of the Ramsar Convention*, available at www.ramsar.org/pdf/cop8/cop8_doc_35_e.pdf on the Secretariat's website. Information is also available at http://dup.esrin.esa.it/projects/summaryp56.aspwebsite, or directly from the ESA:

EO Science and Applications Department
European Space Agency
http://www.esa.int.

Appendix III

Summary of remotely sensed data sets applicable to wetland inventory

SATELLITE DATA

Data Type	Spatial Resolution	Coverage	Spectral Resolution	Temporal Resolution	Contact
IKONOS	1m panchromatic 4m multispectral	100km2 (minimum)	Band 1 (blue) = 0.45-0.53µm Band 2 (green) = 0.52-0.61µm Band 3 (red) = 0.64-0.72µm Band 4 (NIR) = 0.77-0.88µm	1-3 days Not routinely collected Data capture must be ordered	**Space Imaging** [http://www.euspaceimaging.com/products/61/]
Landsat 7 ETM	Bands 1-5 & 7 = 30 m Band 6 = 60m Band 8 = 15m	Typical full scene = 184 x 185km (Super scenes up to 60,000km2 and small scenes 25 x 25km are available)	Band 1 (blue) = 0.45-0.52µm Band 2 (green) = 0.52-0.60µm Band 3 (red) = 0.63-0.69µm Band 4 (NIR) = 0.76-0.90µm Band 5 (MIR) = 1.55-1.75µm Band 6 (TIR) = 10.40-12.50µm Band 7 (MIR) = 2.08-2.35µm Band 8 (pan) = 0.52-0.90µm	Every 16 days Data available since April 1999	**EROS Data Center** of the **U.S. Geological Survey** http://landsat7.usgs.gov/
Landsat 5 TM **Due to be decomm-issioned**	Bands 1-5 & 7 = 30m Band 6 = 120m	Typical full scene = 184 x 185km (Super scenes up to 60,000km2 and small scenes 25 x 25km are available)	Band 1 (blue) = 0.45-0.52µm Band 2 (green) = 0.52-0.60µm Band 3 (red) = 0.63-0.69µm Band 4 (NIR) = 0.76-0.90µm Band 5 (MIR) = 1.55-1.75µm Band 6 (TIR) = 10.40-12.50µm Band 7 (MIR) = 2.08-2.35µm		**U.S. Geological Survey** http://edcsns17.cr.usgs.gov/EarthExplorer/
SPOT	Multispectral = 20m PAN = 10m	60 x 60km	Band 1 (green) = 0.50-0.59µm Band 2 (red) = 0.61-0.68µm Band 3 (NIR) = 0.79-0.89µm Band 4 (SWIR) = 1.58-1.75µm* PAN = 0.51-0.73µm/0.61-0.68* *= SPOT4 only	Every 26 days Data available since 1990	SPOT Image http://www.spot.com/

RADAR-SAT	10 – 100m (varies with angles and # of looks)	50 x 50km – 500 x 500km (varies with angles and # of looks)	Single frequency C Band 56 nm HH polarisation variety of beam selections	Data available since 1995 revisit times approx. 6 days at mid-latitudes	Canadian Space Agency (CSA) Canadian Center for Remote Sensing (CCRS) distributed by **Radarsat International** [http://gs.mdacorporation.com/]
JERS **8 optical bands** **SAR L band** **Bands 3 and 4 provide stereo coverage**	18m pixels	75 x 75km	Eight optical bands Band 1 (green) = 0.52-0.60µm Band 2 (red) = 0.63-0.69µm Bands 3 & 4 (NIR) = 0.76-0.86µm Band 5 (MIR) = 1.60-1.71µm Band 6 (MIR) = 2.01-2.12µm Band 7 (MIR) = 2.13-2.25µm Band 8 (MIR) = 2.27-2.40µm SAR BAND = L band235nm HH polarisation	Data available covering years 1992-1998	EOC Earth Observation Centre, National Space Development Agency of Japan [http://www.jaxa.jp/index_e.html]
ALI	10 m – PAN 30 m – MSS	37 km swath	PAN – 0.48-0.69µm Band 1 – 0.48 – 0.69µm Band 2 – 0.433 – 0.453µm Band 3 – 0.45 – 0.515µm Band 4 – 0.525 – 0.606µm Band 5 - 0.63 – 0.69µm Band 6 – 0.775 – 0.805µm Band 7 – 0.845 – 0.89µm Band 8 – 1.2 – 1.3µm Band 9 – 1.55 – 1.75µm Band 10 – 2.08 – 2.35µm	Data captured since November 1990 Captures must be requested Operation expected until 2002(?)	**GSFC NASA's Goddard Space Flight Center** http://eo1.gsfc.nasa.gov/

HYPER-ION	30 m resolution	7.5 km x 100 km	220 spectral bands covering 0.4 – 2.5µm	Data captured since November 1990 Captures must be requested Operation expected until 2002(?)	**GSFC NASA's Goddard Space Flight Center** http://eo1.gsfc.nasa.gov/
ASTER **Advanced Spaceborne Thermal Emission and Reflection Radiometer**	VNIR (bands 1-3) 15m pixels SWIR (bands 4-9) 30m pixels TIR (bands 10-14) 90m pixels	60 km swath	Band 1 - 0.52 - 0.60µm Band 2 - 0.63 - 0.69µm Band 3N - 0.78 - 0.86µm Band 3V - 0.78 - 0.86µm Band 4 - 1.600 - 1.700µm Band 5 - 2.145 - 2.185µm Band 6 - 2.185 - 2.225µm Band 7 - 2.235 - 2.285µm Band 8 - 2.295 - 2.365µm Band 9 - 2.360 - 2.430µm Band 10 - 8.125 - 8.475µm Band 11 - 8.475 - 8.825µm Band 12 - 8.925 - 9.275µm Band 13 - 10.25 - 10.95µm Band 14 - 10.95 - 11.65µm	Coverage is sporadic Data can be downloaded free of charge	ASTER overview [https://lpdaac.usgs.gov/lpdaac/products/aster_overview[
AVHRR **Advanced Very High Resolution Radiometer**	1.1km pixel	2700km swath width	**5 bands** 0.58-12.50um (varying bandwidths)	daily images	NOAA: Online requests for these data can be placed via the **U.S. Geological Survey [Earth Resources Observation and Science (EROS) Center** http://eros.usgs.gov/]

Orbview-4 **Due for launch in 2001**	**Multispectral** 4m pixel **Hyperspectral** 8m pixel **Panchromatic** 1m pixel	**Multispectral** 8km swath width **Hyperspectral** 5km swath width **Panchromatic** 8km swath width	**Multispectral** 4 bands VIS/ NIR **Hyperspectral** 200 bands 0.4-2.5um **Panchromatic** 1 band in VIS	revisit 2-3 days	Orbital Science Corporation Army,Navy,Airforce, **NASA** [http://www.geoeye.com/CorpSite/]
ERS-1 SAR	12.5m pixel	100 km x 102 km	Single frequency C Band (5.3 GHz), Wave length: 5.6 cm; VV polarisation	Data available since 1991 to 1999 revisit times approx.: 3-day, 35-day and 176-day depending on the mode of operation	**European Space Agency (ESA)** http://www.esa.int
ERS-2 SAR	12.5m pixel	100 km x 102 km	Single frequency C Band (5.3 GHz), Wave length: 5.6 cm; VV polarisation	Data available since 1995 revisit times approx.: 3-day, 35-day and 176-day depending on the mode of operation	**European Space Agency (ESA)** http://www.esa.int
ERS-1 ATSR	1 km pixel	512 km x 512 km	4 bands: 1.6µm (visible) and three thermal bands at 3.7µm, 11µm, and 12µm.	Data available since 1991 to 1999 revisit times approx.: 3-day, 35-day and 176-day depending on the mode of operation	**European Space Agency (ESA)** http://www.esa.int

ERS-2 ATSR2	1 km pixel	512 km x 512 km	7 bands: four bands in the visible: 0.55µm, 0.67µm, 0.87µm; 1.6µm and three thermal bands at 3.7µm, 10.8µm, and 12µm.	Data available since 1995 revisit times approx.: 3-day, 35-day and 176-day depending on the mode of operation	**European Space Agency (ESA)** http://www.esa.int
ENVISAT ASAR	30 m, 150 m or 1km depending on the operational mode	Swat with of < 100km, > 400km and in 5km x 5km vignette, pedending on the operational mode	Single frequency C Band (5.3 GHz), HH and VV polarisation	Data available in 2002	**European Space Agency (ESA)** http://www.esa.int
ENVISAT MERIS	300 m (full reesulution) and 1200 m (reduced resolution)	1150km wide swath	15 spectral bands in the 390 - 1040 nm range of the electromagnetic spectrum	Data available in 2002	**European Space Agency (ESA)** http://www.esa.int
ENVISAT **AATSR**	1 Km	512 km x 512 km	7 bands: four bands in the visible: 0.55µm, 0.67µm, 0.87µm; 1.6µm and three thermal bands at 3.7µm, 10.8µm, and 12µm.	Data available in 2002	**European Space Agency (ESA)** http://www.esa.int
AIRBORNE DATA					
HyMap	Typically 2.5m or 5m	Varies with pixel size 5m = 2.5km swath 2.5m = ~1.3km swath	124 bands covering 0.44-2.4µm	Unreliable – user defined and sensor availability	**Integrated Spectronics Pty Ltd** http://www.intspec.com/
HyMap MK1 (AIS)	Usually 5m	Varies with pixel size 5m = 2.5km swath	98 bands covering 0.50-1.1µm, 1.45-1.80µm, 1.95-2.45µm	Unreliable – user defined and sensor availability	Integrated Spectronics Pty Ltd http://www.intspec.com/

CASI **Compact Airborne/ Spectrograp-hic Imager**	Typically 1m	Depends on spatial resolution 1m pixel = ~500m swath	**Variable bands (~19-288)** (~2-12nm wide) 0.40-1.0um Typically 96 bands covering visible to NIR	Unreliable – user defined and sensor availability	Manufactured by **Itres Research Ltd.** http://www.itres.com/ **BallAIMS** [http://www.ballaerospace.com]
Daedalus	Spatial resolution determined by aircraft flying height. A 1000 metre increase in flying height = 2.5 metre pixel size increase.	Image swath = Flying Height x 1.6	Band 1 – 0.42-0.45µm. Band 2 – 0.45-0.52µm. Band 3 – 0.52-0.60µm. Band 4 – 0.605-0.625µm. Band 5 – 0.63-0.69µm. Band 6 – 0.695-0.75µm. Band 7 – 0.76-0.90µm. Band 8 – 0.91-1.05µm. Band 9 – 1.55-1.75µm. Band 10 - 2.08-2.35µm. Band 11 - 8.5-13.0µm. Band 12 Band 11 X0.5 or X2 Gain.	Unreliable – user defined and sensor availability	Air Target Services http://www.airtargets.com.au/index.html
AIRSAR **Airborne Synthetic Aperture Radar**	Slant range resolution of 10m Azimuth resolution of 1m	Ground swath = 10-15km	P, L, C bands Interferometric with L and C Runs in several modes including high resolution 80MHz SAR, TOPSAR (data coregistered with DEMs, ATI mode (C and L bands along track)	Unreliable, see PACRIM missions	JPL/NASA http://airsar.jpl.nasa.gov/
MASTER **Modis ASTER airborne simulator**	5-50m pixel (depending on flight height)	Swath varies with flying height	**50 bands** 0.40-13.0um	Unreliable, see PACRIM missions	JPL/NASA http://masterweb.jpl.nasa.gov/

AVIRIS **Advanced Visible/ Infra-Red Imaging Spectrom_r**	20m pixel	11.5km swath width	**224 bands**(10nm wide) 0.40-2.50um		**NASA-JPL** [http://aviris.jpl.nasa.gov/]
Airborne Digital Cameras	Spatial resolution determined by aircraft flying height. Typically 0.5 – 1 m resolution.	Swath of image depends on aircraft flying height	Typically colour (RGB) or colour infrared (IR, R, G)	Unreliable – user defined	Contact local companies. Example **Specterra Systems Pty Ltd** http://www.specterra.com.au/
Airborne CIR / Colour / Black and White photos	Spatial resolution determined by aircraft flying height.	Swath of image depends on aircraft flying height	Typically colour (RGB), colour infrared (IR, R, G), or black and white	Unreliable – user defined	Contact local companies. Example FUGRO Airborne Surveys http://www.fugro.com/
LIDAR	Absolute elevation accuracy of 15 cm.	User defined	Varies, depending on type of laser selected.	Unreliable – user defined.	A number of different LIDAR systems made by different manufacturers.
FIELDBASED					
Spectro-meters	Varies – typically nanometres - metres	Varies – typically millimetres - metres	Continuous spectral curve. Range varies from UV-SWIR Typically 0.4 - 2.5µm	Unreliable – user defined and sensor availability	**For hire** contact local companies. **For purchase** contact **Analytical Spectral Devices Inc** http://www.asdi.com/

Appendix IV

Wetland classifications

A wide range of different wetland classifications are in use around the world. An annotated summary of some of these wetland classifications is given below, listed in order of their date of publication.

No single classification is likely to meet all needs of different wetland inventories. Rather it is recommended that a classification suited to the purposes of a particular inventory should be chosen or developed.

In some cases it may be possible to derive a classification from the core information collected in the inventory, such as proposed for the Asian Wetland Inventory, or to establish a mechanism to compile and present information on wetland types under several different classifications, as has been done for the MedWet inventory. However, it should not be assumed that an existing classification will suit all inventory purposes.

USA national wetland classification

Description Hierarchical classification containing 5 levels that describe the components of a wetland, namely, vegetation, substrate composition and texture, water regime, water chemistry and soil. It contains vegetated and non-vegetated habitats.

Reference Cowardin, Carter, Golet & LaRoe 1979; Cowardin & Golet 1995

URL [http://www.fws.gov/wetlands/_documents/gNSDI/ClassificationWetlandsDeepwaterHabitatsUS.pdf]

Hydrogeomorphic classification – Australia

Description Based on landforms and water regimes with further sub-divisions based on areal size, shape, water quality and vegetation features. A binary format for describing wetland habitats is provided.

Reference Semeniuk 1987; Semeniuk & Semeniuk 1997.

Classification of wetlands in the countries of Western Europe: CORINE BIOTOPES (1991)
Classification of Palearctic Habitats (1996)
EUNIS Habitats Classification (2002) (EUropean Nature Information System)

Description European standard for hierarchical description of natural or semi-natural areas, including wetland habitats. Habitats are identified by their facies and their flora. EUNIS Habitat classification (2002) integrates earlier classifications (CORINE-Biotopes, Palearctic Habitat Classification) and establishes links with other Classification types (CORINE-Land-Cover typology, Habitats Directive Annex I, Nordic classification system, and other national systems).

Reference European Communities 1991; Devillers, & Devillers-Terschuren 1996; Davies & Moss 2002.

URL [http://eunis.eea.europa.eu/introduction.jsp]

Ramsar Classification System for Wetland Type

Description Hierarchical listing of wetland habitats loosely based on the USA national wetland classification. It has been modified on several occasions since introduction in 1989 so as to accommodate further habitats of interest to the Contracting Parties to the Ramsar Convention.

Reference Scott & Jones 1995; Ramsar Bureau 2000.

URL [http://www.ramsar.org/cda/en/ramsar-documents-info-information-sheet-on/main/ramsar/1-31-59%5E21253_4000_0__#type]

MedWet Mediterranean wetland classification

Description Hierarchical listing of wetland habitats loosely based on the USA national wetland classification with modifications made to reflect the range of wetland habitats around the Mediterranean. Software that accompanies the methodology enables other classifications commonly used in the region to be generated from the database.

Reference Hecker, Costa, Farinha & Tomas Vives et al 1996

URL [http://www.medwet.org/publications/]

Canadian wetland classification

Description Hierarchical listing of habitats based on broad physiognomy and hydrology, surface morphology and vegetation physiognomy. Further characterisation is based on the chemical features of the habitat.

Reference National Wetlands Working Group 1997; Zoltai & Vitt 1995.

URL [http://www.wetlandscanada.org/Wetland%20Classification%201997.pdf]

South African wetland classification

Description Adaptation of the "Cowardin" wetland classification developed in the USA. Includes adaptations to reflect the functional aspects of wetlands based on geomorphic and hydrologic features. It is hierarchical and able to accommodate all wetland types in the region.

Reference Dini & Cowan 2000

URL [Web-based information not available]

Asian wetland classification

Description Based on landforms and water regimes. Classification can be derived from the core data fields and augmented with information on vegetation, areal size, and water quality.

Reference Finlayson, Howes, Begg & Tagi 2002 Finlayson, Howes, van Dam, Begg & Tagi 2002.

URL [Web-based information not available]

Appendix V

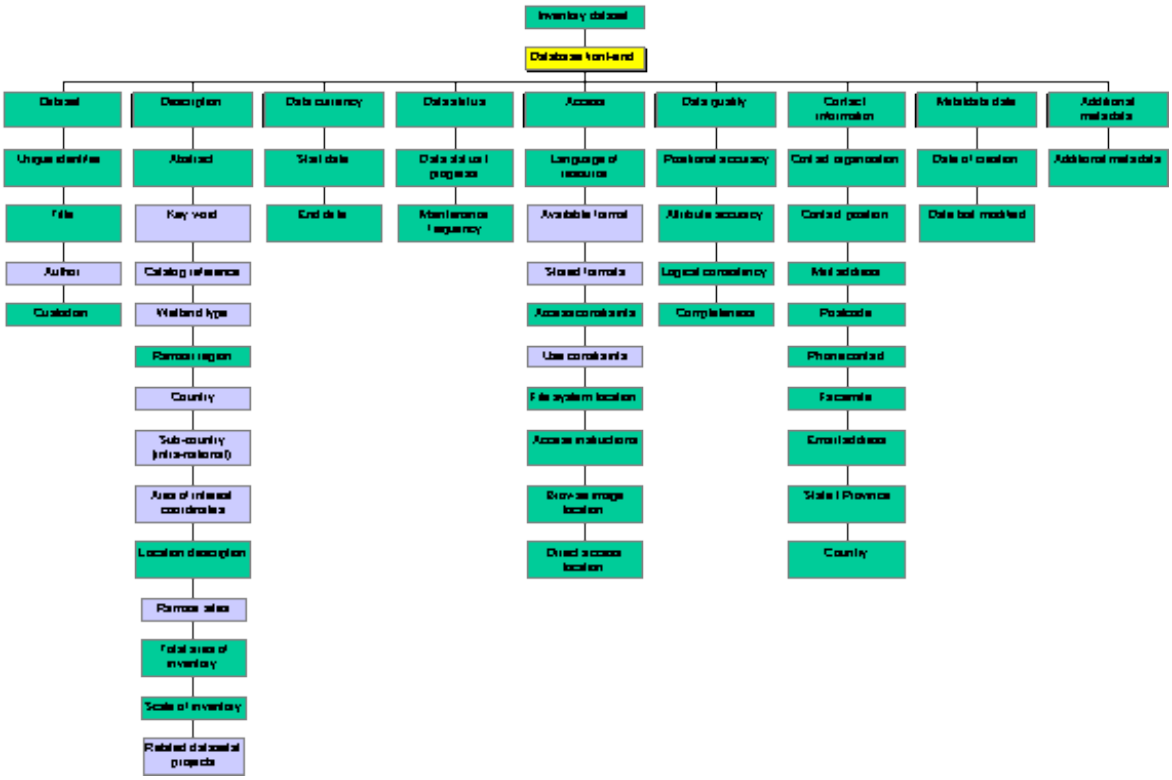
Recommended standard metadata record for the documentation of wetland inventories

The following figure and table summarize the standard structure of a wetland inventory metadata record, designed to assist all those undertaking wetland inventory in documenting and making publicly available information about their inventory, in line with Resolution VII.20.

The inventory metadata record is based on, and consistent with, global standards for metadata recording, (e.g., ISO/DIS 9115 Geographic Information Metadata), and has been prepared for the Ramsar Convention by the Environmental Research Institute of the Supervising Scientist, Australia, with the financial support of the government of the United Kingdom, to support the development of the [second] phase of the *Global Review of Wetland Resources and Priorities for Wetland Inventory (GRoWI 2)*.

Further guidance on the application and use of this inventory metadata standard record for reporting wetland inventory has been published as *Ramsar Technical Report* No. 4 (2010) available at www.ramsar.org/pdf/lib/lib_rtr04.pdf.

Figure 3. Diagrammatic representation of the wetland inventory metadatabase framework



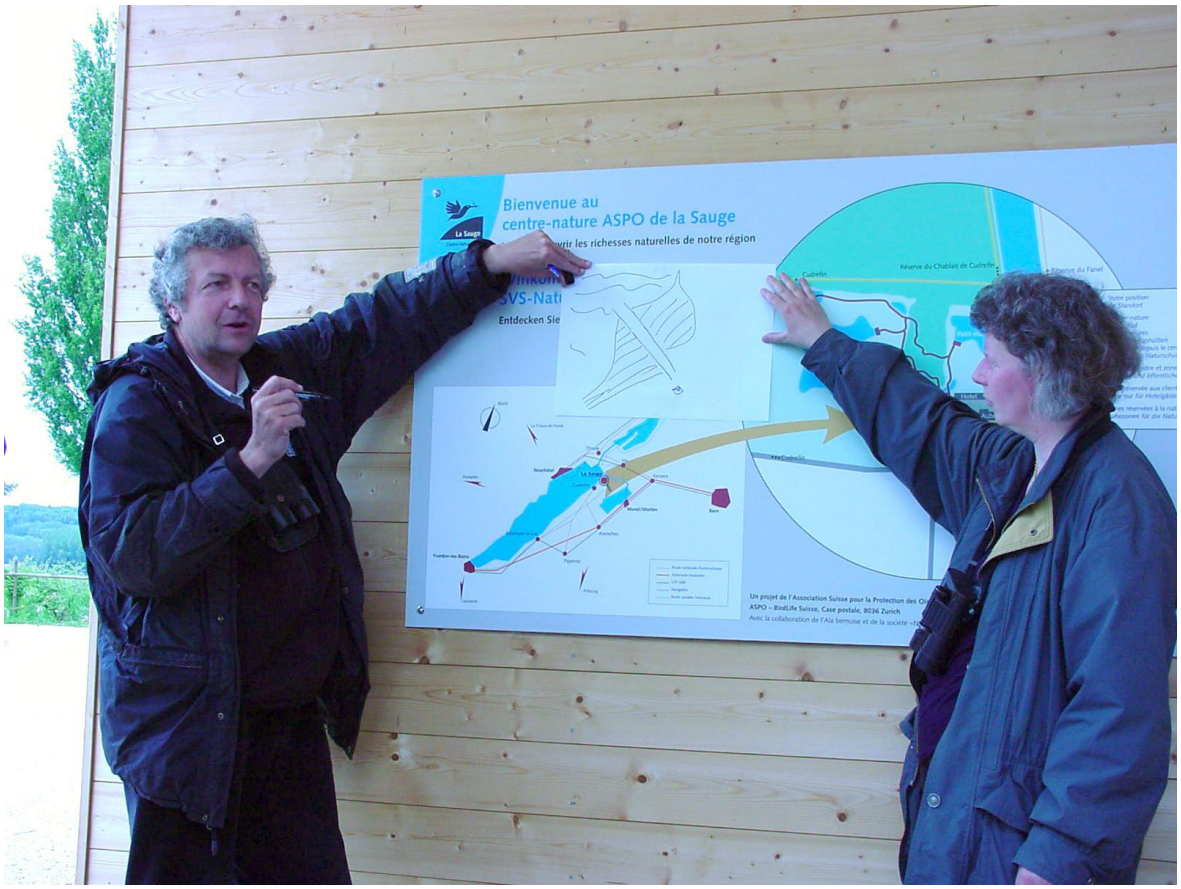
green = Single entry data field purple = Multiple entry data field

Table 4. Description of the fields of the wetland inventory metadatabase

FieldName	Field Description
UNIQ_ID	Unique identifier for each wetland inventory dataset
TITLE	Title of Inventory/ Dataset
AUTHOR	Author / dataset creator
CUSTOD	Organisation/ individual with custodial rights to the data
ABSTRACT	Abstract – summary or short description of the contents of dataset / inventory activity
KEYWORD	Words that may be used to search for a particular dataset. Choose three-five words that describe the key inventory activities i.e. remote sensing – vegetation, and which can be used to search on in database;
CAT_REF	Library catalog reference – e.g. ISBN number – if applicable to dataset
WETL_TYP	Type(s) / nature of wetland(s) being described in inventory
RAMSAR_R	Ramsar region – choose from standard Ramsar 4 letter codes i.e. EEUR; AFRI; etc
COUNTRY	Countries in area of inventory dataset – choose from standard 2-letter ISO country code [http://www.iso.org/iso/english_country_names_and_code_elements]
SUB_COUN	Intra-national regions, described in free text; corresponds with sub_nation field in Wetland Inventory metadatabase
COORDS	Bounding coordinates of area – entered as degrees-minutes-seconds for upper left hand, and lower right hand areas; alternatively, could put in series of coordinates which define the perimeter of the inventory area
LOC_DESC	Freehand description of area
RAMSAR_L	Name of Listed Ramsar Sites in area – if appropriate
INV_AREA	Total area covered by inventory i.e. a few hectares; '000s of kilometres^2
SCALEINV	Textual descriptions to complement the inventory area values – for example, "large scale"; "small scale" inventory, which could be used as search features to locate particular datasets.
REL_DATA	Related datasets. Names of related files / datasets within the overall inventory.
INV_START	First date of information in the inventory dataset
INV_END	Last date of information in the inventory dataset
INV_STAT	Status of progress on the process of creation of the inventory dataset – complete / incomplete
FREQ_MAIN	Frequency of maintenance / changes / updates to the dataset – regular / irregular/ none planned

LANG_RES	The language in which the dataset was created in i.e. English; Spanish; Vietnamese
AV_FORM	The formats in which the inventory dataset is available in, specifically identifying whether the data is available in digital and/or hard copy formats; in the former case, including a list of forms it is available in i.e. Access database; ArcInfo coverage; Text file etc.
STORFORM	The form or formats in which the dataset is stored by the custodian.
ACC_CONS	Access constraints – e.g. may not be available to general public; use may require a license agreement to be signed
USR_CONS	User constraints – e.g. may not reproduce data without payment of royalty or signing of a license that outlines agreed usage of information
NFS_LOC	Dataset network file system locations – may be entered as a URL address
ACC_INST	Data Access instructions on how to access dataset
IMG_LOC	The location of a browseable image – if applicable to dataset
DIR_LOC	Locations on network from which dataset may be directly accessed – if applicable
DATA_LIN	Data quality – lineage. A brief description of the source(s) and processing / analytical steps and methodology which were used in the creation of the dataset.
POS_ACC	Positional accuracy – a brief assessment and description of the location of spatial features in the dataset relative to their true position on the earth. Information could include whether a differential GPS was used, for instance.
ATTRIB_ACC	Attribute accuracy – a brief assessment of the reliability assigned to features in the dataset, relative to their real world values. For example, was a particular sampling intensity utilized in mapping an area
LOGIC_CON	Logical consistency. A brief description of the logical relationships between items in the dataset. For spatial datasets, this may take the form of a topological consistency check, to ensure that all polygons are closed, nodes are formed at the end of lines, and that there is only one label within each polygon.
DATA_COM	Completeness. A brief assessment of the completeness of the dataset, classification, and verification.
CONT_ORG	Contact organisation (option of adding new organisation, or choosing from existing list of organisations)
CONT_POS	Contact position
MAIL_ADD	Mailing / Postal address for contact position and organisation
POSTCODE	Postcode of mailing address
CONT_PH	Phone number of contact position – should include international direct dial code (IDD), and specify whether local code includes a zero or not when using IDD (e.g. ++ (IDD) (0) xx xxxx xxxx)
CONT_FAX	Facsimile of contact position – should include international direct dial code(IDD), and specify whether local code includes a zero or not when using IDD

CONT_EM	Electronic mail address of contact position.
CONT_STA	State / Province in which contact organisation located.
CONT_COU	Country of contact organisation.
META_NEW	Date metadata was created (automatically generated when file created)
META_MOD	Date metadata last modified (automatically generated when file modified)
META_CIT	Citations for metadata; list of other documents, products which cite or use the products described in the metadata record
ADD_META	Additional metadata – reference to other directories or systems that contain additional information about the dataset.; links to additional metadata records, particularly for GIS and remotely sensed products.



Werner Müller, head of the BirdLife International affiliate in Switzerland, explaining management strategies at La Sauge, part of the Baie du Fanel et Le Chablais Ramsar Site (*Photo: Ramsar*)

Appendix VI

Reading list

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Additional Appendix

Global Review of Wetland Resources and Priorities for Wetland Inventory

Summary Report

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Report to the Bureau of the Convention on Wetlands (Ramsar, Iran, 1971) from Wetlands International & the Environmental Research Institute of the Supervising Scientist, Australia

Project Team

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Executive summary

1. This summary is based on reviews of the extent of wetland inventory in each Ramsar region. These were supplemented by a review of regional and international wetland inventories. Standardised data collation and recording formats were used in each of the reviews.

2. It is important to note that these reviews were limited by available funds and time, and that further effort will unearth more information.

3. It was not possible to make reliable overall estimates of the size of the wetland resource globally or regionally. Some good examples of wetland inventory processes exist (e.g., the Mediterranean Wetlands Initiative - MedWet), but many inventories allowed only a cursory assessment of the extent of wetland area or condition. Whilst not undermining the value

of individual inventories, this highlights wetland inventory as being incomplete and difficult to undertake.

4. Recommendations are made to improve the accuracy of quantifying and describing the wetland resource through wetland inventory, and to provide the basic information required for managing the wetland resource.

5. Recommendations focus on the need to conduct national inventory programmes and the inclusion of basic information on the location and extent of each wetland and its major ecological features as a forerunner to collecting further management-oriented information.

6. Development of standardised methods for data collection, collation and storage are called for. These methods should address the use of relatively new techniques for collecting and interpreting remotely-sensed data; storing this in electronic formats, including Geographic Information Systems (GIS); and recording key information in a meta-database.

7. The key conclusion of this review is that little is still known about the extent and condition of the global wetland resource. On a regional basis only parts of North America and Western Europe have adequate past and current inventory. Without good inventory it is difficult to promote and support the wise use of the wetland habitats covered by the Ramsar Convention.

8. Priority habitats for future inventory are identified. These are seagrasses, coral reefs, salt marshes and coastal flats, mangroves, arid-zone wetlands, peatlands, rivers and streams and artificial wetlands.

9. The Ramsar Convention should play a pivotal role in implementing these recommendations.

Recommendations

10. This review makes many critical comments on the state of global wetland inventory. In summary, global wetland inventory is incomplete and inadequate for most management purposes. From our many comments, eight are recommended for priority action. These reflect the effort required to implement an effective inventory programme as the basis for wise use of the global wetland resource. Not all recommendations are, however, relevant to all geographic situations or inventory programmes.

    10.1 All countries lacking a national wetland inventory should undertake one, using an approach that is comparable with other wetland inventories and for which the Ramsar Convention should provide guidance (see below). These inventories are needed to underpin national planning, policy development and all efforts directed at wetland conservation and wise use promoted by the Ramsar Convention and other related conventions. The inventories will assist in identifying wetlands of national and international importance, and through this will contribute to the Ramsar Convention achieving its vision for the List of Wetlands of International Importance (Resolution VII.11).

10.2 Quantitative studies of wetland loss and degradation are urgently required for much of Asia, Africa, South America, the Pacific Islands and Australia.

10.3 Further inventory should focus on a basic data set describing the location and size of each wetland and its major biophysical and hydrological features, including variations in area and the water regime. This information should be made available in both hardcopy and electronic formats.

10.4 After acquisition of the basic data, further information oriented to management, on wetland threats and uses, land tenure and management regimes, benefits and values, should be collected. Source(s) of information should be clearly recorded along with comments on its accuracy and availability.

10.5 Each inventory should include a clear statement of its purpose and the range of information that has been collated or collected. This extends to defining the habitats covered and the date the information was obtained or updated.

10.6 The Ramsar Convention should support the development and dissemination of models for improved globally-applicable wetland inventory. These should be derived from existing models, for example the MedWet Initiative, that are capable of using both remote sensing and ground techniques, as appropriate. Models should cover appropriate habitat classifications (e.g., those based on landform categories), information collation and storage, in particular Geographic Information Systems for spatial and temporal data that can be used for monitoring purposes.

10.7 The Ramsar Convention should support development of a central repository for both hard-copy and electronic inventories. The meta-data that describe the inventories should be published on the World Wide Web for greater accessibility.

10.8 Further support is required for completion of the global review of wetland resources and priorities for wetland inventory; and to develop procedures for regular updating and publishing of inventory information on the World Wide Web. Regular updating (e.g., in conjunction with the triennial national reporting to the Ramsar Convention) may require restructuring the format and style of the current databases and bibliographic materials supplied by this project.

Background and objectives

11. Knowing the location, distribution and character of wetlands, their values and uses, and the threats to them is an essential basis for developing and implementing management for their wise use. This is required at geographical scales ranging from local site management, through development of national policies to global priority setting.

12. Differences in the purpose and use of wetland inventories mean that the information that is collated is often not readily accessible for broader uses

or users. Much of this information is scattered so it has not been clear where adequate inventory information exists, nor where are the major gaps.

13. Action 6.1.3 of the Ramsar Convention Strategic Plan 1997-2002 is to "utilise information from regional wetland directories, national scientific inventories of wetlands and other sources, to begin development of a quantification of global wetlands resources, as baseline information for considering trends in wetland conservation or loss." A pledge of funding for this action was made by the United Kingdom at the 6th Conference of the Contracting Parties of the Convention (Brisbane, 1996) and resulted in this review.

14. There were three aims of the review:

    14.1 To provide an overview of international, regional and national wetland inventories (including regional and national directories of important wetlands), as well as other general information on global wetland resources from publications, Ramsar Convention literature, and information collected by other institutions doing work on the same or related subject(s);

    14.2 To provide recommendations for how to proceed to meet the objective as set out in Action 6.1.3 of the Ramsar Convention Strategic Plan for the current data holdings identified through 14.1 above;

    14.3 To identify the priorities for either establishing, updating or extending wetland inventories so as to improve the accuracy with which the global wetland resource can be quantified and described in future.

15. Wetlands International undertook the review during 1998 under a contract from the Bureau of the Convention on Wetlands (Ramsar, Iran, 1971). Collation and assessment work was undertaken through subcontracts with Wetlands International's regional and subregional licensees and the Environmental Research Institute of the Supervising Scientist, Australia, supporting Wetlands International's Wetland Inventory and Monitoring Specialist Group. A steering committee comprised of representatives of the Ramsar Bureau, the Wetlands International licensees, the UK Government and invited experts was established to review progress and outputs.

16. Members of the steering committee and project teams met in a workshop held in association with the 2nd International Conference on Wetlands and Development in Dakar, Senegal, during November 1998, to review progress with the project reports.

17. As funding was considered to be an absolute minimum for satisfactorily undertaking the project, it was linked to other Wetlands International work under the Biodiversity Conservation Information System (BCIS) initiative. The BCIS project is developing guidance for wetland assessment and inventory and proposals for developing improved wetland inventory and assessment tools. Work in Wetlands International - Africa, Europe, Middle East was conducted jointly with another wetland inventory project in Europe. This contributed information to support the European component of the project and permitted completion of a more detailed compilation and analysis for the African and European Ramsar regions.

Methodology

18. Initial work focused on the development of definitions for inventory categories, the scope and procedures for identifying inventory sources, and for the compilation and handling of inventory information. This was essential to ensure that compilation and handling of information was consistent between regional teams. Three information handling tools were developed:

    18.1 *Wetland inventory assessment sheet* - to permit rapid compilation and assessment of information on each wetland inventory.

    18.2 *Wetland inventory assessment database* - to store the information compiled from the wetland inventory assessment sheet.

    18.3 *Bibliographic database* - to compile details of inventory information that was in a report format, and to allow later searching.

19. These tools were used in reviews of the extent of inventory information available for each of the seven Ramsar regions – Africa, Asia, Eastern Europe, Neotropics, North America, Oceania, and Western Europe. Regional reviews were based primarily on national inventories, although subnational reviews were used where these covered a large area or a major administrative zone. The regional reviews were supplemented by a review of continental and global scale inventory sources. All reviews and their supporting databases are available as hardcopy and on CD-ROM. Only a summary is presented here.

Results & Conclusions

General information

20. Based on the reports for the seven Ramsar regions, it is clear that the extent of global wetland inventory effort is patchy – it does not provide a comprehensive information base for the wise use and monitoring of wetlands. There are many gaps in coverage. Much information is outdated or incomplete and there is very little information on wetland assessment or values derived from wetlands. Thus we do not yet know, at the global level, what wetlands we have and the sum total of their values.

21. Much of the inventory effort has not progressed beyond the collation of existing information. Further, such compilations often used differing sources of information without providing an indication of the age or reliability of the information, or even an adequate reference to the source material.

22. Except for a few imagery-based programs, many inventories do not provide a basis for monitoring the status of wetlands. Even basic questions about wetland extent and distribution are still not answered. This basic information is not readily available for much of Africa, Asia, Eastern Europe, the Neotropics, and Oceania. Notable exceptions are provided by national inventory efforts in the USA and some Western European countries.

Extent and distribution of wetlands

23. Data on the extent and distribution of wetlands at various scales, from global estimates to the areal extent of particular wetland types at specific sites, were

obtained. *However, there is considerable inconsistency in the information, with data unavailable for some sites or countries*.

24. Based on current information it is not possible to provide an acceptable figure of the areal extent of wetlands at a global scale. First, there is little agreement on what constitutes a wetland. Secondly, there are many gaps and inaccuracies in the information. *Thus, the 'best' minimum global estimates provided below are indicative only:*

• natural freshwater wetlands	570,000,000 ha
• rice paddy	130,000,000 ha
• mangroves	18,100,000 ha
• coral reefs	30-60,000,000 ha

25. Based on the above figures the area of wetlands worldwide ranges from 748,000,000 – 778,100,000 ha, but this does not include many wetland types, such as saltmarshes and coastal flats, seagrass meadows, karsts and caves, and reservoirs. Previously published global estimates range from 560,000,000 – 970,000,000 ha.

26. Anything but a cursory consideration of the above values is immediately thrown into doubt when the regional minimum estimates for wetland area are considered.

• Africa	121,322,000 – 124,686,000 ha
• Asia	204,345,000 ha
• Eastern Europe	229,217,000 ha
• Neotropics	134,804,000 – 1,782,103,000 ha
• North America	244,903,000 – 2,057,369,000 ha
• Oceania	35,750,000 ha
• Western Europe	28,822,000 ha

27. The above figures total 999,165,000 ha – 4,462,292,000 ha, which is well in excess of the best global estimates given above.

28. These major discrepancies in the areal estimates make their usefulness very dubious. The discrepancies can be attributed to many factors, such as differences in the definition of wetlands, the techniques used to collect and interpret the basic data, and the scale of the analyses. It is not possible to make an objective assessment of the various figures given as many inventories merely repeat previously gathered information and/or do not clearly describe the methods being used and the accuracy and reliability of the data, especially in relation to determining the boundaries of seasonal and intermittently flooding wetlands.

Wetland types and definitions

29. The broad Ramsar definition of a wetland was adopted in 1971 and is now commonly used in many countries. It has provided, generally with modification, the basis for many national wetland inventories. However, this is not always the case and many inventories are restricted to more specific habitats (e.g. lakes, mangroves or reefs) or do not include both marine and inland wetlands (e.g., the continental scale inventories of Asia and Africa).

30. In many inventories there was no clear definition made of the range of habitats being considered. This is confusing given that the range of wetland habitats covered in inventories varies from coral reefs to coastal mangroves inland to high-altitude lakes and bogs.

31. Artificial wetlands are an important part of the wetland resource in many regions (e.g. rice paddy in Asia), but these habitats are often not included in wetland inventories and were not equally considered in the regional reviews that supported this summary analysis.

32. Regardless of which wetland definitions were used the boundaries of wetlands were often not given, making comparisons between different sources difficult, as did the variable treatment of individual wetlands in wetland complexes.

Rate and extent of wetland loss and degradation

33. Outside Western Europe and North America there is very little information available or attempt made to calculate wetland loss on a systematic basis. The loss of wetlands worldwide has been estimated at 50% of those that existed in 1900 - a figure that includes inland wetlands and possibly mangroves, but not large estuaries and marine wetlands such as reefs and seagrasses. Much of this loss occurred in the northern temperate zone during the first half of this century. However, since the 1950s tropical and subtropical wetlands, particularly swamp forests and mangroves, have increasingly been lost.

34. Agriculture is considered the principal cause for wetland loss worldwide. By 1985 it was estimated that 56-65% of available wetland had been drained for intensive agriculture in Europe and North America, 27% in Asia, 6% in South America and 2% in Africa.

35. Linked with the rate and extent of wetland loss and degradation worldwide is the issue of water allocation and distribution. Many rivers around the world have been heavily regulated by the construction of dams to satisfy the increasing demand for irrigation and hydropower. Impacts on the rivers and associated natural waterbodies, swamps, and marshes include increased salinisation, diminishing underground water reserves, declining biodiversity and impoverishment of fish stocks due to impeded migration and degraded habitat.

36. Impacts are not limited to inland or coastal wetlands. A recent study of coral reefs indicated that 58% of the world's reefs are at moderate to high risk of damage from human disturbance. Globally, 36% of all reefs were classified as threatened by overexploitation, 30% by coastal development, 22% by land-based pollution and erosion, and 12% by marine pollution.

37. The Ramsar Site database provides a regularly updated, but still uneven analysis of threats to wetlands. Data provided by Ramsar Contracting Parties indicated that 84% of Ramsar-listed wetlands had undergone or were threatened by ecological change. The most widespread threats were from pollution, drainage for agriculture, settlements and urbanisation, and hunting.

Land tenure and management

38. Many of the continental, and some national, wetland inventories contain generic information on land management and land tenure. Generally this is in the form of basic statements about jurisdiction, conservation status, and proposed conservation measures. This information is usually brief and often does not outline the effectiveness or otherwise of land tenure measures in protecting wetland resources.

39. In Asia and parts of Oceania, despite some progress in implementing conservation legislation, many countries still require means to enforce safeguards against increasing pressures due to population increases. This is particularly urgent for mangrove conservation.

Wetland benefits and values

40. Many of the inventory sources provided some information on the values and benefits of wetlands. However, this was usually in the form of a summary of the biodiversity values and human use, with little quantitative or economic data being given. Exceptions are the productivity of artificial wetlands, such as rice paddy, fish ponds and salinas.

41. At a global scale the values and benefits of all wetlands for biodiversity conservation and human uses have been outlined. Information is most detailed for mangroves, where values and benefits include coastal protection, flood reduction, sediment accumulation, fish and crustacean nurseries. Similar descriptions are available for peatlands.

42. In Europe there has been an emphasis on the values of protected areas, in particular on the basis of their value as breeding or feeding habitat for birds. This emphasis has also been repeated elsewhere, but not usually as thoroughly. Protected areas are valued by people for various reasons, including conservation, tourism and fishing.

Extent and adequacy of updating programs

43. Few inventories have been regularly updated. At a national level the status and trends analyses done in the USA make a comprehensive attempt to provide updated information. As few other studies were identified the overall extent of wetlands and wetland loss cannot be determined.

44. The Ramsar Convention Bureau provides an updated directory of the sites included in the List of Wetlands of International Importance every six years. The List is fast approaching 1,000 sites with a total area in excess of 70 million hectares and is now available on the World Wide Web and CD-ROM as well as in hardcopy. However, the directory does not contain a comprehensive updated overview of all sites.

45. The apparent absence of regular updating of wetland inventories is not unexpected given the overall cost and logistical effort of conducting and publishing (in hard copy) such work. Recent development of 'user-friendly' database packages and increased availability of electronic information systems, such as Geographic Information Systems (GIS) and the World Wide Web, is increasing the options available for data storage, analysis and access.

It is increasingly possible to store wetland inventory information in an electronic database and make it widely accessible.

Standardising of inventory approaches

46. There is inadequate standardisation of inventory techniques, including the means of recording and reporting the basic information that is necessary for determining, with confidence, the status of wetlands worldwide. Inventories often lack basic information, notably the objective or purpose of the inventory, the wetland definition and classification systems used, the method(s) of data collection, source data for statistics of wetland area and wetland loss, name and affiliation of the compiler for individual site data, a programme for updating the inventory, etc.

47. The development of a standardised and flexible framework for wetland inventory will help individual countries to prepare national wetland inventories not only in a format compatible with their objectives but also compatible with the inventory of neighbouring countries. This would greatly improve the capacity for comprehensive wetland inventory on a regional, and ultimately global, scale.

48. Using electronic data storage systems such as databases and Geographic Information Systems linked to the World Wide Web will enhance the availability of data and related information (e.g. bibliographies) for particular countries and wetland sites. It will also permit regular, cost-effective updating of inventory information.

49. Countries with limited resources or expertise in wetland inventory may particularly benefit from access to standardised or generic wetland inventory methods, including generic databases for recording and storing basic inventory programme information. This information could then be added to a globally accessible meta-database, such as that developed by BCIS, to ensure that details and contacts are available to others for future access to the inventory.

50. Such standardisation could be derived from existing models, notably the Mediterranean wetland inventory (MedWet) and the United States Fish and Wildlife Service national wetland inventory. The remote sensing techniques and the classification systems used in these approaches have been successfully adapted for use in other countries and could provide a basis for a standardised framework and/or generic wetland inventory database.

51. There are regular calls for the increased use of remote sensing technology for wetland inventory. These techniques are available and many are being tested for different wetland habitats. The emphasis should not be on wholesale adoption of such techniques, but rather on the development of models that suit particular purposes and which are linked to on-the-ground management activities, including effective ground truthing and monitoring.

52. Overall, given the difficulties in obtaining even the most basic information for many wetlands, there is a need to identify a basic data set to describe the wetland. This would include the location and area and the basic features of the ecological character that provides values and benefits to humans. The latter would include general indicators or descriptors of the water regime, water quality and biota. An agreed landform classification system

would make it possible to compare between sites and regions and hence provide a basis for management decisions that may lead to the collection of more specific information on threats, values and benefits, land tenure and management, and monitoring.

Information sources

53. A broad range of inventories and published reports on wetlands were reviewed. These included global, regional and supra-national inventories available in published reports, books and journals and augmented by unpublished reports, atlases (e.g., for mangroves) and Web pages (e.g., for coral reefs). Much of the information assessed was not from published inventory sources.

54. It is considered that many other sources of information were not accessed during this review. This is particularly so for the Americas where an immense quantity of information exists. Much less information exists for Africa and Asia. In such instances, at least, some further information may be available in reports dealing with land and water resources, especially for fisheries. However, much of this is believed to be in small library collections that are not easily accessed through library exchange procedures. More extensive networks and familiarity with more languages may enable more information sources to be located.

55. Collections of remotely-sensed imagery and national and global scale maps and charts were not assessed. It seems that topographical and navigational maps have not been greatly used for inventory purposes, partly as they are not easy to obtain and collate. This situation may change as more maps are produced in electronic formats. The increased availability of global and national scale image databases (on CD-ROM and the Web) may also provide improved opportunities for use of remotely-sensed data.

56. Whilst we cannot claim that this current review is comprehensive, our development of the bibliographic and inventory databases provides an initial tool for adding more sources once they are located. If this were to be done on a regular basis (e.g., in conjunction with the triennial inventory of Ramsar Sites), restructuring of the format and style of the current databases may be appropriate.

57. The regional reviews identified a large number of sources for wetland inventories, but coverage at national level is patchy. Many inventories covered only part of a country's wetland resource (e.g., estuaries or peatlands or lakes). Supra-national inventories cover more countries but these are not usually comprehensive (e.g., covering only important wetlands).

58. Many inventories were based on biodiversity criteria, particularly those important for waterbirds. Others were based on specific habitats, such as lakes or reefs. Many of these were non-specific reviews or summaries of wetland information.

59. Many national inventories had been undertaken by national or provincial governmental agencies. In contrast, supra-national inventories were undertaken by international non-governmental organisations. Although the

latter have provided valuable collations of existing material, many have not been well distributed and only occasionally have been updated.

60. The major inventory effort seems to have occurred during the 1980s and early 1990s. Much of the earlier material is now considered of only historical use, given continued loss and degradation that is believed to have occurred in many regions. Where possible, our analyses focussed on inventory sources from the 1990s.

Priorities for future wetland inventory

61. Knowledge of the global wetland inventory resource is, on the whole, far from complete and is inadequate to support management needs. All regions of the world – Africa, Asia, Eastern Europe, Neotropics, North America, Oceania and Western Europe – have information gaps and priority areas for wetland inventory. Some of these information gaps should be addressed urgently, and this urgency will become greater as wetland loss continues.

62. To make the task more manageable, priority should be given to encouraging countries which do not yet have a national wetland inventory to commit, or seek, the resources to complete one. The great importance and urgency of national wetland inventories cannot be over-emphasised. They provide the base information for effective monitoring, management, sustainable use and conservation of wetlands at all levels - local, national, regional and international.

63. Attention must also be given to the inventory of priority wetland habitats, targeting those for which there is little or no information, and those at greatest risk of degradation and destruction. Based on this study the priority wetland habitats are:

    63.1 *seagrasses* - in Southern Asia, the South Pacific, South America and some parts of Africa, are under increasing threat from pollution, coastal development, destructive fishing practices, recreational use, etc.;

    63.2 *coral reefs* - are an important biodiversity resource that is under continuing threat globally due to the development, deforestation and pollution of coastal and inland wetlands;

    63.3 *salt marshes and coastal flats* - have generally been overlooked in wetland inventories, with few areal estimates and no true global 'picture' available. However, they are under increasing threat worldwide, particularly in Africa, Asia and Oceania due to increasing coastal development;

    63.4 *mangroves* - are better mapped than other coastal and marine wetlands, but serious inconsistencies exist and more comprehensive inventory is required. This should be used to better determine the mangrove loss that is proceeding at an alarming rate in many parts of Africa, southeast Asia and Oceania through deforestation, land reclamation, and development for aquaculture;

    63.5 *arid-zone wetlands* - are generally poorly mapped but increasingly important in the light of escalating population pressures and water demand. For example, in Africa and the Middle East, pressures for

increased water supply have led to the construction of many large dams and to disputes over transboundary sharing of limited water resources;

63.6 *peatlands* - are well mapped in comparison to other wetland habitats. However, they are threatened by drainage for agriculture and afforestation in Asia, parts of Europe and North America in particular, despite their importance as a global carbon sink and economic resource, and are poorly known in tropical regions such as southeast Asia;

63.7 *rivers and streams* - are seriously threatened by industrial and domestic pollution, water diversion, and regulation in many regions of the world. Although generally considered to be well mapped, it is difficult to obtain areal estimates of rivers and streams and the extent of associated swamps, marshes, oxbow lakes and lagoons;

63.8 *artificial wetlands* - increasingly important with reservoirs, dams, salinas, paddy, and aquaculture ponds important in many regions, notably Asia, Africa and the Neotropics, where they can provide habitat for wildlife, particularly migratory birds. Under some circumstances they provide many values and benefits to humans and can partially compensate for the loss and degradation of natural wetlands.

64. The work required to establish, update or extend wetland inventory seems monumental when viewed at a global scale, but is achievable by national action if a genuine will exists and key processes are targeted for improvement. These include improved communication to ensure that wetland inventory information is useful to people at all levels, from local to global.

65. Cooperation between countries and agencies, with the common aim of improving wetland inventory for all wetland habitats, particularly those most threatened, should be enhanced. Resources and effort are often 'wasted' on pilot studies or overly-ambitious projects that have little reward in terms of inventory and improved management of wetlands. This indicates a need for even more careful prioritisation when allocating resources for wetland inventory.

66. When undertaking further wetland inventory every effort should be made to link this with other national and international initiatives, such as the identification and delineation of further sites of international importance. Further, the inventory effort should assist with moving to achieve the vision for the Ramsar List of Wetlands of International Importance (Resolution VII.11).

Relevant Resolutions

Resolution VIII.6

(adopted by the 8th meeting of the Conference of the Contracting Parties, Valencia, Spain, 2002)

A Ramsar Framework for Wetland Inventory

1. RECALLING Recommendation 1.5, in which the Contracting Parties stated the need to prepare inventories of their wetlands "as an aid to the formulation and implementation of national wetland policies", and Resolution VII.6, in which the Parties adopted guidelines on these matters;

2. RECALLING ALSO Recommendation 4.6, Resolutions 5.3 and VI.12, and Action 6.1.2 of the Strategic Plan 1997-2002, in all of which the Parties recognized the value of national inventories for identifying sites suitable for inclusion in the List of Wetlands of International Importance (the Ramsar List) under the Convention;

3. AWARE that in Action 6.1.3 of the Strategic Plan 1997-2002 and Resolution VII.20 the Parties also recognized the importance of baseline wetland inventory for quantifying the global wetland resource as the basis for assessment of its status and trends, for identifying wetlands suitable for restoration, and for risk and vulnerability assessments;

4. NOTING that this meeting has adopted *Principles and guidelines for wetland restoration* (Resolution VIII.16); *Wetland issues in Integrated Coastal Zone Management (ICZM)* (Resolution VIII.4); *Additional guidance for identifying and designating under-represented wetland types as Wetlands of International Importance* (Resolution VIII.11); *New Guidelines for management planning for Ramsar Sites and other wetlands* (Resolution VIII.14); and *Guidelines for Global Action on Peatlands* (Resolution VIII.17), the implementation of all of which will be substantially assisted by the availability of wetland inventory at national and other scales;

5. RECALLING the findings of the report of Wetlands International entitled *Global Review of Wetland Resources and Priorities for Wetland Inventory* (GRoWI), from which it was indicated to COP7 that few countries, if any, had comprehensive national inventories of their wetland resources, and that it was not possible to provide a clear baseline estimate of the world's wetland resources with any confidence;

6. NOTING that a joint project between Wetlands International and the Institute for Inland Water Management and Waste Water Treatment (RIZA) in the Netherlands has expanded and updated the GRoWI analyses for all European countries;

7. AWARE that the Millennium Ecosystem Assessment (MA) is evaluating the condition, status and trends in global ecosystems including inland wetlands, subterranean (karst), and coastal and marine systems, and that this will include new applications of remote sensing which may enhance information on the global distribution of wetlands and their status;

8. ALSO AWARE that the European Space Agency's project Treaty Enforcement Services using Earth Observation (TESEO) is evaluating the use of remote sensing for wetland inventory, assessment, monitoring and site management, as well as for dryland ecosystems;

9. RECALLING that in Resolution VII.20 the Conference of the Parties urged "all Contracting Parties yet to complete comprehensive national inventories of their wetland resources, including where possible wetland losses and wetlands with potential for restoration, to give highest priority in the next triennium to the compilation of comprehensive national inventories", but NOTING with concern that in their National Reports to this meeting only

51 Contracting Parties have reported the existence of partial inventories or the initiation of national wetland inventory, and only 29 the completion of comprehensive inventories;

10. ALSO RECALLING that in Resolution VII.20 the Contracting Parties requested the Scientific and Technical Review Panel (STRP), in collaboration with Wetlands Intentional, the Ramsar Bureau, and other interested organizations, to review and further develop existing models for wetland inventory and data management, including the use of remote sensing and low-cost and user-friendly geographic information systems, and to report their findings to the 8th Meeting of the Conference of the Contracting Parties with a view to promoting international common standards;

11. FURTHER RECALLING that in Resolution VII.20 the Contracting Parties resolved that their inventory data, where it exists, should be housed and maintained in such a way that the information resource should be available to all decision-makers, stakeholders, and other interested parties;

12. APPRECIATIVE of the financial support of the governments of the United Kingdom and the United States of America for the preparation by the STRP of further guidance on wetland inventory; and

13. RECOGNIZING that various methodologies for national inventory can in general be applied also to local, sub-national (e.g. provincial), and transboundary international scales;

THE CONFERENCE OF THE CONTRACTING PARTIES

14. ADOPTS the *Framework for Wetland Inventory* as annexed to this Resolution;

15. RECOGNIZES that it is appropriate to apply different wetland inventory approaches, methods and wetland classifications for different purposes and objectives, but that common standards can be achieved by ensuring consistency in the collection of a core (minimum) dataset, as provided in the Framework;

16. URGES all Contracting Parties that have yet to complete comprehensive national wetland inventories to continue to give a high priority in the next triennium to the compilation of such inventories, utilizing the *Framework for Wetland Inventory* to ensure that their inventory design appropriately addresses their purpose and objectives, in order that their activities that require the sound basis of wetland inventory, such as policy development and Ramsar Site designations, can be carried out on the basis of the best possible information;

17. ENCOURAGES Contracting Parties initiating development of a national wetland inventory to consider the application or adaptation of an existing inventory methodology and data management system, including the updated inventory methodology developed by the Mediterranean Wetlands Initiative (MedWet), the Asian Wetland Inventory and other appropriate methodologies, so as to ensure consistency in inventory data and information collected;

18. CALLS UPON Contracting Parties that have undertaken wetland inventories to ensure that they have appropriate arrangements in place for housing and maintaining their wetland inventory data, both in printed and electronic formats, and, where appropriate, to make this data and information available, including where possible through the World Wide Web and CD-ROM formats, to all decision-makers, stakeholders, and other interested parties;

19. ALSO CALLS UPON all Contracting Parties and others who have undertaken, or are undertaking, wetland inventory to document information about the inventory, its data holdings, management and availability using the standard metadata record provided in the *Framework for Wetland Inventory*, so as to make this information available as widely as possible;

20. REQUESTS the Ramsar Bureau and Wetlands International, working with its Wetland Inventory and Monitoring Specialist Group, to make available, if possible, the standard metadata record for wetland inventory on the World Wide Web so that Contracting Parties and others can report and make fully available the information about their wetland inventories, and so as to assist in the updating by Wetlands International of global information about the status of wetland inventory;

21. ENCOURAGES Contracting Parties and other interested organizations and funding bodies to provide resources to Wetlands International, working with other relevant organizations, to review and update the *Global Review of Wetland Resources and Priorities for Wetland Inventory* (GRoWI) report made available to COP7, and to report on its findings to the 9th Meeting of the Conference of the Contracting Parties, including progress in the implementation of Resolution VII.20;

22. REQUESTS the Scientific and Technical Review Panel, working with Wetlands International, the Ramsar Bureau, remote sensing agencies, and other interested organizations to review further the application of remote sensing data, low-cost geographical information systems, and classification systems in wetland inventory, and to report on its findings to the 9th Meeting of the Conference of the Contracting Parties;

23. CALLS UPON Contracting Parties and other organizations with experience in training and capacity building in wetland inventory, including in the use of remote sensing and geographical information systems, to work with Wetlands International in order to make available this expertise through the Ramsar Training Framework, once established;

24. FURTHER CALLS UPON bilateral and multilateral donors to assign priority to supporting wetland inventory projects in developing countries and countries with economies in transition, noting the importance of such projects in forming the basis for developing and implementing the sustainable use of wetlands; and

25. REQUESTS Contracting Parties to give priority to submitting wetland inventory projects to the Ramsar Small Grants Fund.

Resolution VI.12

(adopted by the 6th meeting of the Conference of the Contracting Parties, Brisbane, Australia, 1996)

National Wetland Inventories and candidate sites for listing

1. RECALLING Recommendation 4.6 and Resolution 5.3, which encourage the establishment of national wetland inventories showing, in particular, those wetlands which are of international importance according to the criteria adopted by the Conference of the Parties;

2. NOTING the value of comprehensive inventories of wetland resources as an aid to implementing the wise use obligation under the Convention; and

3. NOTING ALSO the value of recognition of those sites which may be regarded as candidates for listing under the Convention;

THE CONFERENCE OF THE CONTRACTING PARTIES

4. ENCOURAGES Contracting Parties, in establishing and maintaining national scientific inventories of wetlands, to include all wetlands; and

5. URGES each Contracting Party to recognize officially its identified sites meeting the criteria approved by the Conference of the Contracting Parties.

Resolution VII.20

(adopted by the 7th meeting of the Conference of the Contracting Parties, San José, Costa Rica, 1999)

Priorities for wetland inventory

1. RECALLING Recommendation 1.5 which called upon Contracting Parties to prepare inventories of their wetlands "as an aid to the formulation and implementation of national wetland policies" to assist in promoting the wise use of wetlands in their territory;

2. RECALLING ALSO Recommendation 4.6, Resolutions 5.3 and VI.12, and Action 6.1.2 of the Strategic Plan 1997-2002 which recognized the value of national scientific inventories for identifying sites suitable for inclusion in the List of Wetlands of International Importance (Ramsar List) under the Convention;

3. AWARE of Action 6.1.3 of the Strategic Plan 1997-2002 which calls upon the Ramsar Bureau and the International Organization Partners to "utilize information from regional wetland directories, national scientific inventories of wetlands and other sources, to begin development of a quantification of global wetland resources, as baseline information for considering trends in wetland conservation or loss";

4. NOTING the report entitled *Global review of wetland resources and priorities for wetland inventory* and its recommendations as prepared and presented by Wetlands International to Technical Session IV of this Conference, in response to Action 6.1.3 of the Strategic Plan 1997-2002;

5. APPRECIATIVE of the financial support provided for the preparation of the above report by the Governments of the Netherlands, Norway, and the United Kingdom;

6. NOTING WITH CONCERN the findings of the Wetlands International report that, based on the information gathered within the constraints of this project, few countries, if any, have comprehensive national inventories of their wetland resources, and that it is therefore not possible to provide a baseline of the world's wetland resources with any confidence;

7. RECOGNIZING the priorities for future wetland inventory, both in terms of types and regions, as identified in the report and endorsed by the Second International Conference on Wetlands and Development (Dakar, Senegal, November 1998);

8. CONSIDERING that this Conference has also adopted *Guidelines for developing and implementing National Wetlands Policies* (Resolution VII.6), the *Wetland Risk Assessment Framework* (Resolution VII.10), the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Resolution VII.11), and Resolution VII.17 on *Restoration as an element of national planning for wetland conservation and wise use*, all of which, as noted by the previous Resolutions and Recommendations referred to in paragraphs 1 and 2 above, would be greatly assisted by the availability of national scientific inventories;

9. TAKING ACCOUNT of the findings given in the report prepared by the World Conservation Monitoring Centre and presented to COP7 Technical Session IV entitled *Shared wetlands and river basins of the world*; and

10. NOTING the scope of the proposed Millennium Assessment of the World's Ecosystems, currently under development, to deliver valuable related information of relevance to the application of the Convention;

THE CONFERENCE OF THE CONTRACTING PARTIES

11. URGES all Contracting Parties yet to complete comprehensive national inventories of their wetland resources, including, where possible, wetland losses and wetlands with potential for restoration (Resolution VII.17), to give highest priority in the next triennium to the compilation of comprehensive national inventories, in order for related actions such as policy development and Ramsar Site designations to be carried out with the best information possible;

12. FURTHER URGES that in undertaking inventory activities Contracting Parties give consideration to affording highest priority to those wetland types identified as at greatest risk or with poorest information in the *Global review of wetland resources and priorities for wetland inventory* report;

13. REQUESTS Contracting Parties to give consideration in their inventory activities to adopting a suitable standardised protocol for data gathering and handling, such as that provided by the Mediterranean Wetlands Initiative (MedWet), and the use of standardised low-cost and user-friendly Geographic Information System methods;

14. ENCOURAGES Contracting Parties with shared wetlands or river basins to work cooperatively in the gathering of inventory and related management information, as urged through the *Guidelines for international cooperation under the Ramsar Convention* (Resolution VII.19);

15. REQUESTS the Scientific and Technical Review Panel, in collaboration with Wetlands International, the Ramsar Bureau, and other interested organizations, to review and further develop existing models for wetland inventory and data management, including the use of remote sensing and low-cost and user-friendly geographic information systems, and to report their findings to the 8th Meeting of the Contracting Parties with a view to promoting international common standards;

16. CALLS UPON Contracting Parties to review the arrangements they have in place for housing and maintaining their wetland inventory data where it exists, and, as necessary, to seek to establish a central repository or to ensure that access to this information resource is possible for all decision-makers, stakeholders and other interested parties, where possible through the World Wide Web and CD-ROM formats;

17. ALSO ENCOURAGES Contracting Parties and other interested organizations and funding bodies to provide the resources to allow Wetlands International to complete and document suitable standardised protocols for data gathering and handling as well as a comprehensive assessment of wetland inventory information, and to develop procedures for regularly updating this information and making it readily available through the World Wide Web and CD-ROM formats;

18. FURTHER CALLS UPON the bilateral and multilateral donors to give priority to supporting the wetland inventory projects submitted by developing countries and those in economic transition, noting, as urged above, the desirability of such projects being undertaken; and

19. DIRECTS the Standing Committee to give special attention to appropriate wetland inventory projects in its consideration of projects submitted to the Ramsar Small Grants Fund.

Resolution X.15

(adopted by the 10th meeting of the Conference of the Contracting Parties, Changwon, Republic of Korea, 2008)

Describing the ecological character of wetlands, and data needs and formats for core inventory: harmonized scientific and technical guidance

1. AWARE of the suite of technical and scientific guidelines and other materials prepared by the Scientific and Technical Review Panel (STRP) to support Contracting Parties in their implementation of wetland conservation and wise use;

2. NOTING that the 9th meeting of the Conference of the Contracting Parties (COP9) instructed the STRP to prepare further advice and guidance for consideration by Contracting Parties at COP10 that would focus upon the immediate and high priority tasks set out in Annex 1 to Resolution IX.2; and

3. THANKING the STRP for its work in preparing the advice and guidance annexed to this Resolution as part of its high priority work during the 2006-2008 triennium;

THE CONFERENCE OF THE CONTRACTING PARTIES

4. WELCOMES the guidance on "Describing the ecological character of wetlands, and harmonized data formats for core inventory" provided in the annex to this Resolution, and URGES Contracting Parties to make good use of it as appropriate, adapting it as necessary to suit national conditions and circumstances, within the frameworks of existing regional initiatives and commitments and in the context of sustainable development;

5. CONFIRMS that the summary description and structure of core data fields for wetland inventory included in the annex to this Resolution update and wholly supersede the earlier guidance on this matter adopted as Table 2 in the annex to Resolution VIII.6;

6. URGES Contracting Parties to draw this guidance to the attention of relevant stakeholders, including in particular those responsible for the management of Ramsar Sites and other wetlands;

7. INVITES Contracting Parties and those responsible for the management of Ramsar Sites to apply these guidelines in the preparation of ecological character descriptions of Ramsar Sites, and as part of their management planning processes, so that these descriptions constitute a complementary basis to the Information Sheets on Ramsar Wetlands (RIS) for detecting and notifying changes in ecological character, as established through Article 3.2 of the Convention text, and RECOMMENDS that Contracting Parties provide any completed descriptions of the ecological character of Ramsar Sites to the Secretariat as a supplement to the information provided in the RIS;

8. INSTRUCTS the Scientific and Technical Review Panel to include in its work plan for the 2009-2012 period the development of further guidance on describing ecological character, to include to the extent practicable:

   i) further operational guidance for practitioners on completing the ecological character description sheet for sites;

   ii) guidance and information on using relevant conceptual models;

iii) cross-references, where available, from each relevant description sheet data field to worked examples, case studies or other sources of potential, actual or *de facto* standards for completing the fields;

iv) guidance on the scope for using Ramsar information fields in enhancing harmonisation and streamlining of reporting under related MEAs; and

v) a review of practical implementation experiences, with lessons learned; and

9. INSTRUCTS the Ramsar Secretariat to disseminate widely this guidance on "Describing the ecological character of wetlands, and data needs and formats for core inventory" annexed to this Resolution, including through amendment and updating of the Ramsar Wise Use Handbooks.

The Ramsar Convention 'toolkit' for the conservation and wise use of wetlands, 4th ed. (2010)	
Convention pillar 1: Wise Use	
Handbook 1	**Wise use of wetlands** Concepts and approaches for the wise use of wetlands
Handbook 2	**National Wetland Policies** Developing and implementing National Wetland Policies
Handbook 3	**Laws and institutions** Reviewing laws and institutions to promote the conservation and wise use of wetlands
Handbook 4	**Avian influenza and wetlands** Guidance on control of and responses to highly pathogenic avian influenza
Handbook 5	**Partnerships** Key partnerships for implementation of the Ramsar Convention
Handbook 6	**Wetland CEPA** The Convention's Programme on communication, education, participation, and public awareness (CEPA) 2009-2015
Handbook 7	**Participatory skills** Establishing and strengthening local communities' and indigenous people's participation in the management of wetlands
Handbook 8	**Water-related guidance** An Integrated Framework for the Convention's water-related guidance
Handbook 9	**River basin management** Integrating wetland conservation and wise use into river basin management
Handbook 10	**Water allocation and management** Guidelines for the allocation and management of water for maintaining the ecological functions of wetlands
Handbook 11	**Managing groundwater** Managing groundwater to maintain wetland ecological character
Handbook 12	**Coastal management** Wetland issues in Integrated Coastal Zone Management
Handbook 13	**Inventory, assessment, and monitoring** An Integrated Framework for wetland inventory, assessment, and monitoring
Handbook 14	**Data and information needs** A Framework for Ramsar data and information needs
Handbook 15	**Wetland inventory** A Ramsar framework for wetland inventory and ecological character description
Handbook 16	**Impact assessment** Guidelines on biodiversity-inclusive environmental impact assessment and strategic environmental assessment
Convention pillar 2: Ramsar sites designation and management	
Handbook 17	**Designating Ramsar Sites** Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance
Handbook 18	**Managing wetlands** Frameworks for managing Ramsar Sites and other wetlands
Handbook 19	**Addressing change in wetland ecological character**
Convention pillar 3: International cooperation	
Handbook 20	**International cooperation** Guidelines and other support for international cooperation under the Ramsar Convention on Wetlands
Companion document	
Handbook 21	**The Ramsar Convention Strategic Plan 2009-2015** Goals, strategies, and expectations for the Ramsar Convention's implementation for the period 2009 to 2015

Ramsar
Handbooks
4th edition

Handbook 15

Wetland inventory

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