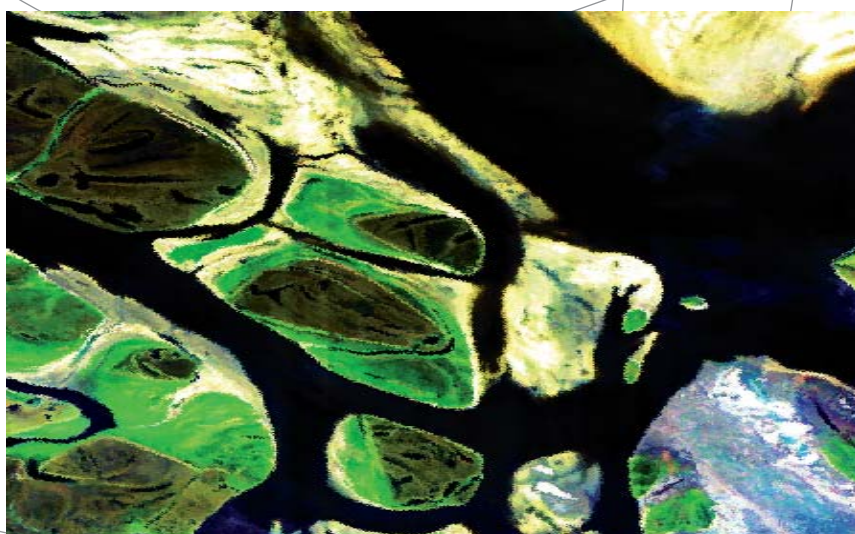


Ramsar Technical Report No. 4



A Framework for a Wetland Inventory Metadatabase

John Lowry

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Foreword

The importance of knowing where wetlands are, and what characteristics (ecological character) they have, has long been recognised by the Contracting Parties to the Ramsar Convention on Wetlands as providing vital underpinning to many aspects of implementing the Convention successfully, so as to achieve the conservation and wise use of all wetlands, including Ramsar sites (Wetlands of International Importance). The 1999 review of the state of wetland inventory worldwide (*Global review of wetland resources and priorities for wetland inventory - GRoWI*), which was undertaken for the Ramsar Convention, identified not only the major gaps in the extent to which wetland inventory had been undertaken, but also found that for the inventories which had been made it was frequently very hard to trace their existence, to identify their purpose, scope and coverage, and/or to access the information contained in them.

In the light of these findings and to help address this lack of access by those who need to use wetland inventory for a wide range of Convention implementation purposes, work was commissioned by the Convention's Scientific & Technical Review Panel (STRP) to develop a standard model for wetland inventory metadata (i.e., data about the characteristics of a wetland inventory, rather than the inventory data itself) in order to facilitate those who have inventories in making the existence and availability of these more publicly accessible.

This work was undertaken for the STRP by John Lowry of the Australian Department of the Environment, Water Heritage and the Arts – Supervising Scientist Division.

In summary, the scope of the work was to:

- i) confirm the core data fields for a wetland inventory metadatabase, taking into account international standards for metadata recording and results of earlier GRoWI work;
- ii) construct a framework for a metadatabase for wetland inventory, including ensuring that the framework would be compatible with the planned subsequent development of a web-based database to hold wetland inventory metadata; and
- iii) develop a data dictionary (identifying the contents and formats of tables and fields in the database) and a user guide / set of explanatory notes for the metadatabase.

The standard wetland inventory metadatabase model provided in this Ramsar Technical Report will enable the consistent provision, collation and compilation of information about wetland inventory worldwide, and it can be utilised by anyone who has undertaken a wetland inventory, at whatever spatial (geographical) scale. Work is now underway by the Ramsar Secretariat, STRP and Wetlands International to develop a web-based tool, using the metadata model, for all those with such inventory information to submit a metadata record of their inventory. This report therefore provides the basis for filling a major gap in available wetland data and information – as recognised by the *Framework for Ramsar data and information needs* prepared by the STRP and adopted by Contracting Parties at their 10th Conference of the Contracting Parties (COP10, Republic of Korea, November 2008) as Resolution X.14.

Heather MacKay, Max Finlayson & Nick Davidson
Series Editors
May 2010

Acknowledgements

The draft of this report was prepared during 2003 for the Ramsar Scientific & Technical Review Panel (STRP) as part of the work of its Working Group 1 on wetland inventory and assessment. We are grateful to the members and observers of the STRP and its Working Group 1, and others, for their help, advice, and review of the draft of this guidance, and in particular the following people: George Begg, Geoff Cowan, Nick Davidson, Kevin Erwin, Max Finlayson, Chris Gordon, Johnathon Kool, Makoto Komoda, Yumiko Kura, Randy Milton, Stuart Phinn, Carmen Revenga, Abbie Spiers, and Doug Taylor.

Summary

This report provides a framework for a standard wetland inventory metadatabase. The metadatabase standard was developed for the Ramsar Convention by the Environmental Research Institute of the Supervising Scientist (eriss, Darwin, Australia).

The work was undertaken for the Convention's Scientific & Technical Review Panel (STRP) as part of its response to key recommendations concerning the lack of access to existing wetland inventories made by the 1999 *Global review of wetland resources and priorities for wetland inventory* (GRoWI).

The resulting metadatabase framework has been developed from core metadata fields for wetland inventory identified through the GRoWI project, integrated with other internationally recognized metadata fields that are in use elsewhere in the world.

The metadatabase framework has been designed to provide the basis for the development of an on-line web-based wetland inventory metadata system which can serve up accessible information about wetland inventories worldwide.

Recommendations for the successful implementation of a web-based system include that:

- an organisation (or group of organisations) be identified which has both the resources and technical capabilities to fully support the implementation and subsequent ongoing maintenance and future development of the database;
- attention be paid to the utility of the database with respect to the selection of the format chosen for data entry, storage and exchange;
- emphasis be placed on maximising the 'user-friendliness' of the database, to ensure that it meets the 'end-user' requirements and capabilities;
- attention be paid to the need to ensure security and control over data entry and editing through procedures such as passwords; and
- standardised international definitions / classifications should be used wherever possible to control the standards and quality of data entered into the metadatabase.

1. Background

The key importance of wetland ecosystems in achieving the conservation and wise use of biological diversity and their contribution to peoples' health and well-being through their delivery of many ecosystem services (the benefits people derive from nature – Millennium Ecosystem Assessment 2003) has been increasingly recognised.

If wetlands are to be maintained (and if degraded wetlands are to be restored), in order to achieve their wise use through planning and management to maintain their ecological character (Ramsar Convention text – available on www.ramsar.org), an obvious prerequisite for governments, spatial planners and wetland managers is to know the location, size and characteristics of the wetland resource.

This has been recognised by the Contracting Parties to the Ramsar Convention on Wetlands since its inception. Recommendation 1.5 (COP1, Cagliari, 1980) called upon Contracting Parties “to prepare inventories of their wetlands . . . as an aid to the formulation and implementation of national wetland policies” as part of their undertaking ‘to promote the wise use of wetlands in their territory’. Subsequent Ramsar COP decisions, including Recommendation 4.6, Resolutions 5.3, VI.12, VII.20, VIII.6 and IX.1 Annex E, have also recognised the value of national scientific wetland inventories for identifying sites suitable for inclusion in the List of Wetlands of International Importance (Ramsar List) as well as for various other purposes.

Such baseline wetland inventory provides a vital basis for many different activities necessary for achieving the wise use of wetlands (Finlayson *et al.* 1999), and in Resolution VII.20 (COP7, Costa Rica, 1999) in particular the Contracting Parties identified some of these as policy development, identification and designation of Ramsar sites, documentation of wetland losses, and identification of wetlands with potential for restoration.

However, despite these repeated calls by the Conference of the Parties over the years to give a high priority to undertaking and making available comprehensive national wetland inventories, the 1999 *Global review of wetland resources and priorities for wetland inventory* (GRoWI), prepared for the Convention by Wetlands International, reported that very few countries had undertaken a comprehensive national wetland inventory, and that one-quarter of countries at that time had no wetland inventory at all, thus hindering the soundly-based implementation of wetland

conservation and wise use (see also, e.g., Bayliss *et al.* 1997; Bunn *et al.* 1997; Finlayson *et al.* 1999).

There are indications from Ramsar Parties that further wetland inventories have been undertaken in the past ten years since the GRoWI report: their National Reports to the 8th meeting of the Conference of the Contracting Parties (2002) indicated that 28 Parties had comprehensive wetland inventory with national coverage (24%) and that a further 51 had partial inventories (COP8 DOC.5). By COP10 (2008), 37% of Parties reported having, or are developing, a comprehensive national wetland inventory (COP10 DOC. 6). However, this means that almost two-thirds of Ramsar Parties have yet to even initiate a process for national wetland inventory, and it is clear that large gaps remain in the baseline information about the location and characteristics of wetlands worldwide.

Amongst the other GRoWI findings was that it was often hard or impossible a) to identify from publicly-available information what wetland inventories had been undertaken and b) to access the results of such inventories. Accordingly, in the light of these findings, COP7 Resolution VII.20:

- i) Called on 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; and
- ii) Encouraged 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.

These calls concerning mechanisms for making wetland inventory accessible were repeated in updated form at COP8 (2002) in Resolution VIII.6 by:

- i) Calling 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; and

- ii) Requesting the Ramsar [Secretariat] and Wetlands International, 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.

The “standard metadata record” referred to in Resolution VIII.6 and included in its *Framework for Wetland Inventory* was derived from work to prepare advice on establishing such a standard record commissioned by the Convention’s Scientific & Technical Review Panel (STRP) from the Environmental Research Institute of the Supervising Scientist (eriss), Australia.

The present report provides the full advice and structure of this wetland inventory standard metadata record. The standard has already been utilised to handle wetland metadata in the recently completed European Space Agency and Ramsar Convention *GlobWetland* project (www.globwetland.org; see also Fernandez-Prieto & Finlayson 2009 and other papers in that volume) to underpin its web-accessible spatial data and information products developed to support wetland managers in their implementation of management planning on over fifty Wetlands of International Importance worldwide.

The Ramsar Secretariat, STRP, and Wetlands International are now working to establish a mechanism for making available a searchable web-based system using this metadata standard to permit those people and organisations who have undertaken wetland inventory to submit a metadata record for these inventories, so as to increase their accessibility, as part of the current effort by the STRP in partnership with other organisations to establish a “Global Wetland Observing System” (G-WOS). The standard metadata record described below can also be used by countries and other organisations to provide accessible information about their own inventory processes, in support of the calls for this in Resolutions VII.20 and VIII.6.

2. Metadata and metadata standards

What is metadata ?

2 **M**etadata is often described simply as ‘data about data’ (ANZLIC 2001). While this is a valid and

succinct description, it is important to understand what is meant by it.

Metadata has many elements that can include information that describes the age, accuracy, content, currency, scale, reliability, lineage, authorship and custodianship of an individual dataset. Recording and describing this information enables data to be easily located, identified, understood and managed. It also enables data to be used more efficiently and effectively (Environment Australia 1998).

While metadata is not a new concept, it has gained added significance through the increasing recognition of data collections and associated information as corporate assets, which need to be managed and maintained efficiently (Shelley 1997).

A *metadatabase*, therefore, may be viewed as the receptacle that links all of these data descriptions together to provide a comprehensive description of the dataset. An important distinction is that the metadatabase stores descriptions of the data, but not the actual data itself.

Existing standards for metadata and metadatabases

Standards for metadata, and metadatabases, have been developed at a national and international level through the collaboration of several organisations.

One of the earliest initiatives to develop metadata standards produced the so-called ‘Dublin Core’ standard. While this was originally created for libraries and document management, it identified a set of fields (or ‘elements’) with universal application. A list and description of these elements are contained in Appendix 1. More information on this initiative may be found at <http://dublincore.org>.

Much of the metadatabase development which has occurred has focused on the development of metadatabases for spatially-referenced data, such as maps, remotely sensed imagery, plan diagrams, and geographic information system (GIS) datasets. As a result, metadata standards for spatial datasets are well developed compared to standards for non-spatial data. Further, a large number of metadata entry tools which incorporate accepted international metadata standards have been developed for use in conjunction with spatial datasets and specific proprietary software applications. One example of this is the ArcCatalog tool developed by ESRI Inc for use in conjunction with the ArcGIS suite of GIS products (Environmental Systems Research Institute 2001).

Wetland Inventory Metadabase

While spatial/spatially-referenced data represent a significant component of wetland inventory information, a metadatabase developed specifically for wetland inventory also requires some modification of the fields used in existing databases.

One of the components of the GRoWI project was an analysis of the metadata needs specifically for wetland inventory, which identified many of the fields which would need to be recorded. These were identified in a simplified metadatabase framework included as an appendix to the GRoWI report (Finlayson & Spiers 1999a), and reproduced here in Figure 1. It was intended that this generic metadatabase framework could be utilized as a guide to those interested in developing their own database (Finlayson *et al.* 1999b).

- the World Conservation Monitoring Centre (WCMC) of the United Nations Environment Program;
- the Australia New Zealand Land Information Council (ANZLIC) Metadata Working Group; and
- the technical committee on geographic information of the International Organisation for Standardisation (ISO TC211).

Examples of metadatabases relevant to national wetland inventory which have been developed include:

- the NWI (US National Wetlands Inventory) metadatabase, developed to FGDC standards;
- the Australian Spatial Data Directory (ASDD) (developed by ANZLIC);

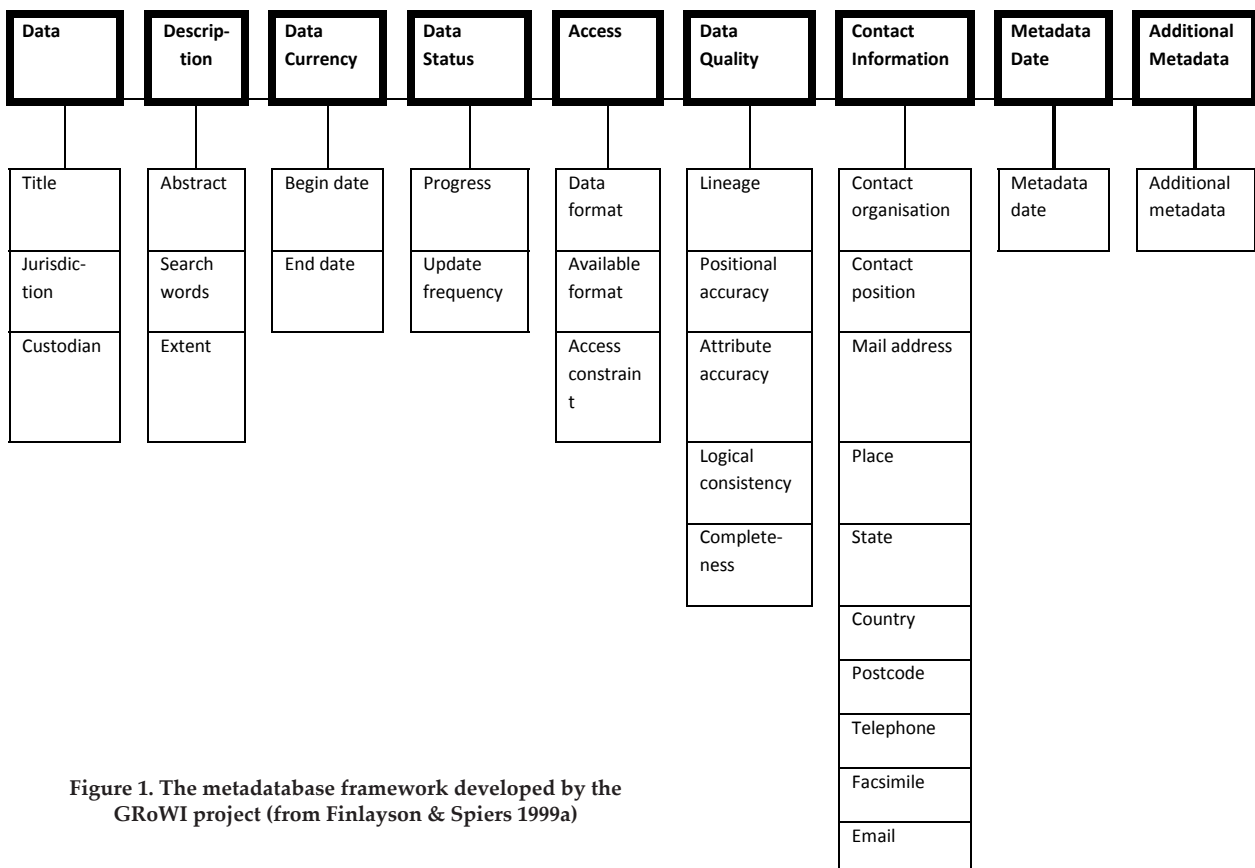


Figure 1. The metadatabase framework developed by the GRoWI project (from Finlayson & Spiers 1999a)

A number of organisations have been involved in the development of metadata standards and metadatabases at an international level. These include:

- the United States Federal Geographic Data Committee (FGDC);
- the United States Biological Information Infrastructure (NBII);

- the Inventory Level metadatabase developed by CIESIN (Centre for International Earth Science Information Network);
- the Global Resources Information Database (GRID), developed by the United Nations Environment Program.

Importantly, each of the metadatabases listed above can be viewed by anyone with access to the World

Wide Web. Registered users are also able to update these databases over the Internet.

While similar standards were used in the development of these various databases, the type of metadata they record and store differs, depending upon their purpose and scope. Some provide for the recording of records of only 'high level' metadata – that is, information gathered at the highest levels, such as corporate databases. Such an approach is often developed to publicize the availability of broad areas of data, as opposed to providing all the details that may be required to obtain and use the data. In contrast, the ASDD / ANZLIC metadatabases advocate the recording of lower level metadata (Bull *et al.* 2000).

3. Developing the wetland inventory metadata framework

When developing any metadatabase, it is necessary to consider a number of key design questions. Relevant questions relating to the development of a wetland inventory metadatabase may include:

- i) What is the purpose of the metadatabase?
- ii) Should the metadatabase focus on individual datasets, or should it focus on the organisations which hold and produce the data?
- iii) How will the metadatabase be used, and what type of data will it hold? For example, will it hold information on spatial datasets (maps, digital datasets, remotely sensed imagery, etc.) or bibliographic information, or some combination of both (see, e.g., Bull *et al.* 2000; Finlayson *et al.* 1995)?
- iv) What are core (essential) data fields and what are optional datafields?
- v) Which metadata standards are most appropriate for the purpose?
- vi) Who will be operating/implementing the metadatabase (entering and maintaining metadata records) and what training is required? and
- vii) Who will be the end users?

This report is intended to provide a framework for a wetland inventory metadatabase. For this purpose, "wetland inventory" was defined as "the collection and/or collation of core information for wetland management, including the provision of an information base for specific assessment and monitoring activities" (Finlayson *et al.* 2001), and this definition was adopted by the Ramsar Convention in COP8 Resolution VIII.6 *A Framework for wetland inventory.*

Using this definition, the framework was developed in the expectation that the metadatabase developed from the metadata framework would be used to record information on individual inventory activities, rather than only high level information on organisations. This conforms with the ANZLIC position that "there is little value in metadata directories that contain only the high-level core element" (ANZLIC 1998).

In order to be used widely, the metadatabase needs to be as accessible as possible, both in terms of being easy to operate and easy to locate and access. As set out above, it is anticipated that the metadatabase to be developed from this metadata model for wetland inventory would be accessed through the World Wide Web and would need to be simple to use by a range of users with different technical capabilities, and easy to modify if required.

In creating the metadata framework the following issues concerning subsequent metadatabase development were also taken into consideration. The metadatabase should be able to:

- i) help the owner / custodian of the data to organize, manage and maintain the datasets. This is especially important with staff turnover, when new staff may be unfamiliar with the dataset's origins and utility;
- ii) provide information to potential users on the different elements of the dataset, including the content and source of the data and the quality statements associated with the data;
- iii) provide information to data catalogs, clearing-houses and brokerages, identifying the type of information products that are potentially available. This can be useful in preventing the duplication of datasets that already exist; and
- iv) provide information to wetland managers and researchers on the whereabouts and main features of wetland inventories.

4. The Wetland Inventory Metadatabase Framework

The fields that were used to develop the framework outlined below were compiled from a number of sources. The principle sources were existing wetland databases as well as existing national and internationally developed metadatabases.

In selecting the fields that were used, consideration was given to their relevance (specifically, the information that they would contain) to wetland inven-

tory, and their compliance with international metadata standards. No single existing metadatabase was assessed that contained all of the fields that would be relevant or important for a wetland inventory record.

Fields relevant to wetland inventory in particular were identified in the wetland inventory metadata model developed as part of the GRowI project – see Appendix 2. Fields extracted from this model primarily serve to identify the geographical location and context of the inventory area and the nature of the inventory. The remainder of the fields in the metadata framework were sourced primarily from existing metadata models, such as those developed by the FGDC (1998) and ANZLIC (2001).

The framework includes a field which is intended to record the type of wetland being described in the inventory. This presents a challenge, since at present there is no single universally-adopted classification system for wetlands, and as a result a plethora of terms and definitions which describe the wetland environments exist. Some attempts at classification – such as the Ramsar wetland typology – are extremely subjective, relying on the individual interpreted classification of a wetland area. As a result, a further field which identifies the basis of the classification – whether the Ramsar typology was used, for example – has been included in the framework. Future development may enable the replacement of these two fields by a single field for a standardised wetland classification, if and when any such classification is agreed.

The large range of spatial scales at which wetland inventory work is undertaken (ranging from continental inventories and supranational regional inventories to national and local inventories) has meant that a variety of fields are required to describe the scale and the area of coverage of the inventory. Fields in the metadatabase framework intended to address this requirement include:

- the Ramsar region in which the inventory occurs;
- the countries in the inventory area;
- the provincial or subnational boundaries in the area;
- the latitudinal and longitudinal coordinates which define the boundary of the inventory area (this will be particularly relevant to transboundary inventories or those which may be based on catchments);
- the scale at which the inventory was performed;

- the minimum size of wetland mapped (e.g., 1-2 hectares); and
- the total area of the inventory or the area covered by the inventory.

Other related fields include those which identify the type(s) of wetland being inventoried and the number of Ramsar sites in the inventory area.

Where possible, fields should be populated with values representing established international standards, to ensure consistency and quality in the data entry. The extent of subjective individual interpretations or descriptions should be minimised where possible, to avoid confusion or inconsistency. This is a particular concern when data is exchanged between organisations.

The use of 'look-up' tables containing existing established values – such as ISO country codes and Ramsar region codes – in implementing the metadatabase will assist this process through reducing the amount of 'quality control' and data checking required by the organisation(s) responsible for developing and implementing the database. Selecting items from a list (rather than typing them in) can also assist the data entry process and improve the 'user-friendliness' of the system.

Some database and spreadsheet software packages (particularly early versions of some software) have limitations as to the length of a field name that may be displayed. For this reason, all field names that are used in the database have been limited to eight characters. The fields themselves can contain up to 2,000 characters, depending on the nature / type of the field.

Another consideration is the need for all field names to be able to be translated into languages other than English without losing the significance or meaning of the field in the translation process, so as to make both the metadatabase fields and their contents as widely understood as possible. The Ramsar Convention operates with three official languages (English, French and Spanish). The key requirement is that whoever is responsible for creating the database in another language must understand what the content of each field is meant to represent. The actual name of the field is not important in the translation process, provided that it abides by standards such as those discussed earlier. The field names in the English version of the database framework set out here are merely contractions of words that describe the contents of the fields.

A further consideration is the file format in which the metadata should be stored, exported and imported. The format which is chosen should reflect current and prevailing trends for file formatting. Selecting a commonly used file format which can be imported and exported into different software programs will enable users to create, view, extract and export metadata without being reliant on technical proficiency or knowledge of a single specific software programme. Amongst users / creators of spatial products, for example, metadata records are now commonly produced and exported as *.xml files.

By identifying the fields required for the metadata-base and recommending the parameters and file formats, it is intended that the metadatabase could be developed on a range of database platforms. Using standardized parameters should assist with the transfer of data between such platforms. It is important to note, however, that the design of the framework cannot take into account human error in creating or populating the database.

The parameters included in the wetland inventory metadatabase framework are described in Table 1.

Each of the fields in the framework are classed as either 'mandatory' or 'optional'. Mandatory fields must be included in any database developed from the framework and must also be populated in that database. Optional fields should also be included in the framework of any metadatabase, but need not necessarily be populated.

An overview of the framework for the wetland inventory metadatabase is shown in Figure 2. A description of the contents of each of the fields in the database is outlined in Table 2, and the full metadatabase framework is provided in Appendix 2.

Table 1. Wetland inventory metadatabase parameters

Database Parameter	Description of Parameter
*Field Number	ID number for each field – reference only
Category	Field groups – potential database tables
Field name	Name of field
*Field description	Description of field contents
Type	Nature of field – text, date, number, etc.
Field Status	Identifies whether the field is mandatory or optional
Occurrence	Number of times field may be populated, i.e., allows more than one author to be recognised
Field size	Character size of field i.e. 30 characters
Notes	Extra information – for example, whether selections could be made from an existing selection on a drop-down list; and the standards intended to be used in selected fields

** These parameters need not be included in the final database –they are included here for reference / identification purposes only.*

Wetland Inventory Metadabase

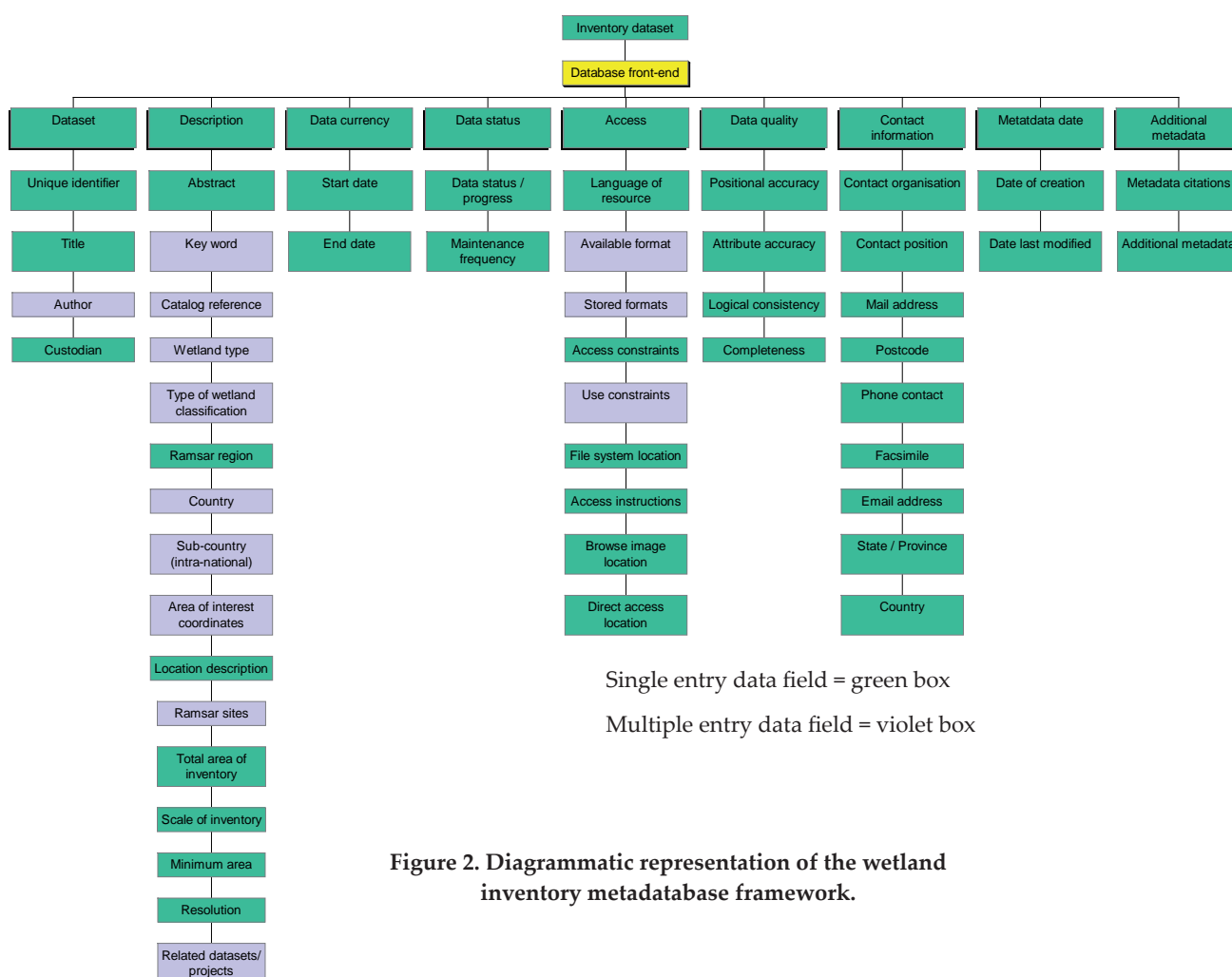


Figure 2. Diagrammatic representation of the wetland inventory metadabase framework.

5. Metadabase implementation recommendations

The following recommendations should be taken into consideration in implementing the development of a wetland inventory metadabase based on the framework set out above.

1. *An organisation (or group of organisations) should be identified that have the resources and technical capabilities to fully support the implementation and subsequent ongoing maintenance and future development of the database.*

Past attempts at implementing and applying some metadabases have met with limited success, in significant part because no individual organisation has had sufficient 'ownership' of the product and was prepared to 'drive' the process. If the wetland inventory metadabase is to be successfully implemented, it must be done by an organisation that is able to commit itself both to

the implementation of the metadabase and, just as importantly, its subsequent ongoing maintenance and development. One option to facilitate the subsequent population of the metadabase framework may be to expect all Contracting Parties to the Ramsar Convention to submit metadata which meets the framework requirements as part of their triennial National Reports to each Conference of the Contracting Parties.

A number of issues will also have to be addressed by the organisation(s) which progress the implementation of the metadabase. These include determining:

- *whether a single database should be developed, and copies sent to all parties involved in wetland inventory;*
- *who is best qualified to build the database: if individual parties and organisations are able to build metadabases on the system of their choice, this*

Table 2. Description of each of the fields in 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, e.g., 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
TYP_CLAS	Basis of wetland classification, e.g., Ramsar typology, geomorphic classification
RAMSAR_R	Ramsar region – choose from standard Ramsar 4-letter codes from drop-down list
COUNTRY	Countries in area of inventory dataset – choose from standard 3-letter ISO country code http://www.bcpl.net/~jspath/isocodes.html in drop-down list
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, e.g., a few hectares, '000s of kilometres ²
SCALEINV	Scale at which inventory performed, e.g., 1:50,000
MIN_AREA	Minimum size wetland mapped, e.g., 1-2 ha
RESOLUT	Spatial resolution of inventory datasets, e.g., +/- 25m, or pixel size of imagery
REL_DATA	Related datasets. Names of related files / datasets within the overall inventory.
INVSTART	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
FREQMAIN	Frequency of maintenance / changes / updates to the dataset – regular / irregular/ none planned
LANG_RES	The language in which the dataset was created, e.g., English, Spanish, Vietnamese
AV_FORM	The formats in which the inventory dataset is available, 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, e.g., 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 – for example, may not be available to general public; use may require a license agreement to be signed

USR_CONS	User constraints – may not be able to 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.
ATTR_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?
LOGICCON	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 is 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/ 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.

increases the possibility that the resultant databases may not be compatible with others; and

- *how the quality of the metadata will be controlled.* The use of standardised terms/ definitions will go some way towards addressing quality control issues. However, will one organisation be responsible for checking the remaining data entered (a potentially large task for one organisation) or will the control be up to the individual parties (which may result in different standards)?
2. *Attention must be paid to the utility of the database with respect to the selection of the format chosen for data entry, storage and exchange.*

The format chosen will have a significant effect on the ability and ease of import, exchange and storage of metadata between different platforms / programmes. The format selected should reflect current and prevailing trends / attitudes towards metadata formatting. A recent trend in GIS software, for example, has been to produce metadata records in *.xml format.

3. *Emphasis should be placed on maximising the 'user-friendliness' of the database, to ensure that it meets 'end-user' requirements.*

There are a number of aspects to ensuring the user-friendliness of the metadatabase, for example,

- ensuring that the database is able to be translated into other languages without losing the significance or meaning of the fields and their contents;
- enhancing the capability of users to input, extract and retrieve metadata through queries and searches;
- ensuring that the database is easy to use and understand – from a user's perspective. This will require consultation with a selection of prospective users to assess the database.

4. *Attention must be paid to the need to ensure security and control over data entry and editing through procedures, such as through passwords.*

In order to prevent unwanted, unintentional or inappropriate entry, editing or deletion of data, security devices such as passwords should be considered as a key part of the implementation of the database. This is especially pertinent if the database is able to be accessed easily, such as through the Internet.

5. *Standardised international definitions / classifications should be used (wherever possible) to*

control the standards and quality of data entered into the metadatabase.

This may be achieved through the use of 'look-up' tables associated with specific fields in the database, in which the users populate a field from an existing selection of attributes, rather than creating or typing in their own values (thereby entering potentially incorrect or invalid data). This would have the benefit of ensuring that data would be entered to a known standard and quality. This could be an area of on-going development in the metadatabase, as new standards are developed and implemented. One example of a look-up table proposed for this database is the list of ISO country codes, used to identify the country (or countries) in which the inventory was undertaken; another might be the inclusion of a standardised wetland classification system to categorise the wetland types being described.

6. References

- ANZLIC 1998. *Technology evaluation and proposed framework for the Australian Spatial Data Directory (ASDD) for land and geographic data directories in Australia and New Zealand.* Executive summary and recommendations of the report on the Australian Spatial Data Directory.
- ANZLIC 2001. ANZLIC Metadata Guidelines Version 2, February 2001. Available from http://www.anzlic.org.au/asdi/metaelem_ch2.htm#ch2guidelines
- Bayliss, B., Brennan, K., Eliot, I., Finlayson, M., Hall, R., House, T., Pidgeon, B., Walden, D. & Waterman, P. 1997. *Vulnerability assessment of predicted climate change and sea level rise in the Alligator Rivers Region, Northern Territory, Australia.* Supervising Scientist Report 123, Department of the Environment, Canberra.
- Bull, A. & Boggs, G. 2000. *Information management.* In: I Elliot, M Saynor, M Eliot & CM Finlayson (eds). *Assessment and monitoring of coastal change in the Alligator Rivers Region, northern Australia.* Supervising Scientist Report 157, Supervising Scientist, Darwin.
- Bunn, S.E., Boon, P.I., Brock, M.A., & Schofield, N.J. (eds). 1997. *National Wetlands R&D Program Scoping Review.* Land and Water Resources Research and Development Corporation, Canberra, Australia.
- Environment Australia 1998. *Metadata kit.* Department of the Environment, Canberra.

- Environmental Systems Research Institute 2001. ArcGIS ArcView 8.1 Overview – ArcCatalog. Available from <http://www.esri.com/software/arcgis/arcview/overview2.html>
- Federal Geographic Data Committee FGDC-STD-001-1998. *Content Standard for Digital Geospatial Metadata (revised June 1998)*. Federal Geographic Data Committee, Washington DC.
- Fernandez-Prieto, D. & Finlayson, C.M. 2009. Editorial: Earth Observation and wetlands. *Journal of Environmental Management* 90: 2119-2120.
- Finlayson, C.M. & Bayliss, B.L. (eds). 1997. *Data management systems for environmental research in northern Australia: Proceedings of a workshop held in Jabiru, Northern Territory 22 July 1995*. Supervising Scientist Report 124. Supervising Scientist, Canberra.
- Finlayson, C.M. & Spiers, A.G. (eds). 1999a. *Global review of wetland resources and priorities for wetland inventory*. Supervising Scientist Report 144 / Wetlands International Publication 53. Supervising Scientist, Canberra/Wetlands International, Wageningen, Netherlands.
- Finlayson, C.M. & Davidson, N.C. 1999b. Project description and methodology. In: C.M. Finlayson & A.G. Spiers (eds). *Global review of wetland resources and priorities for wetland inventory*. Supervising Scientist Report 144 / Wetlands International Publication 53. Supervising Scientist, Canberra/ Wetlands International, Wageningen, Netherlands.
- Finlayson, C.M., Davidson, N.C., Spiers, A.G. & Stevenson, N.J. 1999. Global wetland inventory – current status and future priorities. *Marine & Freshwater Research* 50: 717-727.
- Finlayson, C.M., Davidson, N.C. & Stevenson, N.J. 2001. *Wetland inventory, assessment and monitoring: Practical techniques and identification of major issues*. Proceedings of Workshop 4, 2nd International Conference on Wetlands and Development, Dakar, Senegal, 8-14 November 1998. Supervising Scientist Report 161. Supervising Scientist, Darwin.
- Millennium Ecosystem Assessment. 2003. *Ecosystems and human well-being: A Framework for Assessment*. Island Press, Washington, DC.
- Ramsar Convention on Wetlands. The texts of all Ramsar Resolutions are available at http://www.ramsar.org/cda/en/ramsar-documents-resol/main/ramsar/1-31-107_4000_0__.
- Shelley, P. 1997. Metadata: Some national and international perspectives. In: C.M. Finlayson & B.L. Bayliss (eds). *Data management systems for environmental research in northern Australia: Proceedings of a workshop held in Jabiru, Northern Territory, 22 July 1995*, Supervising Scientist Report 124. Supervising Scientist, Canberra.

Appendix 1

List and description of Dublin Core metadata elements
(for further information see at <http://dublincore.org>)

Dublin Core metadata element	Description
Title	A name by which the dataset is formally known
Creator	An entity primarily responsible for making the content of the dataset
Subject	The topic of the content of the dataset
Description	An account – such as an abstract – of the content of the dataset
Publisher	The entity responsible for making the dataset available
Contributor	An entity which has made contributions to the content of the dataset
Date	A date associated with an event in the life cycle of the dataset ie date of creation or completion of dataset
Type	The nature or genre of the dataset
Format	The physical or digital manifestation of the dataset
Identifier	An unambiguous reference to the dataset within a given context i.e. ISBN number
Source	A reference to a resource from which the dataset is derived
Language	The language of the intellectual content of the dataset
Relation	A reference to a related dataset
Coverage	The extent or scope of the content of the dataset – could include geographical boundaries
Rights	Information about rights held in and over the dataset

Appendix 2

Wetland Inventory Metadabase Framework fields and structure

Field Name	Type	Size	Question	Code words	3/6/98 Codes
1. Reference Details					
1	RAMSAR_REG	4	Ramsar region	Africa, Asia, Eastern Europe, Western Europe, Neotropics, North America, Oceania	afri, asia, euro, noam, ocea, neot
2	REFER_NUMB	20	Reference Number	(geo. scope)(Office)(number)(library reference code)	glo spr reg sbr nat sbn, aeme amer aspa ocep erris
3	STATESINCL Sub_nation	180 25	Countries Covered If subnational, then describe geographic coverage	Use National code/s Text	
4	WI_LOCATIO	20	WI / ERISS location	Text	
5	INV_TITLE	180	Title of Inventory	Text	
6	AUTHORNAME	100	Full Name of Author(s) / Correspondent:	Text	
7	PUB_DETAIL	200	Publication details	Text (or "in development")	(text) or in-devt
8	DIRECTORY	1	Wetland Inventory Directory?	Y / N	Y, n
9	PUBL_DATE	8	Date of Publication:	Year	
10	PUBL_TYPE	10	Publication Type:	A-Peer review Journal, A-Peer review Book, A-Chapter in a book, Conf-Presentation/ Keynote address, Conf-Article in proceedings, Govt/Agency-Internal Report, Govt/Agency-Publication, Govt/Agency-Other, NGO-report, NGO-Formal publication, Consultancy report, Practitioner-newsletter, Practitioner-periodical, Database Manual /Software, Other	jourm, book, chapt, presn, proce, govvp, govpb, govot, ngorp, ngopb, consl, newsl, perio, dbman, dbsof, other
11	LANGUAGE	7	State language used:	Text	
12	ENG_SUMMRY	1	English summary available?	Y / N	Y, n
Field Name	Type	Size	Question	Code words	3/6/98 Codes

13	OTHER_INFO	Text	100	If not a publication, how has the info been obtained?	Personal communication, ??
2. Data availability					
14	CUSTODIAN	Text	100	Full name of data custodian/organisation	Text
15	CONTACT_DT	Text	200	Contact details	Text
16	INV_FORMAT	Text	30	Format of inventory material	Paper, Word Processed File, Database, Personal communication, WWW pub, GIS, Map
17	CIRCULATIO	Text	10	Circulation	Published, Interdepartmental, Internal, Restricted, Unrestricted, Other
18	DATA_STORE	Text	20	Data Storage	Paper text, paper maps, part of GIS, database, digitised maps, other electronic
19	IMPLAGENCY	Text	25	3. Implementing Agency	NGO-I, NGO-N, NGO-SN, NGO-L, GO-I, GO-N, GO-SN, GO-L, Private, Academic Institution, Other, Unknown
20	AGENT_NAME	Text	200	Name	Text
21	FUND_SPONS	Text	25	4. Funding Sponsor	NGO-I, NGO-N, NGO-SN, NGO-L, GO-I, GO-N, GO-SN, GO-L, Private, Academic Institution, Other, Unknown
22	SPONS_NAME	Text	200	Name	Text
5. Objectives					
23	EXPL_OBJEC	Logical	1	Are the objectives explicitly stated?	Y / N / ?

24	MAINISSIONS	Text	50	Main issues being addressed:	Biodiversity-research, Research-other, Biodiversity-baseline, Biodiversity-monitoring, Biodiversity-repeat survey/surveillance, Biodiversity-management tool, Wetland Products, Geographical, Landuse Planning, Other	bio-res, bio-bas, bio-mon, bio-sur, bio-man, wetprod, geograf, land-up, oth-res, pub-edu, otheris
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6. Definitions – Wetlands and Classification

<i>Field Name</i>	<i>Type</i>	<i>Size</i>	<i>Question</i>	<i>Code words</i>	<i>3/6/98 Codes</i>
25	WETLAN_DEF	3	Is a definition of wetlands explicitly stated ?	explicit, inferred, nil	explicit, inferred, nil
26	RAMSAR_DEF	1	Was the Ramsar definition used?	Y / N / variable	y, n, variable
27	WET_CLASSI	10	Wetland Classification:	Ramsar, Other, Not Applicable	ramsar, other, not_app
28	CLASSNOTES	200	Other classification (specify)	Text	
29	VARIABILIT	20	Source of variability:	Definition of wetland type, between sites, other	

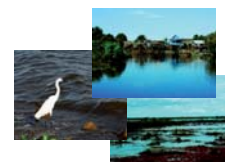
7. Basis of Study/Wetland Inclusion

30	ALL_OR_PRT	10	All wetlands or just part?	All / Part	all, part
31	SAMPLE_BAS	20	If sample, what was the basis of selection?	Land Cover/Remotely Sensed Data, Political/geographical Boundary, Landform, Suprahabitat / System, Habitat, Faunal or Floral Groups, Climate, Function, Hydrology, Biodiversity Value, Cultural value, Artefact of data collation, Other	rs-landc, boundary, landform, system, habitat, flo-faun, climate, function, hydrolog, biovalue, culture, artefact, other
32	OTHER_BASI	50	Text for Other	Text	
33	NOT-APPLC	2	Temporal Scale of Study		
34	DISCR_SURV	1	Not applicable (e.g. review/collation) Discrete survey	Y / N	y, n

35	DSURV_RANG	Date	16	Date (range) of data collection/collation ?	Dates	
36	DSURV_UPDT	Text	1	Has the Inventory been updated?	Y / N / U	y, n, u
37	DSURV_PLAN	Text	1	Any plans to update	Y / N / U	y, n, u
38	AH_UP_SURV	Text	1	Material updated on ad-hoc basis	Y / N / U	y, n, u
39	UPDAT_PURP	Text	10	Purpose of update	Add sites, review status, other, unknown	add, rev, oth, unkno
40	CURR_SURV	Text	1	Ongoing survey/program	Y / N / U	y, n, u
41	START_DATE	Date	8	Start date:	Year	
42	Field Name	Type	Size	Question	Code words	3/6/98 Codes
42	PL_DURATION	Text	10	Planned duration (in yrs/mths):	Years / U	(text) u
43	UPDAT_FREQ	Text	10	Frequency/periodicity of survey regimen:		
44	CURRSTATUS	Text	10	Current status:	Open / Closed / U	open, closed, unkno
9. Methods						
45	DATA METHO	Text	30	Data collection methods:	Collation /review, ground survey, remote sensing, not stated	collate, grounsur, remote, unkno
46	GRND-SURV	Text	10	Extent of ground survey?	Text	total, partial, none, unkno
47	RS_DETAILS	Text	50	Details of remotely sensed data	Satellite, Aerial Photo, Video, LIDAR, Radar, Satellite imagery, Map Product, Other, Not provided	satel, aerial, video, lidar, radar, s-imagry, unkno
48	SCALE_RESO	Text	20	Spatial resolution	Text (see Guidelines)	
49	GROUND_TRU	Text	1	Was the Inventory ground truthed?	Y / N	y, n,u
10. Inventory Synthesis						
50	INV_SUMMAR	Text	1	Summary given?	Y / N / U	y, n, u
51	AMOUNT_WET	Text	1	Extent of wetlands given?	Y / N / U	y, n, u
52	WETLAND_HA	Numeric	10	Total extent of wetlands covered (ha)	Number of ha	

53	WET_SITES	Numeric	10	Number of sites		Number	
54	AREA_CLASS	Text	1	Areas by class?		Y / N / U	y, n, u
55	AREA_CATEG	Text	200			Text	
56	WET_LOSS	Text	1	Estimate/summary of wetland loss?		Y / N / U	y, n, u
57	LOSS_NOTES	Text	200	Additional notes on wetland loss		Text	
58	GEO_COORDS	Numeric	1	Geographical coordinates			0, 1, 2, 3, 4, 5
59	MAP_PROVID	Numeric	1	Map of site included?			0, 1, 2, 3, 4, 5
60	GEN_LOCATI	Numeric	1	Justification of criteria			0, 1, 2, 3, 4, 5
	Field Name	Type	Size	Question			3/6/98 Codes
61	COMPILER	Numeric	1	General location			0, 1, 2, 3, 4, 5
62	RAM_CRITER	Numeric	1	Ramsar Criteria			0, 1, 2, 3, 4, 5
63	CRIT_JUSTI	Numeric	1	Compiler			0, 1, 2, 3, 4, 5
64	AREA	Numeric	1	Area			0, 1, 2, 3, 4, 5
65	OVERVIEW	Numeric	1	Overview			0, 1, 2, 3, 4, 5
66	WET_TYPE	Numeric	1	Wetland type			0, 1, 2, 3, 4, 5
67	PHYSFEATUR	Numeric	1	Physical features			0, 1, 2, 3, 4, 5
68	HYDROFEATU	Numeric	1	Hydrological values			0, 1, 2, 3, 4, 5
69	ECOLFEATUR	Numeric	1	Ecological features			0, 1, 2, 3, 4, 5
70	NOTEWFLOA	Numeric	1	Noteworthy flora			0, 1, 2, 3, 4, 5
71	NOTEWFAUNA	Numeric	1	Noteworthy fauna			0, 1, 2, 3, 4, 5
72	SOCULTVALU	Numeric	1	Social and cultural values			0, 1, 2, 3, 4, 5
73	LANDTENURE	Numeric	1	Land tenure/ownership			0, 1, 2, 3, 4, 5
74	LANDUSES	Numeric	1	Current land use			0, 1, 2, 3, 4, 5
75	THREATS	Numeric	1	Adverse factors			0, 1, 2, 3, 4, 5
76	CONSERVED	Numeric	1	Conservation measures taken			0, 1, 2, 3, 4, 5
77	CSV_PROPOS	Numeric	1	Conservation measures proposed			0, 1, 2, 3, 4, 5
78	RESEARCH	Numeric	1	Current scientific research and facilities			0, 1, 2, 3, 4, 5

79	CONSRV_EDU	Numeric	1	Current conservation education		0, 1, 2, 3, 4, 5
80	REC_TOURIS	Numeric	1	Current recreation and tourism		0, 1, 2, 3, 4, 5
81	JURISDICTI	Numeric	1	Jurisdiction		0, 1, 2, 3, 4, 5
82	MANAG_AUTH	Numeric	1	Management authority		0, 1, 2, 3, 4, 5
	Field Name	Type	Size	Question		3/6/98 Codes
83	REFERENCES	Numeric	1	Bibliographical references		0, 1, 2, 3, 4, 5
84	OVERSTATUS	Text	1	11. Overall status of wetlands		
85	STATUSNOTE	Text	200	Description of status of wetlands included?	Text	
				12. Values and benefits		
86	VALUE_BENE	Text	1	Description of values and benefits included?	Y / N / U	y, n, u
87	VALUE_NOTE	Text	200		Text	
88	ENTRY_BY	Text	20	13. Completed by	Text	
89	ENTRY_DATE	Date	8	Date of form completion	Year	



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