



9th Meeting of the Conference of the Parties to the
Convention on Wetlands (Ramsar, Iran, 1971)

*“Wetlands and water: supporting life, sustaining
livelihoods”*

Kampala, Uganda, 8-15 November 2005

**An Integrated Framework for wetland inventory,
assessment and monitoring (IF-WIAM)**

(Resolution IX.1 Annex E)

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I. Background

1. Considerable attention has been paid by the Convention on Wetlands (Ramsar, Iran, 1971) to the importance of wetland inventory, assessment and monitoring as tools for the conservation and wise use of wetlands, as well as to their use through management planning processes to maintain and enhance the ecological character of Ramsar sites and other wetlands under Article 3 of the Convention.
2. This has led to the adoption of a substantial suite of guidelines and other technical guidance on these matters by the meetings of the Conference of the Parties to the Convention, materials which have been designed to assist Contracting Parties and others in implementing these key Convention processes. Guidance adopted up to and including

COP8 (Valencia, Spain, 2002) have been incorporated into Ramsar Wise Use Handbooks (2nd edition) 7 (*Designating Ramsar sites*), 8 (*Managing wetlands*), 10 (*Wetland inventory*) and 11 (*Impact assessment*).

3. Furthermore, the Contracting Parties called in several COP8 Resolutions for the Scientific and Technical Review Panel (STRP) to prepare further guidance on different aspects of wetland inventory and assessment in order to fill gaps in the current toolkit. These include the “Ecological ‘outcome-oriented’ indicators for assessing the implementation effectiveness of the Ramsar Convention” (Resolution IX.1 Annex D), and “Guidelines for the rapid assessment of inland, coastal and marine wetland biodiversity” (Resolution IX.1 Annex E i). Further detailed methodological guidance on several types of wetland assessment is being prepared by the STRP for publication as *Ramsar Technical Reports*.
4. Parties at Ramsar COP8 also requested the STRP to undertake and report on assessment of the status and trends in the ecological character of Ramsar sites, as far as possible within the wider context of the status and trends of inland, coastal and marine wetlands (Resolution VIII.8), including through the work of the Millennium Ecosystem Assessment (MA) and through contributing to the work of the Convention on Biological Diversity (CBD) in developing and reporting on indicators of the status and trends for inland waters and coastal and marine biodiversity (Resolutions VIII.7 and VIII.8).
5. At COP8 Contracting Parties recognized that, with this increasingly large suite of guidance on different aspects of wetland inventory, assessment and monitoring, there is a need to provide overall guidance to Parties and others on when and for what purposes to use the various different inventory, assessment and monitoring tools and guidelines, and in Resolution VIII.7 the Parties requested the STRP to consider the consolidation of the Convention’s guidance in the form of an integrated framework for wetland inventory, assessment and monitoring.
6. The integrated framework provided here focuses on the purposes of and interrelationships among the different aspects and tools for wetland inventory, assessment and monitoring and provides summary information on each aspect of the relevant guidance adopted by the Convention. It also includes additional aspects of guidance requested by Resolution VIII.7.
7. The integrated framework provides a rationale for applying the mechanisms of the Convention for inventory, assessment and monitoring in order to increase public and political awareness and understanding of the critical values and functions of wetlands in supporting sustainable development and human well-being; provides general guidance for further steps to be taken to improve inventory, assessment and monitoring processes; and recognizes some key topics requiring further guidance and elaboration under the Convention to support full implementation of the framework.
8. The related Resolution VIII.7 request for harmonization of definitions and terms throughout the suite of Ramsar guidance on inventory, assessment, monitoring and management of the ecological character of wetlands is addressed by Resolution IX.1 Annex A as part of the “Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character”.

II. The importance of identifying, assessing and reporting the status of Ramsar sites and other wetlands in the implementation of the Convention

9. The delivery of the conservation and wise use of wetlands, in line with the commitments embodied in the Ramsar Convention, entails:
 - a) establishing the location and ecological characteristics of wetlands (baseline inventory);
 - b) assessing the status, trends and threats to wetlands (assessment);
 - c) monitoring the status and trends, including the identification of reductions in existing threats and the appearance of new threats (monitoring); and
 - d) taking actions (both *in situ* and *ex situ*) to redress any such changes causing or likely to cause damaging change in ecological character (management).
10. At the site scale, the Convention's guidance on management planning, including the *New Guidelines for management planning for Ramsar sites and other wetlands* (Resolution VIII.14; Ramsar Wise Use Handbook 8, 2nd edition), stresses that establishing the ecological character features of a site, and the factors that are positively or adversely affecting or likely to affect this character, is essential to the implementation of an effective management planning process.
11. At regional and global scales an understanding of the status and trends of wetland ecosystems has been recognized as an essential basis for the establishment of national and international policies, strategies and priorities for actions.
12. Monitoring and reporting the conservation status of designated Ramsar sites and other wetlands will also provide an indication of the success of the Ramsar Convention as an international treaty and its mechanisms for achieving wetland conservation and wise use. Resolution VII.11 is explicit in Objective 4.1 of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance*: "To use Ramsar sites as baseline and reference areas for national, supranational/regional, and international environmental monitoring to detect trends in the loss of biological diversity, climate change, and the processes of desertification." The Convention's "Ecological 'outcome-oriented' indicators for assessing the implementation effectiveness of the Ramsar Convention" (Resolution IX.1 Annex D) have been designed to address this issue, for which reporting and assessment mechanisms will be established during the 2006-2008 triennium (Resolution IX.2 Annex 1).
13. A number of studies have drawn together available information on the distribution, status and trends of wetland ecosystems and have shown substantial gaps in available information:
 - i) The *Global Review of Wetland Resources and Priorities for Wetland Inventory*, undertaken by eriss (Australia) and Wetlands International for the Convention in 1999, found that at that time only 7% of countries had adequate national wetland inventory and 25% of countries had no available national wetland inventory. Parties' National Reports to COP8 indicated that although this situation had somewhat improved – 28 Parties indicated that they have comprehensive wetland inventory with national coverage

(24%) and a further 51 that they had partial inventories (COP8 DOC.5) – there remain large gaps in the baseline information about the location and characteristics of wetlands.

- ii) The MA's synthesis report for the Ramsar Convention (*Ecosystems and Human Well-being: Wetlands and Water. Synthesis*), published in 2005, has concluded that "there is insufficient information on the extent of all wetland types such as inland wetlands that are seasonally or intermittently flooded and some coastal wetlands to document the extent of wetland loss globally". Nevertheless this report has concluded that on available evidence past losses and present rates of loss and decline of inland and coastal wetland ecosystems and their wetland-dependent species are greater than those in marine and terrestrial ecosystems.
14. By 2002, management plans, including monitoring programmes, were in place for all designated Ramsar sites in only 24 Contracting Parties (20%) (COP8 DOC. 6), and the use of the Ramsar sites network as a national and international network for monitoring the status and trends of wetland ecosystems, as envisaged by Objective 4.1 of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Resolution VII.11), had not yet been established.
 15. There is thus a need to ensure more comprehensive collection and reporting of such information essential for determining future policies and priorities for wetland conservation and wise use, underpinned by a clearer understanding of the purposes and objectives of inventory, assessment and monitoring.
 16. A number of inventory and assessment initiatives that have recently been developed or are ongoing support Convention implementation of different aspects of this integrated framework. These include:
 - i) further development and elaboration of the Mediterranean Wetlands Initiative (MedWet) inventory methodology through European Union-funded SUDOE (see http://www.medwet.org/medwetnew/en/03.PROJECTS/03.proj_04sudde02.html) and CODDE (see http://www.medwet.org/medwetnew/en/03.PROJECTS/03.proj_02codde01.html) projects;
 - ii) the development of the Asian Wetland Inventory methodology, a multiple purpose and multi-scalar approach (see also section 4 below), now being prepared for implementation in several parts of Asia (Finlayson C.M., Begg G.W., Howes J., Davies J., Tagi K. & Lowry J. 2002. A manual for an inventory of Asian wetlands (version 1.0). *Wetlands International Global Series 10*, Wetlands International, Kuala Lumpur, Malaysia. 72 pp. Downloadable in English and five Asian languages from: <http://www.wetlands.org/awi/default.htm>);
 - iii) the first phase of a Pan-European wetland inventory project, undertaken by Wetlands International and RIZA, the Netherlands (see <http://www.wetlands.org/inventory&/pewi.htm>), which expanded and updated the European component of the 1999 *Global Review of Wetland Resources and Priorities for Wetland Inventory*;
 - iv) the preparation through the STRP of a wetland inventory metadata model (in response to Resolution VIII.6) for a creation of a standardised record of information

about each wetland inventory (see also section 5), now being developed within the Ramsar Sites Information Service by Wetlands International;

- v) the European Space Agency's TESEO and GlobWetland projects, which are developing demonstration products based on earth observation (remote sensing) to improve the ability of wetland managers to better monitor and assess the condition of wetlands within their respective countries (see <http://www.globwetland.org/>);
- vi) The methodologies and results of the Millennium Ecosystem Assessment (MA), focusing on assessment of ecosystem services and human well-being (reports, in the three Convention languages and several others, available on: <http://www.millenniumassessment.org/en/index.aspx>); and
- vii) The CGIAR Comprehensive Assessment of Water and Agriculture, led by the International Water Management Institute (IWMI), Sri Lanka, which is preparing a special report on wetlands, water and agriculture for the Ramsar Convention, based on a series of questions developed by the STRP.

III. The relationship between wetland inventory, assessment, monitoring and management

17. Working definitions for wetland inventory, assessment and monitoring are incorporated into Ramsar's *Framework for Wetland Inventory* (Resolution VIII.6). They are:

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: the 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. The collection of time-series information that is not hypothesis-driven from wetland assessment is here termed *surveillance* rather than monitoring (refer to Resolution VI.1).

18. The approach and the scope of activity for inventory, assessment and monitoring as separate components of the management process differ substantially, but these are not always well distinguished in implementation projects.
19. Importantly, wetland inventory and wetland monitoring require different types of information. Whilst wetland inventory provides the basis for guiding the development of appropriate assessment and monitoring, wetland inventories repeated at given time intervals do not in themselves constitute monitoring.
20. Essentially, wetland (baseline) inventory is used to collect information to describe the ecological character of wetlands; assessment considers the pressures and associated risks of adverse change in ecological character; and monitoring, which can include both survey and surveillance, provides information on the extent of any change. All three are important and

interactive data gathering exercises. They should be considered as linked elements of this overall integrated framework which, when implemented, provides for identification of key features of the character of wetlands. Taken together, they provide the information needed for establishing strategies, policies and management interventions to maintain the defined wetland ecosystem character and hence ecosystem benefits/services.

21. However, in practice a clear distinction between inventory and assessment is hard to draw, and many projects and initiatives described as wetland inventory also include elements of assessment of the status of, and pressures and threats to, wetlands.
22. The data and information collected through inventory, assessment and monitoring are essential parts of an overall wetland management planning process, at site, catchment, national or regional scales. The management planning process provides the mechanisms for maintenance of the ecological character of the wetlands, drawing on the data and information provided by inventory, assessment and monitoring, as is set out in the Convention's *New Guidelines for management planning for Ramsar sites and other wetlands* adopted by COP8 (Resolution VIII.14).

IV. Multi-scalar approaches to wetland inventory, assessment and monitoring

23. Key issues in implementing wetland inventory, assessment and monitoring are the choice of the scale at which to undertake the work and the choice of appropriate methods for each scale.
24. Wetland assessment, as with inventory and monitoring, can be undertaken at discrete spatial scales using (different) appropriate techniques for each. Whenever possible, an integrated inventory, assessment and monitoring programme should be developed and conducted at a single appropriate scale. This can be achieved when an integrated analysis encompassing inventory, assessment and monitoring components is planned and implemented. However, these components are typically planned or undertaken separately. Wetland assessment should be undertaken at a spatial scale compatible with the scale of information contained within the wetland inventory. Subsequent monitoring should also be undertaken at a scale compatible with the assessment.
25. Since much wetland inventory, assessment and monitoring will be constrained by the scale and availability of information, practitioners are encouraged to aggregate data wherever possible rather than attempt to disaggregate data. This is possible when subsequent analyses draw on data from larger scales (e.g., combining data collected at 1:10,000 scale to represent a composite image at 1:50,000 scale) rather than smaller scales where issues of accuracy and precision will likely constrain effective analysis.
26. The issue of scale has so far been most fully addressed in methodologies for wetland inventory, and this is summarized below, using the Asian Wetland Inventory method as an example. However, many of the scale issues for inventory are equally relevant for the application of wetland assessment and monitoring, but further evaluation of options for these elements of the overall process may be necessary.
27. Wetland inventory has been carried out at a number of spatial scales, with specific purposes at each scale. These cover:

- i) global – purpose: presence/absence of wetlands in continents and islands;
 - ii) continental – purpose: distribution of regions dominated by wetlands within continents or islands;
 - iii) regional – purpose: range of specific wetland types;
 - iv) local – purpose: characteristics of individual wetlands; and
 - v) site – purpose: variability within individual wetlands.
28. Some wetland inventory methodologies, notably the Mediterranean Wetland Inventory and, more recently, the Asian Wetland Inventory (AWI), have been developed as multi-scalar approaches and have been recognized by the Ramsar Convention as appropriate for application for a variety of purposes. Depending on particular local, national and regional needs and priorities, they can be implemented at one or more scales, and their methods may be applied also to other regions of the world.
29. The Asian Wetland Inventory has been developed with multiple purposes in mind. These take into account the need for information at multiple scales (local to global) and include the need to:
- i) develop standardised field data collection sheets; and
 - ii) provide core data/information on wetlands to support international conventions and treaties on wetlands, climate change, biodiversity, migratory species and desertification, and their implementation by governments;
- in order to:
- i) analyse long-term trends in wetlands and their natural resources;
 - ii) enable regular revisions and updates of information on wetlands of national and international importance; and
 - iii) disseminate these analyses for wider consideration and use in sustainable development and conservation of wetland resources.
30. The key feature of the AWI is the production of hierarchical and map-based outputs at four levels of detail. The level of detail is related to the scale of the maps that are contained within a standardised GIS format with a minimum core data set. The hierarchical approach comprises a progression in scale from river basins to individual sites (see Figure 1).
31. The initial analysis (level 1) involves delineation of geographical regions (major river basins and islands) in Asia and encompasses a description of the geology, climate and ecology of each based on existing information sources. Level 2 analysis concerns delineation of wetland regions within each geographic region. This is done on the basis of similar climatic, geologic, hydrologic and vegetation features. Level 3 analysis undertakes grouping and description of wetland complexes within each region on the basis of more detailed information. Finally, level 4 analysis makes detailed descriptions of individual wetland habitats.
32. This approach results in the production of more detailed information on wetlands as the inventory progresses from levels 1 to 4, and it is anticipated that in many cases the implementation of an inventory will initially be undertaken at levels 1 and 2, followed, as resources become available, by levels 3 and 4.

33. While a hierarchical framework has been developed, it is not essential for all purposes to work through all levels of detail. The hierarchical approach is designed to respond to existing needs to obtain information at different levels and detail. A key point of this approach, however, is the adoption of compatible data fields and data management procedures to allow maximum use of the data, whether this is immediately planned or not for the particular purpose of an inventory exercise. However, for such reuse for different purposes, it is important to recognize the limits or constraints on interpretation of the original data.
34. At all levels of analysis the usefulness of existing information is first assessed and used as a basis for determining whether or not further analysis or collection of information is necessary. In many instances, analyses will be undertaken as follows:
 - Level 1 – desk study to describe the broad geologic, climatic and ecological features of each geographic region using existing datasets, increasingly available on the Internet;
 - Level 2 – desk study to identify the wetland regions within each geographic region using information already collated on geology, climate, hydrology, and vegetation;
 - Level 3 – fieldwork and analysis to identify the physical, physico-chemical and biological features of wetland complexes within each wetland region; and
 - Level 4 – detailed fieldwork and analysis to describe the physical, physico-chemical and biological features of each wetland habitat within each wetland complex. This includes information on plant and animal assemblages and species, land and water use and wetland management.
35. Data collection and analysis is based on standardised procedures and data management formats, although flexibility is not discouraged where necessary. Proforma data sheets for each level of analysis have been developed and are accompanied by guidelines for collecting the required information.

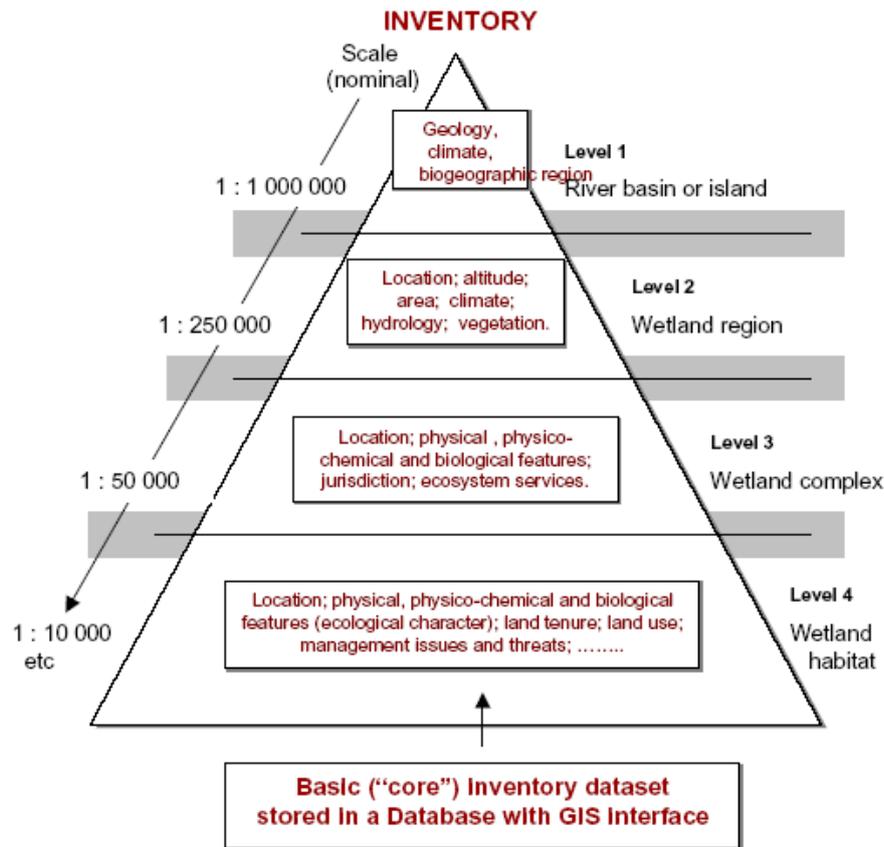


Figure 1. The hierarchical approach to wetland inventory. Data fields most appropriate for each level are shown with the most data being collected at level 4 (shown at the base of the triangle).

36. Similar multi-scalar procedures can be developed for wetland assessment and monitoring. These procedures will most likely build on the multi-scalar information collected under the inventory process and provide managers and others with analyses suitable for the scale of investigation.
37. However, detailed monitoring at broad scales is usually not possible because of its high cost, and thus monitoring at this scale must be cost-effective and sufficiently rapid to generate adequate first-pass data over large areas. The data may be adequate for management purposes or they may help managers to decide what type of further information may be required.
38. Typically, rapid assessment methods, including rapid biological assessment (see also Appendix 1) and remote sensing, are applied at broad scales. For specific sites, however, more detailed, quantitative monitoring may be required, utilising designs that provide stronger inference about a putative impact.

V. The Ramsar ‘toolkit’ of guidance available to Ramsar Parties for implementing the integrated wetland inventory, assessment and monitoring framework

39. A substantial set of Ramsar guidance already exists for wetland inventory, assessment, monitoring, and management. Guidance adopted up to and including COP8 has been compiled in Ramsar Wise Use Handbooks (2nd Edition) 8, 10 and 11. Key guidelines, definitions and other relevant guidance is listed in Table 1. Key aspects and features of the Convention’s guidance on wetland inventory, assessment and monitoring are summarized in the following sections of this integrated framework.

Table 1. Guidance available through the Ramsar Convention for implementing wetland inventory, assessment, monitoring and management. Note that a number of the wetland management guidances include aspects related to wetland inventory and assessment techniques.

COP Resolution and other sources	Guidance compiled in Ramsar Handbooks (2nd Edition, 2004)
Wetland inventory, assessment & monitoring	
Definition of “Wise Use” (Recommendation 3.3) [now updated in Resolution IX.1 Annex A]	1. Wise use of wetlands
Definitions of “ecological character” and “change in ecological character” (Resolution VII.10). [now updated in Resolution IX.1 Annex A]	8. Managing wetlands
<i>Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character</i> (Resolution IX.1 Annex A)	-
<i>Integrated framework for wetland inventory, assessment and monitoring</i> (this document)	-
<i>Gaps and harmonization of Ramsar guidance on wetland ecological character, inventory, assessment and monitoring</i> (Resolution VIII.7)	10. Wetland inventory
<i>Guidelines for Global Action on Peatlands</i> Resolution VIII.17)	14. Peatlands
Guidance for GIS applications for wetland inventory, assessment and monitoring (<i>Ramsar Technical Report</i> in preparation)	-
Wetland inventory	
<i>A Framework for Wetland Inventory</i> (Resolution VIII.6)	10. Wetland inventory
Wetland assessment	
<i>Wetland risk assessment framework</i> (Resolution VII.10)	8. Managing wetlands
<i>Assessing and reporting the status and trends of wetlands, and the implementation of Article 3.2 of the Convention</i> (Resolution VIII.8)	8. Managing wetlands

<i>Guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or processes and in strategic environmental assessment, adopted by the Convention on Biological Diversity, and their relevance to the Ramsar Convention (Resolution VIII.9)</i>	11. Impact assessment
Strategic Environmental Assessment (SEA) (COP7 Technical Session IV)	11. Impact assessment
<i>Guidelines for the rapid assessment of inland, coastal and marine wetland biodiversity (Resolution IX.1 Annex E i.)</i>	-
<i>Ecological 'outcome-oriented' indicators for assessing the implementation effectiveness of the Ramsar Convention (Resolution IX.1 Annex D)</i>	-
A framework and guidelines for valuing wetland benefits/services (<i>Ramsar Technical Report in preparation</i>)	-
Methodologies for assessing the vulnerability of wetlands to change in their ecological character (<i>Ramsar Technical Report in preparation</i>)	-
Methodologies for assessing the environmental water requirements of wetlands (<i>Ramsar Technical Report in preparation</i>)	-
Wetland monitoring	
<i>A Framework for designing a wetland monitoring programme (Annex to Resolution VI.1)</i>	8. Managing wetlands
Wetland management	
<i>New Guidelines for management planning for Ramsar sites and other wetlands (Resolution VIII.14)</i>	8. Managing wetlands
<i>Principles and guidelines for wetland restoration (Resolution VIII.16)</i>	8. Managing wetlands
<i>Guidelines for establishing and strengthening local communities' and indigenous people's participation in the management of wetlands (Resolution VII.8)</i>	5. Participatory management
<i>Participatory Environmental Management (PEM) as a tool for the management and wise use of wetlands Resolution VIII.36</i>	5. Participatory management
<i>Guidelines for integrating wetland conservation and wise use into river basin management (Resolution VII.18)</i>	4. River basin management
<i>Principles and guidelines on integrated coastal zone management (Resolution VIII.4)</i>	13. Coastal management

<i>Guidelines for the allocation and management of water for maintaining the ecological functions of wetlands</i> (Resolution VIII.1)	12. Water allocation and management
<i>Guidelines for Global Action on Peatlands</i> Resolution VIII.17)	14. Peatlands
<i>River basin management: additional guidance and framework for analysis of case studies</i> (Resolution IX.1 Annex C i.)	-
<i>Guidelines for the management of groundwater to maintain wetland ecological character</i> (Resolution IX.1 Annex C ii.)	-

40. In addition, there are a number of other ecosystem and wetlands and water-related global assessment initiatives currently underway, whose methodologies may be of relevance to any further development and implementation of this integrated framework. These include, *inter alia*, the Millennium Ecosystem Assessment (MA), the Global International Waters Assessment (GIWA), UN Waters' World Water Assessment Programme (WWAP), the CGIAR Comprehensive Assessment of Water and Agriculture, and the IUCN Species Survival Commission's Freshwater Biodiversity Assessment Programme.
41. Furthermore, the assessment results of these and other synthesised assessments such as UNEP's Global Environmental Outlook (GEO) and CBD's Global Biodiversity Outlook (GBO) will provide assessment information helpful for decision-making and identification of priorities for the future conservation and wise use of wetlands in their broader landscape/seascape context.

The Ramsar Framework for Wetland Inventory

42. The *Framework for Wetland Inventory* was adopted by COP8 in Resolution VIII.6. It provides a 13-step structured framework, supported by guidance on each step, for planning a wetland inventory. These steps are:
1. State the purpose and objective
 2. Review existing knowledge and information
 3. Review existing inventory methods
 4. Determine the scale and resolution
 5. Establish a core or minimum data set
 6. Establish a habitat classification
 7. Choose an appropriate method
 8. Establish a data management system
 9. Establish a time schedule and the level of resources that are required
 10. Assess the feasibility & cost effectiveness
 11. Establish a reporting procedure
 12. Establish a review and evaluation process
 13. Plan a pilot study
43. This planning framework is supported by examples of successfully applied standardized inventory methodologies from different regions, guidance on determining the most appropriate remotely-sensed data for a wetland inventory, a summary of different widely-

used wetland classifications, and a standard metadata record for the documentation of wetland inventories.

44. The *Framework for Wetland Inventory* identifies a set of core (minimum) data fields for biophysical and management features of wetlands (Table 2) which should be collected in each inventory, depending on the specific purpose of the inventory.

Table 2. Core (minimum) data fields for inventory of biophysical and management features of wetlands (derived from the Annex to Resolution VIII.6)

Biophysical features

- Site name (official name of site and catchment)
- Area and boundary (size and variation, range and average values) *
- Location (projection system, map coordinates, map centroid, elevation) *
- Geomorphic setting (where it occurs within the landscape, linkage with other aquatic habitat, biogeographical region) *
- General description (shape, cross-section and plan view)
- Climate – zone and major features
- Soil (structure and colour)
- Water regime (periodicity, extent of flooding and depth, source of surface water and links with groundwater)
- Water chemistry (salinity, pH, colour, transparency, nutrients)
- Biota (vegetation zones and structure, animal populations and distribution, special features including rare/endangered species)

Management features

- Land use – local, and in the river basin and/or coastal zone
- Pressures on the wetland – within the wetland and in the river basin and/or coastal zone
- 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
- Ecosystem benefits/services derived from the wetland – including products, values, functions and attributes (see Resolution VI.1) and, where possible, their relevance to human well-being (see Resolutions VI.23 and VII.8)
- 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)

* These features can usually be derived from topographical maps or remotely sensed images, especially aerial photographs.

45. The *Framework for Wetland Inventory* recognizes that wetland inventory has multiple purposes, including:
- 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.
46. The *Framework* also stresses that 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. A clear statement of the purpose(s) will assist in making decisions about the methods and resources needed to undertake the inventory.
47. Unlike the use of wetland assessment techniques (see below), there is less likelihood that more than one inventory technique will be applied simultaneously. Since wetland inventory can be carried out at different levels of detail, it is far more likely that sequential inventory, starting simply and subsequently undertaking more detailed work, will be undertaken.

Metadata records for wetland inventory

48. The *Framework for Wetland Inventory* also stresses the importance of establishing a publicly-accessible and standardized metadata record for each inventory undertaken, and it includes a standard model for wetland inventory metadata. Metadata has many elements that can include information describing 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.
49. Whilst 'metadata' is not a new concept, it has gained added significance through the increasing recognition of data collections and associated information as assets which need to be managed and maintained efficiently. A *metadatabase* can be viewed as the mechanism which links all of these data descriptions together to provide a comprehensive description of the dataset. The metadatabase stores descriptions of the data, not the actual data itself. Where possible, the data 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 are exchanged between organizations. By identifying the fields required for the metadatabase and recommending the parameters and file formats, it is intended that the metadatabase could be produced on a range of database platforms. Using standardized parameters should assist with the transfer of data between platforms.

Types of wetland assessment

50. There is a wide range of different types and methods of wetland assessment relevant to different aspects of Convention implementation, with each suited to, and designed for, different purposes and situations. These include:
- i) Environmental Impact Assessment (EIA)

- ii) Strategic Environmental Assessment (SEA)
- iii) Risk Assessment (RA)
- iv) Vulnerability Assessment (VA)
- v) Change (status and trends) assessment
- vi) Species-specific assessment
- vii) Indicator assessment
- viii) Resource (ecosystem benefits/services) assessment
- ix) Assessment of values of wetland benefits/services
- x) Environmental water requirement (environmental flows) assessment

51. The Ramsar Convention has adopted guidance on a number of these types of assessments, and further guidance has been adopted by COP9 in 2005 or is being prepared by the STRP for publication as *Ramsar Technical Reports* (see Table 1). Summary information on a number of these types of assessment guidance available to the Convention is provided in COP9 DOC. 24.

Rapid assessment of wetlands

52. “Rapid assessment” of wetlands is an approach which, depending on the purpose of the assessment, involves one or more of the different types of wetland assessment listed in paragraph 50 above, but where the methods are adapted to permit the adequate collection, analysis and presentation of the assessment information when this information is urgently needed. It may also involve the rapid collection of ‘baseline’ wetland inventory information. Rapid assessment methods can be particularly useful in the assessment of the impacts of natural disasters such as storm surges, tsunamis and hurricanes.
53. Guidelines for the rapid assessment of inland water, coastal and marine biodiversity have been jointly developed by the Convention on Biological Diversity and the Ramsar Convention. A consolidated version of this guidance, covering the range of wetland types in the Ramsar Classification System, has been included in Resolution IX.1 Annex E i. This guidance focuses on assessments at the species level of biodiversity, and it recognizes that there is a need to develop rapid assessment guidance for wetland ecosystems further.
54. The guidance recognizes that the purposes for rapid assessment of wetlands include:
- a) collecting general biodiversity data in order to inventory and prioritize wetland species, communities and ecosystems; obtaining baseline biodiversity information for a given area;
 - b) gathering information on the status of a focus or target species (such as threatened species); collecting data pertaining to the conservation of a specific species;
 - c) gaining information on the effects of human or natural disturbance (changes) on a given area or species;
 - d) gathering information that is indicative of the general ecosystem health or condition of a specific wetland ecosystem; and
 - e) determining the potential for sustainable use of biological resources in a particular wetland ecosystem.
55. The rapid assessment guidance in Resolution IX.1 Annex E i. includes a five-step procedure for designing a rapid assessment, modified from Ramsar’s structured framework

for wetland inventory (Annex to Resolution VIII.6). Summary information on this approach to rapid assessment is also provided in COP9 DOC. 24.

Indicator assessment

56. The development and use of indicators are designed to assess temporal patterns in the status and trends of ecosystems, habitats and species, the pressures and threats they face, and the responses made to address these pressures and threats. Such indicators are not designed to provide a complete and comprehensive assessment of all aspects of wetland ecosystems and their dynamics: rather they are intended to give a series of related pictures of these patterns, in order to guide further design and the focusing of decision-making for addressing unwanted change. Such indicators are also generally components of hypothesis-driven wetland monitoring programmes (see below).
57. Ramsar has worked closely with the Convention on Biological Diversity in its development of a set of indicators designed to assess the progress towards achieving the 2010 target of significantly reducing the rate of loss of biodiversity. The results of assessment of many of these indicators, which will be reported through the CBD's *Global Biodiversity Outlook*, will have relevance to the delivery of wetland conservation and wise use under the Ramsar Convention. The CBD's 2010 global indicators for immediate testing (UNEP/CBD/COP/7/20/Add.3) are:
- i) trends in extent of selected biomes, ecosystems and habitats;
 - ii) trends in abundance and distribution of selected species;
 - iii) change in status of threatened species;
 - iv) trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socio-economic importance;
 - v) coverage of protected areas;
 - vi) criteria and indicators for sustainable management of ecosystems;
 - vii) biodiversity used in food and medicine;
 - viii) water quality in aquatic ecosystems;
 - ix) trophic integrity of ecosystem;
 - x) nitrogen deposition; and
 - xi) numbers and cost of alien invasions.
58. For Ramsar, and in response to Resolution VIII.26, the STRP has developed "Ecological "outcome-oriented" indicators for assessing the implementation effectiveness of the Ramsar Convention", which are provided in Resolution IX.1 Annex D. These indicators seek to go beyond the assessment and reporting of the status and trends of different aspects of wetlands and their conservation and wise use (such as the CBD 2010 indicators), and they are formulated in such a way as to yield insights into the Convention's effectiveness, in conjunction with analysis of certain 'process-oriented indicators' such as those in the COP9 National Report Format.
59. An initial tranche of eight effectiveness indicators, some with one or more sub-indicator, has been developed, with a further five indicators recommended for further consideration and development. The initial eight indicators are:

Indicator	Sub-indicator(s)
A. The overall conservation status	i. Status and trends in wetland ecosystem extent

of wetlands	ii. Trends in conservation status – qualitative assessment
B. The status of the ecological character of Ramsar sites	i. Trends in the status of Ramsar site ecological character – qualitative assessment
C. Trends in water quality	i. Trends in dissolved nitrate (or nitrogen) concentration ii. Trends in Biological Oxygen Demand (BOD)
D. The frequency of threats affecting Ramsar sites	i. The frequency of threats affecting Ramsar sites – qualitative assessment
E. Wetland sites with successfully implemented conservation or wise use management plans	i. Wetland sites with successfully implemented conservation or wise use management plans
F. Overall population trends of wetland taxa	i. Trends in the status of waterbird biogeographic populations
G. Changes in threat status of wetland taxa	i. Trends in the status of globally-threatened wetland-dependent birds ii. Trends in the status of globally-threatened wetland-dependent amphibians
H. The proportion of candidate Ramsar sites designated so far for wetland types/features	i. Coverage of the wetland resource by designated Ramsar sites

60. A priority task for the STRP during 2006-2008 is the development of mechanisms for the implementation and assessment of these effectiveness indicators (Resolution IX.2 Annex 1).

The relationships among the different wetland assessment tools available through the Convention

61. Figure 2 illustrates the relationships among various assessment tools as a flow diagram that shows the linkages between the tools and the choices that may need to be made when assessing the condition of or change in a wetland.
62. The specific applications of each these individual assessment tools are summarized in COP9 DOC. 24. It is important to recognize that whilst each assessment tool has a specific application there can exist considerable overlaps between tools under some circumstances. In some instances, one or more specific tools can be used as part of a broader form of assessment. Practitioners need to consider the choice of tool or tools in relation to the specific purpose of the assessment they need to undertake.

63. The assessment tools and approaches shown in Figure 2 and described further in COP9 DOC. 24 are relevant in one way or another to assessing change or potential change in wetlands. These can be effectively integrated in a hierarchical decision-making framework, so that there is an efficient flow of information and influence from one to the other. Some of the ways in which this can occur are:
- *Strategic Environmental Assessment* can provide a framework or context which helps to determine the need for, and the parameters of, relevant project-specific *Environmental Impact Assessments*, focusing on key issues, priority risks and opportunities.
 - *Environmental Impact Assessment* can help determine the need for, and the parameters of, *Vulnerability and Risk Assessments* and *Wetland Valuations*.
 - *Vulnerability and Risk Assessments* help define baselines, tolerance limits and other elements to feed in to *Environmental Impact Assessment*, as well as potential measures for reducing the risk of wetland degradation.
 - *Risk Assessment* can also quantify the magnitude and likelihood of impacts, as part of an *Environmental Impact Assessment*.
 - *Wetland Valuation* (of ecosystem provisioning, regulating, cultural and supporting benefits/services) can provide information to assist in articulating the benefits obtained from a wetland and hence support the concepts provided in *Vulnerability and Risk Assessments*.
 - Information on impacts collected in the *Environmental Impact Assessment* process and through subsequent monitoring activities can feed into the *Strategic Environmental Assessment* process, as well as informing *Vulnerability and Risk Assessments* and *Wetland Valuations*.
 - *Rapid Assessment* of biodiversity provides information that can guide *Environmental Impact Assessment* and support *Vulnerability and Risk Assessment*, and identify elements of biodiversity that could be used within *Wetland Valuation*.
64. Thus Strategic Environmental Assessment, Environmental Impact Assessment, and Vulnerability and Risk Assessment will help define the scope of monitoring for policies/plans/programmes, for projects and for site management, respectively.
65. The Convention's *Wetland Risk Assessment Framework* (Resolution VII10; Ramsar Handbook 8) includes a substantial component addressing early warning indicators. Measurement of these indicators will draw on data from site management and monitoring and will feed back to adjustments in that management. Rapid Assessment of biodiversity can also provide early warning of impending change, but as illustrated in Figure 4 there is an inverse relationship between the extent of the ecological relevance of an indicator and the extent of early warning. Early warning indicators can also provide data to the monitoring stimulated in relation to projects by Environmental Impact Assessment.

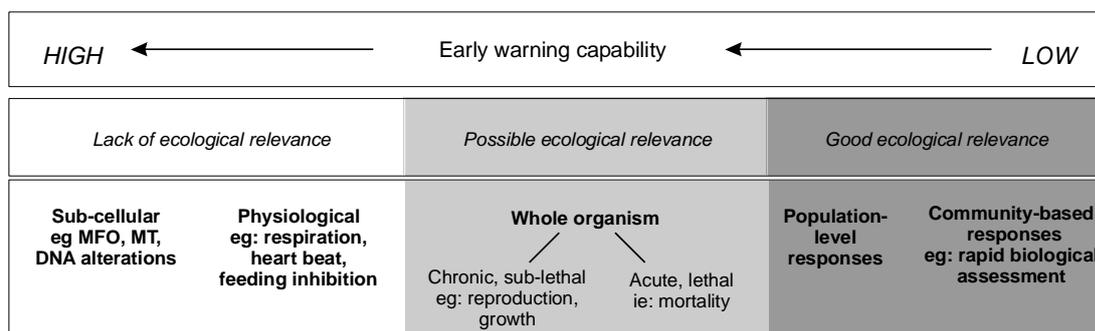


Figure 3. The relationship between ecological relevance and early warning capability to measure biological responses (from Annex to Resolution VII.10 *Wetland Risk Assessment Framework*).

Wetland monitoring

66. A framework for designing a wetland monitoring programme was adopted by COP6 (Resolution VI.1) in 1996 and is incorporated into Ramsar Wise Use Handbook 8 “Managing Wetlands”. This monitoring framework is summarized in Figure 5.
67. The framework is not a prescriptive recipe for any particular monitoring programme. It simply provides a series of steps that can be used by wetland managers and planners, working in partnership with local users and managers, to design a monitoring programme based on their particular circumstances and needs.
68. When designing a monitoring program it is necessary to consider a number of principles that ensure valid results, analysis and interpretation (see also Downes *et al.* 2002. *Monitoring Ecological Impacts: Concepts and Practice in Flowing Waters*. Cambridge University Press, Melbourne, Australia).
69. Many monitoring techniques are also available in the MedWet monitoring manual, which provides a listing and guidance on specific approaches (Tomas Vives, P. (ed). 1996 *Monitoring Mediterranean Wetlands: A Methodological Guide*. MedWet Publication, Wetlands International, Slimbridge, U.K. & ICN, Lisbon, Portugal) (downloadable from: http://www.wetlands.org/pubs&/wetland_pub.html).

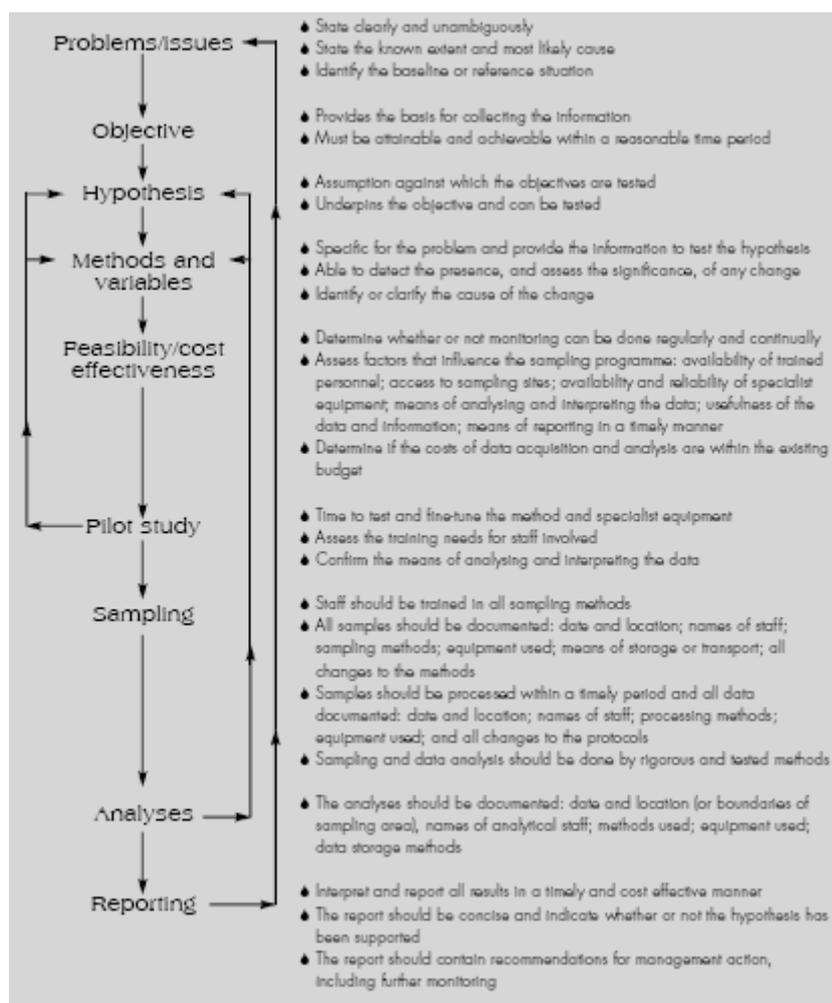


Figure 4. Framework for designing a wetland monitoring programme (from Ramsar Wise Use Handbook 8. 2nd Edition, 2004). The arrows illustrate the feedback which enables assessment of the effectiveness of the monitoring programme in achieving its objective(s).

Applying wetland inventory, assessment and monitoring tools in the context of the wise use of wetlands

70. This integrated framework for wetland inventory, assessment and monitoring, and the tools and methodologies it covers, forms one of several framework guidances developed by the STRP to assist Contracting Parties and others in more readily selecting and applying each of the increasing range of the Convention's wetland conservation and wise use guidelines.
71. The STRP has also recognized the significance of the Millennium Ecosystem Assessment's Conceptual Framework for Ecosystems and Human Well-being in providing an overarching framework for the delivery of Ramsar's wise use of wetlands (Resolution IX.1 Annex A). It provides a multi-scalar approach which indicates how and where policy and management interventions, including the different components of the Convention's toolkit of Wise Use Handbooks, can be made (see Figure 2 in Resolution IX.1 Annex A).

72. Within this conceptual framework, most of the Convention's tools for inventory, assessment and monitoring concern the maintenance of the ecological character of wetlands through interventions within wetland ecosystems themselves – between the components and processes of wetlands and the ecosystem benefits/services these deliver. Others, notably Environmental Impact Assessment, Risk Assessment, and Vulnerability Assessment concern addressing the interactions between “Direct Drivers of Change” to wetlands and the wetlands themselves. However, since Strategic Environmental Assessment is concerned with policies, plans and programmes, it acts as an intervention between Indirect and Direct Drivers of Change.

VI. Gaps in Ramsar's toolkit of inventory, assessment and monitoring guidance

73. Although this *Integrated Framework for wetland inventory, assessment and monitoring* now includes a large number of different tools and approaches, a number of gaps in methodological guidance remain before it provides a comprehensive Ramsar framework for implementation by Contracting Parties and others. These are identified in the schedule of actions for the scientific and technical implementation of the Convention, 2006-2011 (Annex 2 to Resolution IX.2). They include:
- i) development and testing of a hydro-geomorphically-based system of classification of wetland types, including an evaluation of how this relates to other possible systems and to the current Ramsar classification system;
 - ii) further development of the Web-based wetland inventory meta-database;
 - iii) a review of data and information needs for Ramsar sites and other wetlands, including guidance for the description of the ecological character of wetlands, and harmonisation of the Information Sheet on Ramsar Wetlands (RIS) with the wetland inventory core data fields and the description of ecological character;
 - iv) advice on delineating and mapping wetlands (in conjunction with the description of ecological character);
 - v) further consolidated guidance on detecting, reporting and responding to change in the ecological character of wetlands; and
 - vi) establishment and implementation of mechanisms for the ecological ‘outcome-oriented’ indicators of effectiveness of the implementation of the Convention and development of further such indicators.
74. In addition to these methodological developments, Resolution IX.2 also recognizes that regular assessment and reporting on the status and trends of the ecological character of Ramsar sites and other wetlands will need to ensure that the results of national wetland inventory and assessments are made fully accessible, as is called for in Resolution VIII.6.
75. There is also a need, recognized in the work of the Millennium Ecosystem Assessment (see Finlayson, D’Cruz & Davidson. 2005. *Ecosystems and Human Well-being: Wetlands and Water. Synthesis*. World Resources Institute, Washington D.C.), for more case studies and more widespread and comprehensive assessments of the socio-economic value of wetland

ecosystem benefits/services, particularly in relation to the potential conversion of wetlands to other land uses, as the basis for sound decision-making.

VII. Priorities for improving integrated wetland inventory, assessment and monitoring

76. The following practical steps for improving integrated wetland inventory, assessment and monitoring are recommended.
- i) All countries that have not yet conducted a national wetland inventory should do so, preferably using an approach that is comparable with other large-scale wetland inventories already underway or complete. These should focus on a basic data set that describes the location and size of the wetland and the major biophysical features, including variation in the areas and the water regime – see the further guidance in the Convention's *Framework for Wetland Inventory* (Resolution VIII.6).
 - ii) Once the baseline data have been acquired and adequately stored, more management-oriented information on wetland threats and uses, land tenure and management regimes, benefits and values should be added. When such assessment information is recorded, it should be accompanied by clear records that describe when and how the information was collected and its accuracy and reliability.
 - iii) Each inventory and assessment program should contain a clear statement of its purpose and the range of information that has been collated or collected. This extends to defining the habitats being considered and the date the information was obtained or updated.
 - iv) Priority should be given to improving the global inventory for wetland habitats that are currently poorly covered in most parts of the world, i.e. seagrasses, coral reefs, saltmarshes and coastal tidal flats, mangroves, arid-zone wetlands, rivers and streams, and artificial wetlands.
 - v) The effectiveness of all aspects of wetland inventory and assessment should be increased through the use of a standardised framework and a generic wetland inventory core dataset (as provided in Resolution VIII.6), designed to be as flexible as possible for use in all regions of the world and to accommodate various inventory and assessment objectives.
 - vi) Models for effective wetland inventory, assessment and monitoring, using appropriate remote sensing and ground techniques, should be compiled and widely disseminated. These should outline useful habitat classifications (e.g., those based initially on landform and not vegetation parameters) and methods and means of collating and storing the information, in particular Geographic Information Systems (GIS) for spatial and temporal data that could be used for monitoring purposes.
 - vii) Wetland monitoring systems should build upon the information provided in wetland inventory and assessment activities. Specific monitoring should be based on a hypothesis derived from the assessment data and be contained within a suitable management structure.

77. These and other issues will be taken into account in the comprehensive review of data and information needs of the Convention, proposed to be undertaken by the STRP as a priority task in its 2006-2008 programme (Resolution IX.2 Annex 1).