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Global Review of Wetland Resources and Priorities for Wetland Inventory

Summary Report

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**Report to the Bureau of the Convention on Wetlands (Ramsar, Iran, 1971) from Wetlands
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from colleagues spread around the globe and an international steering committee. The European team was also supported by project funding from RIZA from the Netherlands and NORAD from Norway. This summary was taken from the material supplied by this collective group. Individual reports and databases prepared for each of the Ramsar global regions will be published separately in hardcopy and CD-ROM formats.

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Executive summary

1. This summary is based on reviews of the extent of wetland inventory in each Ramsar region. These were supplemented by a review of regional and international wetland inventories. Standardised data collation and recording formats were used in each of the reviews.
2. It is important to note that these reviews were limited by available funds and time, and that further effort will unearth more information.
3. It was not possible to make reliable overall estimates of the size of the wetland resource globally or regionally. Some good examples of wetland inventory processes exist (e.g., the Mediterranean Wetlands Initiative - MedWet), but many inventories allowed only a cursory assessment of the extent of wetland area or condition. Whilst not undermining the value of individual inventories, this highlights wetland inventory as being incomplete and difficult to undertake.
4. Recommendations are made to improve the accuracy of quantifying and describing the wetland resource through wetland inventory, and to provide the basic information required for managing the wetland resource.
5. Recommendations focus on the need to conduct national inventory programmes and the inclusion of basic information on the location and extent of each wetland and its major ecological features as a forerunner to collecting further management-oriented information.
6. Development of standardised methods for data collection, collation and storage are called for. These methods should address the use of relatively new techniques for collecting and interpreting remotely-sensed data; storing this in electronic formats, including Geographic Information Systems (GIS); and recording key information in a meta-database.
7. The key conclusion of this review is that little is still known about the extent and condition of the global wetland resource. On a regional basis only parts of North America and Western Europe have adequate past and current inventory. Without good inventory it is difficult to promote and support the wise use of the wetland habitats covered by the Ramsar Convention.
8. Priority habitats for future inventory are identified. These are seagrasses, coral reefs, salt marshes and coastal flats, mangroves, arid-zone wetlands, peatlands, rivers and streams and artificial wetlands.
9. The Ramsar Convention should play a pivotal role in implementing these recommendations.

Recommendations

10. This review makes many critical comments on the state of global wetland inventory. In summary, global wetland inventory is incomplete and inadequate for most management

purposes. From our many comments, eight are recommended for priority action. These reflect the effort required to implement an effective inventory programme as the basis for wise use of the global wetland resource. Not all recommendations are, however, relevant to all geographic situations or inventory programmes,

- 10.1 All countries lacking a national wetland inventory should undertake one, using an approach that is comparable with other wetland inventories and for which the Ramsar Convention should provide guidance (see below). These inventories are needed to underpin national planning, policy development and all efforts directed at wetland conservation and wise use promoted by the Ramsar Convention and other related conventions. The inventories will assist in identifying wetlands of national and international importance, and through this will contribute to the Ramsar Convention achieving its vision for the List of Wetlands of International Importance [Ramsar COP7 DOC. 15.11].
- 10.2 Quantitative studies of wetland loss and degradation are urgently required for much of Asia, Africa, South America, the Pacific Islands and Australia.
- 10.3 Further inventory should focus on a basic data set describing the location and size of each wetland and its major biophysical and hydrological features, including variations in area and the water regime. This information should be made available in both hardcopy and electronic formats.
- 10.4 After acquisition of the basic data, further information oriented to management, on wetland threats and uses, land tenure and management regimes, benefits and values, should be collected. Source(s) of information should be clearly recorded along with comments on its accuracy and availability.
- 10.5 Each inventory should include a clear statement of its purpose and the range of information that has been collated or collected. This extends to defining the habitats covered and the date the information was obtained or updated.
- 10.6 The Ramsar Convention should support the development and dissemination of models for improved globally-applicable wetland inventory. These should be derived from existing models, for example the MedWet Initiative, that are capable of using both remote sensing and ground techniques, as appropriate. Models should cover appropriate habitat classifications (e.g., those based on landform categories), information collation and storage, in particular Geographic Information Systems for spatial and temporal data that can be used for monitoring purposes.
- 10.7 The Ramsar Convention should support development of a central repository for both hard-copy and electronic inventories. The meta-data that describe the inventories should be published on the World Wide Web for greater accessibility.
- 10.8 Further support is required for completion of the global review of wetland resources and priorities for wetland inventory; and to develop procedures for regular updating and

publishing of inventory information on the World Wide Web. Regular updating (e.g., in conjunction with the triennial national reporting to the Ramsar Convention) may require restructuring the format and style of the current databases and bibliographic materials supplied by this project.

Background and objectives

11. Knowing the location, distribution and character of wetlands, their values and uses, and the threats to them is an essential basis for developing and implementing management for their wise use. This is required at geographical scales ranging from local site management, through development of national policies to global priority setting.
12. Differences in the purpose and use of wetland inventories mean that the information that is collated is often not readily accessible for broader uses or users. Much of this information is scattered so it has not been clear where adequate inventory information exists, nor where are the major gaps.
13. Action 6.1.3 of the Ramsar Convention Strategic Plan 1997-2002 is to “*utilise information from regional wetland directories, national scientific inventories of wetlands and other sources, to begin development of a quantification of global wetlands resources, as baseline information for considering trends in wetland conservation or loss.*” A pledge of funding for this action was made by the United Kingdom at the 6th Conference of the Contracting Parties of the Convention (Brisbane, 1996) and resulted in this review.
14. There were three aims of the review:
 - 14.1 To provide an overview of international, regional and national wetland inventories (including regional and national directories of important wetlands), as well as other general information on global wetland resources from publications, Ramsar Convention literature, and information collected by other institutions doing work on the same or related subject(s);
 - 14.2 To provide recommendations for how to proceed to meet the objective as set out in Action 6.1.3 of the Ramsar Convention Strategic Plan for the current data holdings identified through 14.1 above;
 - 14.3 To identify the priorities for either establishing, updating or extending wetland inventories so as to improve the accuracy with which the global wetland resource can be quantified and described in future.
15. Wetlands International undertook the review during 1998 under a contract from the Bureau of the Convention on Wetlands (Ramsar, Iran, 1971). Collation and assessment work was undertaken through subcontracts with Wetlands International’s regional and subregional licensees and the Environmental Research Institute of the Supervising Scientist, Australia, supporting Wetlands International’s Wetland Inventory and Monitoring Specialist Group. A steering committee comprised of representatives of the Ramsar Bureau, the Wetlands

International licensees, the UK Government and invited experts was established to review progress and outputs.

16. Members of the steering committee and project teams met in a workshop held in association with the 2nd International Conference on Wetlands and Development in Dakar, Senegal, during November 1998, to review progress with the project reports.
17. As funding was considered to be an absolute minimum for satisfactorily undertaking the project, it was linked to other Wetlands International work under the Biodiversity Conservation Information System (BCIS) initiative. The BCIS project is developing guidance for wetland assessment and inventory and proposals for developing improved wetland inventory and assessment tools. Work in Wetlands International - Africa, Europe, Middle East was conducted jointly with another wetland inventory project in Europe. This contributed information to support the European component of the project and permitted completion of a more detailed compilation and analysis for the African and European Ramsar regions.

Methodology

18. Initial work focused on the development of definitions for inventory categories, the scope and procedures for identifying inventory sources, and for the compilation and handling of inventory information. This was essential to ensure that compilation and handling of information was consistent between regional teams. Three information handling tools were developed:
 - 18.1 *Wetland inventory assessment sheet* - to permit rapid compilation and assessment of information on each wetland inventory.
 - 18.2 *Wetland inventory assessment database* - to store the information compiled from the wetland inventory assessment sheet.
 - 18.3 *Bibliographic database* - to compile details of inventory information that was in a report format, and to allow later searching.
19. These tools were used in reviews of the extent of inventory information available for each of the seven Ramsar regions – Africa, Asia, Eastern Europe, Neotropics, North America, Oceania, and Western Europe. Regional reviews were based primarily on national inventories, although subnational reviews were used where these covered a large area or a major administrative zone. The regional reviews were supplemented by a review of continental and global scale inventory sources. All reviews and their supporting databases are available as hardcopy and on CD-ROM. Only a summary is presented here.

Results & Conclusions

General information

20. Based on the reports for the seven Ramsar regions, it is clear that the extent of global wetland inventory effort is patchy – it does not provide a comprehensive information base for the wise use and monitoring of wetlands. There are many gaps in coverage. Much information is outdated or incomplete and there is very little information on wetland assessment or values derived from wetlands. Thus we do not yet know, at the global level, what wetlands we have and the sum total of their values.
21. Much of the inventory effort has not progressed beyond the collation of existing information. Further, such compilations often used differing sources of information without providing an indication of the age or reliability of the information, or even an adequate reference to the source material.
22. Except for a few imagery-based programs, many inventories do not provide a basis for monitoring the status of wetlands. Even basic questions about wetland extent and distribution are still not answered. This basic information is not readily available for much of Africa, Asia, Eastern Europe, the Neotropics, and Oceania. Notable exceptions are provided by national inventory efforts in the USA and some Western European countries.

Extent and distribution of wetlands

23. Data on the extent and distribution of wetlands at various scales, from global estimates to the areal extent of particular wetland types at specific sites, were obtained. *However, there is considerable inconsistency in the information, with data unavailable for some sites or countries.*
24. Based on current information it is not possible to provide an acceptable figure of the areal extent of wetlands at a global scale. First, there is little agreement on what constitutes a wetland. Secondly, there are many gaps and inaccuracies in the information. *Thus, the 'best' minimum global estimates provided below are indicative only:*
 - natural freshwater wetlands 570,000,000 ha
 - rice paddy 130,000,000 ha
 - mangroves 18,100,000 ha
 - coral reefs 30-60,000,000 ha
25. Based on the above figures the area of wetlands worldwide ranges from 748,000,000 – 778,100,000 ha, but this does not include many wetland types, such as saltmarshes and coastal flats, seagrass meadows, karsts and caves, and reservoirs. Previously published global estimates range from 560,000,000 – 970,000,000 ha.
26. Anything but a cursory consideration of the above values is immediately thrown into doubt when the regional minimum estimates for wetland area are considered.
 - Africa 121,322,000 – 124,686,000 ha
 - Asia 204,345,000 ha
 - Eastern Europe 229,217,000 ha

- Neotropics 134,804,000 – 1,782,103,000 ha
- North America 244,903,000 – 2,057,369,000 ha
- Oceania 35,750,000 ha
- Western Europe 28,822,000 ha

27. The above figures total 999,165,000 ha – 4,462,292,000 ha, which is well in excess of the best global estimates given above.
28. These major discrepancies in the areal estimates make their usefulness very dubious. The discrepancies can be attributed to many factors, such as differences in the definition of wetlands, the techniques used to collect and interpret the basic data, and the scale of the analyses. It is not possible to make an objective assessment of the various figures given as many inventories merely repeat previously gathered information and/or do not clearly describe the methods being used and the accuracy and reliability of the data, especially in relation to determining the boundaries of seasonal and intermittently flooding wetlands.

Wetland types and definitions

29. The broad Ramsar definition of a wetland was adopted in 1971 and is now commonly used in many countries. It has provided, generally with modification, the basis for many national wetland inventories. However, this is not always the case and many inventories are restricted to more specific habitats (e.g. lakes, mangroves or reefs) or do not include both marine and inland wetlands (e.g., the continental scale inventories of Asia and Africa).
30. In many inventories there was no clear definition made of the range of habitats being considered. This is confusing given that the range of wetland habitats covered in inventories varies from coral reefs to coastal mangroves inland to high-altitude lakes and bogs.
31. Artificial wetlands are an important part of the wetland resource in many regions (e.g. rice paddy in Asia), but these habitats are often not included in wetland inventories and were not equally considered in the regional reviews that supported this summary analysis.
32. Regardless of which wetland definitions were used the boundaries of wetlands were often not given, making comparisons between different sources difficult, as did the variable treatment of individual wetlands in wetland complexes.

Rate and extent of wetland loss and degradation

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

34. Agriculture is considered the principal cause for wetland loss worldwide. By 1985 it was estimated that 56-65% of available wetland had been drained for intensive agriculture in Europe and North America, 27% in Asia, 6% in South America and 2% in Africa.
35. Linked with the rate and extent of wetland loss and degradation worldwide is the issue of water allocation and distribution. Many rivers around the world have been heavily regulated by the construction of dams to satisfy the increasing demand for irrigation and hydropower. Impacts on the rivers and associated natural waterbodies, swamps, and marshes include increased salinisation, diminishing underground water reserves, declining biodiversity and impoverishment of fish stocks due to impeded migration and degraded habitat.
36. Impacts are not limited to inland or coastal wetlands. A recent study of coral reefs indicated that 58% of the world's reefs are at moderate to high risk of damage from human disturbance. Globally, 36% of all reefs were classified as threatened by overexploitation, 30% by coastal development, 22% by land-based pollution and erosion, and 12% by marine pollution.
37. The Ramsar site database provides a regularly updated, but still uneven analysis of threats to wetlands. Data provided by Ramsar Contracting Parties indicated that 84% of Ramsar-listed wetlands had undergone or were threatened by ecological change. The most widespread threats were from pollution, drainage for agriculture, settlements and urbanisation, and hunting.

Land tenure and management

38. Many of the continental, and some national, wetland inventories contain generic information on land management and land tenure. Generally this is in the form of basic statements about jurisdiction, conservation status, and proposed conservation measures. This information is usually brief and often does not outline the effectiveness or otherwise of land tenure measures in protecting wetland resources.
39. In Asia and parts of Oceania, despite some progress in implementing conservation legislation, many countries still require means to enforce safeguards against increasing pressures due to population increases. This is particularly urgent for mangrove conservation.

Wetland benefits and values

40. Many of the inventory sources provided some information on the values and benefits of wetlands. However, this was usually in the form of a summary of the biodiversity values and human use, with little quantitative or economic data being given. Exceptions are the productivity of artificial wetlands, such as rice paddy, fish ponds and salinas.
41. At a global scale the values and benefits of all wetlands for biodiversity conservation and human uses have been outlined. Information is most detailed for mangroves, where values and benefits include coastal protection, flood reduction, sediment accumulation, fish and crustacean nurseries. Similar descriptions are available for peatlands.

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

Extent and adequacy of updating programs

43. Few inventories have been regularly updated. At a national level the status and trends analyses done in the USA make a comprehensive attempt to provide updated information. As few other studies were identified the overall extent of wetlands and wetland loss cannot be determined.
44. The Ramsar Convention Bureau provides an updated directory of the sites included in the List of Wetlands of International Importance every six years. The List is fast approaching 1,000 sites with a total area in excess of 70 million hectares and is now available on the World Wide Web and CD-ROM as well as in hardcopy. However, the directory does not contain a comprehensive updated overview of all sites.
45. The apparent absence of regular updating of wetland inventories is not unexpected given the overall cost and logistical effort of conducting and publishing (in hard copy) such work. Recent development of 'user-friendly' database packages and increased availability of electronic information systems, such as Geographic Information Systems (GIS) and the World Wide Web, is increasing the options available for data storage, analysis and access. It is increasingly possible to store wetland inventory information in an electronic database and make it widely accessible.

Standardising of inventory approaches

46. There is inadequate standardisation of inventory techniques, including the means of recording and reporting the basic information that is necessary for determining, with confidence, the status of wetlands worldwide. Inventories often lack basic information, notably the objective or purpose of the inventory, the wetland definition and classification systems used, the method(s) of data collection, source data for statistics of wetland area and wetland loss, name and affiliation of the compiler for individual site data, a programme for updating the inventory, etc.
47. The development of a standardised and flexible framework for wetland inventory will help individual countries to prepare national wetland inventories not only in a format compatible with their objectives but also compatible with the inventory of neighbouring countries. This would greatly improve the capacity for comprehensive wetland inventory on a regional, and ultimately global, scale.
48. Using electronic data storage systems such as databases and Geographic Information Systems linked to the World Wide Web will enhance the availability of data and related information (e.g. bibliographies) for particular countries and wetland sites. It will also permit regular, cost-effective updating of inventory information.

49. Countries with limited resources or expertise in wetland inventory may particularly benefit from access to standardised or generic wetland inventory methods, including generic databases for recording and storing basic inventory programme information. This information could then be added to a globally accessible meta-database, such as that developed by BCIS, to ensure that details and contacts are available to others for future access to the inventory.
50. Such standardisation could be derived from existing models, notably the Mediterranean wetland inventory (MedWet) and the United States Fish and Wildlife Service national wetland inventory. The remote sensing techniques and the classification systems used in these approaches have been successfully adapted for use in other countries and could provide a basis for a standardised framework and/or generic wetland inventory database.
51. There are regular calls for the increased use of remote sensing technology for wetland inventory. These techniques are available and many are being tested for different wetland habitats. The emphasis should not be on wholesale adoption of such techniques, but rather on the development of models that suit particular purposes and which are linked to on-the-ground management activities, including effective ground truthing and monitoring.
52. Overall, given the difficulties in obtaining even the most basic information for many wetlands, there is a need to identify a basic data set to describe the wetland. This would include the location and area and the basic features of the ecological character that provides values and benefits to humans. The latter would include general indicators or descriptors of the water regime, water quality and biota. An agreed landform classification system would make it possible to compare between sites and regions and hence provide a basis for management decisions that may lead to the collection of more specific information on threats, values and benefits, land tenure and management, and monitoring.

Information sources

53. A broad range of inventories and published reports on wetlands were reviewed. These included global, regional and supra-national inventories available in published reports, books and journals and augmented by unpublished reports, atlases (e.g., for mangroves) and Web pages (e.g., for coral reefs). Much of the information assessed was not from published inventory sources.
54. It is considered that many other sources of information were not accessed during this review. This is particularly so for the Americas where an immense quantity of information exists. Much less information exists for Africa and Asia. In such instances, at least, some further information may be available in reports dealing with land and water resources, especially for fisheries. However, much of this is believed to be in small library collections that are not easily accessed through library exchange procedures. More extensive networks and familiarity with more languages may enable more information sources to be located.
55. Collections of remotely-sensed imagery and national and global scale maps and charts were not assessed. It seems that topographical and navigational maps have not been greatly used for

inventory purposes, partly as they are not easy to obtain and collate. This situation may change as more maps are produced in electronic formats. The increased availability of global and national scale image databases (on CD-ROM and the Web) may also provide improved opportunities for use of remotely-sensed data.

56. Whilst we cannot claim that this current review is comprehensive, our development of the bibliographic and inventory databases provides an initial tool for adding more sources once they are located. If this were to be done on a regular basis (e.g., in conjunction with the triennial inventory of Ramsar sites), restructuring of the format and style of the current databases may be appropriate.
57. The regional reviews identified a large number of sources for wetland inventories, but coverage at national level is patchy. Many inventories covered only part of a country's wetland resource (e.g., estuaries or peatlands or lakes). Supra-national inventories cover more countries but these are not usually comprehensive (e.g., covering only important wetlands).
58. Many inventories were based on biodiversity criteria, particularly those important for waterbirds. Others were based on specific habitats, such as lakes or reefs. Many of these were non-specific reviews or summaries of wetland information.
59. Many national inventories had been undertaken by national or provincial governmental agencies. In contrast, supra-national inventories were undertaken by international non-governmental organisations. Although the latter have provided valuable collations of existing material, many have not been well distributed and only occasionally have been updated.
60. The major inventory effort seems to have occurred during the 1980s and early 1990s. Much of the earlier material is now considered of only historical use, given continued loss and degradation that is believed to have occurred in many regions. Where possible, our analyses focussed on inventory sources from the 1990s.

Priorities for future wetland inventory

61. Knowledge of the global wetland inventory resource is, on the whole, far from complete and is inadequate to support management needs. All regions of the world – Africa, Asia, Eastern Europe, Neotropics, North America, Oceania and Western Europe – have information gaps and priority areas for wetland inventory. Some of these information gaps should be addressed urgently, and this urgency will become greater as wetland loss continues.
62. To make the task more manageable, priority should be given to encouraging countries which do not yet have a national wetland inventory to commit, or seek, the resources to complete one. The great importance and urgency of national wetland inventories cannot be over-emphasised. They provide the base information for effective monitoring, management, sustainable use and conservation of wetlands at all levels - local, national, regional and international.

63. Attention must also be given to the inventory of priority wetland habitats, targeting those for which there is little or no information, and those at greatest risk of degradation and destruction. Based on this study the priority wetland habitats are:
 - 63.1 *seagrasses* - in Southern Asia, the South Pacific, South America and some parts of Africa, are under increasing threat from pollution, coastal development, destructive fishing practices, recreational use, etc.;
 - 63.2 *coral reefs* - are an important biodiversity resource that is under continuing threat globally due to the development, deforestation and pollution of coastal and inland wetlands;
 - 63.3 *salt marshes and coastal flats* - have generally been overlooked in wetland inventories, with few areal estimates and no true global 'picture' available. However, they are under increasing threat worldwide, particularly in Africa, Asia and Oceania due to increasing coastal development;
 - 63.4 *mangroves* - are better mapped than other coastal and marine wetlands, but serious inconsistencies exist and more comprehensive inventory is required. This should be used to better determine the mangrove loss that is proceeding at an alarming rate in many parts of Africa, southeast Asia and Oceania through deforestation, land reclamation, and development for aquaculture;
 - 63.5 *arid-zone wetlands* - are generally poorly mapped but increasingly important in the light of escalating population pressures and water demand. For example, in Africa and the Middle East, pressures for increased water supply have led to the construction of many large dams and to disputes over transboundary sharing of limited water resources;
 - 63.6 *peatlands* - are well mapped in comparison to other wetland habitats. However, they are threatened by drainage for agriculture and afforestation in Asia, parts of Europe and North America in particular, despite their importance as a global carbon sink and economic resource, and are poorly known in tropical regions such as southeast Asia.
 - 63.7 *rivers and streams* - are seriously threatened by industrial and domestic pollution, water diversion, and regulation in many regions of the world. Although generally considered to be well mapped, it is difficult to obtain areal estimates of rivers and streams and the extent of associated swamps, marshes, oxbow lakes and lagoons.
 - 63.8 *artificial wetlands* - increasingly important with reservoirs, dams, salinas, paddy, and aquaculture ponds important in many regions, notably Asia, Africa and the Neotropics, where they can provide habitat for wildlife, particularly migratory birds. Under some circumstances they provide many values and benefits to humans and can partially compensate for the loss and degradation of natural wetlands.
64. The work required to establish, update or extend wetland inventory seems monumental when viewed at a global scale, but is achievable by national action if a genuine will exists and key

processes are targeted for improvement. These include improved communication to ensure that wetland inventory information is useful to people at all levels, from local to global.

65. Cooperation between countries and agencies, with the common aim of improving wetland inventory for all wetland habitats, particularly those most threatened, should be enhanced. Resources and effort are often 'wasted' on pilot studies or overly-ambitious projects that have little reward in terms of inventory and improved management of wetlands. This indicates a need for even more careful prioritisation when allocating resources for wetland inventory.
66. When undertaking further wetland inventory every effort should be made to link this with other national and international initiatives, such as the identification and delineation of further sites of international importance. Further, the inventory effort should assist with moving to achieve the vision for the Ramsar List of Wetlands of International Importance (Ramsar COP7 DOC. 15.11).