Wetland inventory: Overview at a global scale

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Abstract

As part of a Global Review of Wetland Resources and Priorities for Wetland Inventory (GRoWI), global and continental scale wetland inventories were collated and assessed in order to determine the status of wetland inventory worldwide, and to identify priority areas for future inventory effort. From global-scale remote sensing analyses the natural terrestrial wetland resource has been estimate at 530–570 M ha, with rice paddies forming another 130 M ha. Major gaps in global-scale information exist, notably for artificial wetlands other than rice paddy and for coastal and marine wetlands, for which global estimates are available only for mangroves and coral reefs. Inventory at the regional and national scales is also very incomplete. Review of a wide variety of inventories and other sources of wetland information has revealed that there are also major inconsistencies in approaches to wetland inventory, which hamper its effectiveness as a management tool. GRoWI recommended techniques and strategies to improve further wetland inventory. Key recommendations include: the development and dissemination of models for improved globally-applicable wetland inventory; a national wetland inventory be conducted in every country that currently lacks one; the urgent need for quantitative studies of wetland loss and degradation in many parts of the world; and recommendations on approach and design of a wetland inventory, including the need for a clear statement of its purpose, the initial acquisition of a basic data set of key information for each wetland, and publication of inventory information in both hardcopy and electronic formats.

Keywords: global wetland inventory, status of wetlands, distribution and loss of wetlands, Ramsar Convention

1 Introduction

A Global Review of Wetland Resources and Priorities for Wetland Inventory (GRoWI) was undertaken in 1998 by Wetlands International and the Environmental Research Institute of the Supervising Scientist on behalf of the Bureau of the Ramsar Convention on Wetlands (Finlayson & Spiers 1999).

The aims of the review were to:

- provide an overview of international, regional and national wetland inventories as well as other general information on global wetland resources;
- outline steps to quantify the extent of global wetland resources and to provide a baseline for measuring trends in wetland conservation or loss; and
- identify priorities for establishing, updating or extending wetland inventories.

One component of the project reviewed international and continental-scale wetland inventories and other global wetland sources (Spiers 1999). This paper summarises the findings of this part of the GRoWI analyses.

2 Materials and methods

A broad range of inventories and other global wetland information sources were reviewed by Spiers (1999), including global atlases for particular wetland types, regional inventories, journal and conference papers, books and websites. Other sources, such as continental or global scale general maps or remotely sensed imagery, were outside the scope of this analysis, although Sahagian and Melack (1996) have identified these as a source of inventory information that requires assessment.

The broad definition of wetlands adopted by the Ramsar Convention on Wetlands was used in the review. Wetland information sources assessed by Spiers (1999) covered specific wetland types (eg seagrasses, mangroves, coral reefs, and peatlands), and wetlands in general, including Ramsar sites, protected areas, important bird areas and artificial wetlands.

The detailed methodology adopted in the GroWI analysis is summarised by Finlayson and Davidson (1999a).

3 Results

3.1 Wetland extent and distribution

Sources reviewed by Spiers (1999) provide data on extent and distribution of wetlands at various scales, from global estimates to the areal extent of particular wetland types at specific sites. There is considerable inconsistency in the information obtained for review, with data unavailable for some sites or countries due to a lack of adequate inventory or maps. Estimates of global wetland areas from global sources are listed in table 1 and those for regional wetland areas in table 2.

As part of methane-emission studies the global extent of natural freshwater wetlands was calculated by Matthews and Fung (1987) as 530 M ha, and by Aselmann and Crutzen (1989) as 570M ha (table 1). These figures are approximately double those from earlier global wetland area estimates (Lieth 1975, Whittaker & Likens 1975, Ajtay et al 1979). This seems largely because the two more recent studies used a broader definition of methane-producing wetlands, including seasonal and permanent freshwater ecosystems whether peat-forming or not (Aselmann & Crutzen 1989), and small ponded wetlands (Matthews & Fung 1987). Saltwater wetlands were excluded from these estimates since their methane production is usually insignificant (Aselmann & Crutzen 1989).

Global estimates identified during the study for particular freshwater wetland types, eg swamps, lakes, floodplains and peatlands, are listed in table 1.

No overall figure for the global extent of coastal and/or marine wetlands was located (Spiers 1999), but estimates have been made for coral reefs and mangroves (table 1). Likewise, no estimate for the global extent of saltmarshes was found, and there are large information gaps for this wetland habitat throughout the world. However, some regional salt marsh data are available (table 2), and is discussed in further detail by Spiers (1999). There are also limited data on the extent and distribution of coastal lagoon wetlands and seagrasses.

Table 1 Global area estimates obtained from wetland inventory sources

Source	Region	Wetland type	Global area (ha)
Matthews & Fung (1987)	Asia, Oceania, Africa, Europe, Neotropics, North America	Forested bog	207 800 000
		Nonforested bog	89 700 000
		Forested swamp	108 700 000
		Nonforested swamp	100 700 000
		Alluvial formations	19 400 000
		Total natural wetlands (excl. irrigated rice fields)	530 000 000
Aselmann & Crutzen (1989)	Asia, Oceania, Africa, Europe, Neotropics, North America	Rice paddies	130 000 000
		Bogs	190 000 000
		Fens	150 000 000
		Swamps	110 000 000
		Floodplains	80 000 000
		Marshes	27 000 000
		Lakes	12 000 000
		Total natural freshwater wetlands	570 000 000
Dugan (1993)	Asia, Oceania, Africa, Europe, Neotropics, North America	Wetlands (assumedly freshwater only)	560 000 000
Frazier (1996)	Asia, Oceania, Africa, Europe, Neotropics, North America	Wetland sites on the Ramsar List of Wetlands of International Importance	52 334 339 *
Spalding et al (1997)	Asia, Africa, Oceania, Neotropics, North America	Mangroves only	18 100 000
WCMC (1998)	Asia, Oceania, Africa, Neotropics, North America	Coral reefs only	30 000 000 – 60 000 000
Dugan (1993)	Asia, Oceania, Africa, Europe, Neotropics, North America	Peatlands only	400 000 000
Aselmann & Crutzen (1989)	Asia, Oceania, Africa, Europe, Neotropics, North America	Artificial wetlands — rice paddies only**	130 000 000
Finlayson & Davidson (1999b)	Asia, Oceania, Africa, Europe, Neotropics, North America	All wetlands	1 275 847 000– 1 279 211 000 ha

* Update (07/09/00): Ramsar now lists 1034 wetland Sites of International Importance, covering over 78 M ha;

** No other global areas located for artificial wetland types.

Table 2 Regional wetland area estimates by wetland type. (Note: Approximate only, refer to Finlayson and Spiers (1999) and original sources for further detail)

Region	Wetland type	Continental area (ha)	Source
Africa	Freshwater wetlands	34 500 000	Dugan (1993)
	Freshwater wetlands	35 600 000	Aselmann & Crutzen (1989)
	Tropical swamps	>34 000 000	Thompson & Hamilton (1983)
	Headwater swamps	8 500 000	Thompson & Hamilton (1983)
	Floodplains[1]	10 980 000	Denny (1993)
	Swamps[1]	12 640 000	Denny (1993)
	Shallow waterbodies[1]	2 830 000	Denny (1993)
Asia	All wetlands	>120 000 000	Scott & Poole (1989)
	Mangroves	>7 517 300	Spalding et al (1997)
Oceania	No regional estimate available		
Europe	Freshwater wetlands	670 000	Aselmann & Crutzen (1989)
	Coastal salt marshes	230 000	Dijkema (1987)
Canada	All wetlands	127 200 000	Glooschenko et al (1993)
United States of America	Marine wetlands	31 741	Wilen & Tiner (1993)
	Estuarine wetlands	2 123 199	Wilen & Tiner (1993)
	Palustrine wetlands	37 949 958	Wilen & Tiner (1993)
North America total[2]	All wetlands	167 304 898	(author's calculations)
Caribbean	All wetlands	23 500 000	Dugan (1993)
South America	Freshwater wetlands	152 000 000	Aselmann & Crutzen (1989)
Central America	Freshwater wetlands	1 750 000	Aselmann & Crutzen (1989)
Neotropics total[3]	All wetlands	>177 250 000	(author's calculations)

1 Author's calculations from figures provided in table 3, Denny (1993).

2 Further information from the review of North American wetland inventory sources (Davidson et al 1999a) enables calculation of a total wetland estimate of 241 574 000 ha for North America (Finlayson & Davidson 1999b).

3 Further information from Davidson et al (1999b) enables a total wetland estimate of 414 917 000 ha to be calculated for the Neotropics (Finlayson & Davidson 1999b).

There are apparently huge gaps in knowledge of seagrasses in the South Pacific, Southern Asia, South America and some parts of Africa (L McKenzie, pers comm 1998).

Artificial wetlands (reservoirs, dams, irrigation culverts and canals, fish farms, aquaculture ponds and rice fields) are known to contribute significantly to the global wetland area, and they often provide important habitats for flora and fauna as well as benefits to humankind. Aselmann and Crutzen (1989) calculated the global area of rice paddies as 1.3 million km^2 (130 million ha), of which almost 90% is cultivated in Asia (table 1). It is likely this figure is now outdated: Matthews et al (1991), cited in NASA (1999), provide a map of rice harvest areas worldwide which updates this information.

The GroWI analysis, derived from information in national inventories, came up with a very different estimate (12.76–12.79 M ha) to those derived from global-scale remote sensing (table 1), suggesting that the latter are major underestimates — especially given the major limitations of the national inventory coverage.

3.2 Wetland loss and degradation

The loss of wetlands worldwide has been estimated at 50% of those that existed since 1900 (Dugan 1993, OECD 1996). Without further clarification of this estimate (a definition of wetlands and/or the source data was not provided in references obtained by Spiers, 1999), it is assumed that the 50% wetland loss estimate applies to inland wetlands and possibly mangroves, but is unlikely to include marine wetlands. Much of this wetland loss occurred in northern countries during the first 50 years of the 20th century. Since the 1950s, tropical and sub-tropical wetlands have been increasingly degraded or lost through conversion to agricultural use. Agriculture is 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, a total of 26% loss to agriculture worldwide (OECD 1996). As wetland loss to agriculture and other uses is continuing, and indeed intensifying, in regions such as Africa, Asia, and the Neotropics, these figures need to be updated with more quantitative studies.

Impacts are not limited to inland or coastal wetlands: marine wetlands are also under threat. A recent study of coral reefs (WRI 1998) indicated that 58% of the world's reefs are at moderate to high risk from human disturbance. Globally, 36% of all reefs were classified as threatened by overexploitation, 30% by coastal development, 22% by inland pollution and erosion, and 12% by marine pollution.

Moser et al (1996) note that data provided by Ramsar Contracting Parties indicated that 84% of Ramsar-listed wetlands had undergone or were threatened by ecological change.

4 Discussion

On the basis of this and the other regional GRoWI analyses Finlayson and Davidson (1999b) concluded that, based on current information, it is not possible to provide an acceptable figure of the areal extent of wetlands at a global scale. There is little agreement on what constitutes a wetland, and many gaps and inaccuracies in the information. Spiers (1999) notes that all regions of the world — Africa, Asia, Oceania, Neotropics, North America, Western and Eastern Europe — have information gaps and priority areas for wetland inventory. The priority regions are Asia, Africa, Eastern Europe, the Neotropics, and Oceania, all of which urgently require further wetland inventory, and studies on the rate and extent of wetland loss. Attention must also be given to inventory of priority wetland habitats, which include seagrasses, salt marshes and coastal flats, coral reefs, mangroves, arid-zone wetlands, peatlands, rivers and streams, and artificial wetlands.

The work required to establish, update or extend wetland inventory may seem monumental when viewed at a global scale, but it is eminently achievable, if a genuine will exists and a few key processes are targeted for improvement (Finlayson & van der Valk 1995, Scott & Jones 1995). Spiers (1999) discusses issues of communication, cooperation, reporting and inventory format, standardisation of inventory approaches and techniques, electronic data storage and accessibility of wetland inventory information. These issues are further elaborated upon by Finlayson and Davidson (1999b), culminating in a list of recommendations which, if acted upon, will greatly assist the global community to improve wetland inventory and management into the new century.

Key recommendations include:

- 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).
- Quantitative studies of wetland loss and degradation are urgently required for much of Asia, Africa, Eastern Europe, South America, the Pacific Islands and Australia.
- Further inventory should focus on a basic data set describing the location and size of each wetland, and its major biophysical features, including variations in area and the water regime. This information should be made available in both hardcopy and electronic formats.
- 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.
- 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 program, that are capable of using both remote sensing and ground techniques, as appropriate. Models should cover appropriate habitat classifications (eg 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.

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