

Wetlands of the world's arid zones

24/09/1997

This study was written by Richard T. Kingsford on assignment from the Ramsar Bureau as a briefing paper for distribution at the First COP of the UN Convention to Combat Desertification, Rome, 29 September to 10 October 1997. It is a particularly valuable effort in that it both surveys the relationships between wetland conservation and concern for the threats of desertification and at the same time outlines the differences and similarities between the CCD and the Ramsar Convention on Wetlands. -- Web Editor.

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A contribution from the Convention on Wetlands (Ramsar, Iran, 1971) to the First Session of the Conference of the Parties to the UN Convention to Combat Desertification

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About the Ramsar Convention

The Convention on Wetlands (Ramsar, Iran, 1971) provides the framework for international cooperation for the conservation and wise use of wetland resources and biodiversity.

As defined by the Convention, wetlands include "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Manmade wetlands such as rice fields and reservoirs are also covered by the Convention.

Wetlands are very important for the ecological functions which they perform, as well as for their rich flora and fauna. They also constitute a resource of great economic, cultural, scientific and recreational value to human life. Wetlands and people are ultimately interdependent.

Adopted in 1971 in Ramsar, Iran, the Convention celebrated its 25th anniversary in 1996, with a membership of more than 100 countries. The Convention programme focuses on the conservation of the nearly 900 wetlands designated for the Ramsar List, and on national planning to maintain wetland values and functions as a means to promote wise use of

wetland resources, including water.

The Secretariat, or Bureau, of the Convention is based in Gland, Switzerland, hosted by IUCN-The World Conservation Union.

Introduction

1. Arid zones occur on every continent in the world and cover 33% of the earth's land surface, taking up significant amounts of some continents (Africa - 57%, Australia - 69%,) and 84% of the area of the Middle East. They are characterised by low annual rainfall 0-600mm, usually hot temperatures up to 47°C and high evaporation of up to 4000mm per year.
2. Aridity does not preclude wetlands or rivers (rivers are in fact comprised in the Ramsar definition of "wetland"). Many of the world's most spectacular wetlands are in the arid zones and are fed by major rivers (e.g. Amu- and Syr-Darya, Colorado River, Cooper Creek, Darling River, Indus River, Molopo River, Okavango River, Nile River, Volga River). Some of these rivers reach the sea in deltas, others end in inland wetlands. Cooper Creek ends in the largest salt lake in Australia, Lake Eyre. The Amu- and Syr-Darya Rivers flow into the Aral Sea. The Okavango River flows into the Okavango Delta.
3. Our understanding of arid zone wetlands is relatively poor. There are many thousands and possibly hundreds of thousands of wetlands distributed through the world's arid zone. Mongolia has 3,500 lakes with areas greater than 0.1 hectares. Many large lakes are found in the arid parts of Australia, India, South America and South Africa. In these areas upwellings of the groundwater can form springs and salt lakes which can be filled by the occasional rains and associated runoff.
4. Many of the arid zone wetlands are distributed in developing countries where scientific output seldom matches that of richer regions such as Europe and North America with only 2.4% and 16.3% of their land surface. It is not surprising that our understanding of limnology reflects this bias.
5. Wetlands in the arid zone probably account for a significant proportion of the world's wetlands. The proportion of water held in saline lakes (0.008%), representative of the arid zone, compared with freshwater lakes (0.009%), representative of other areas, are remarkably similar.
6. Combined with the disparate scientific effort, arid environments can be inhospitable to humans, so scientific studies are costly and difficult. Australia is a good example of this bias in scientific understanding. Australia is a relatively rich country with a long history of ecological research on waterbirds, based on impacts of duck hunting on waterfowl. Waterbirds are undoubtedly the most well known animal or plant group associated with wetlands. The distribution of scientific studies of this group reveals a clear bias. Of 246 studies on waterbirds between 1876 and 1990 in Australia, most (85%) were done outside the continent's arid zone in the 30% where most people live. Few of the remaining 15% of studies had depth. They were a compilation of species' lists or banding (or ringing) records. It is likely more wetlands exist in

Australia's arid zone than elsewhere on the continent. The distribution of wetlands designated by Australia for the Ramsar Convention's "List of wetlands of international importance" exhibits a similar bias. Eight out of 45 or 18% of the listed wetlands are in the arid zone, yet the arid zone covers most of the continent.

7. This paper examines the characteristics of wetlands in arid zones, their conservation importance and the threats to their future. A comparison is also made of the differences and similarities between the provisions of the Ramsar Convention on Wetlands (1971) and the Convention to Combat Desertification (1994).

Hydrological Characteristics

8. There may be thousands and possibly hundreds of thousands of wetlands in each of the world's arid areas ranging in size from small clay pans to large lakes. Wetlands in the arid zone range from perennial or temporary, and from freshwater to saline, the latter often with a distinctive fauna and flora. Temporal patterns of water supply and salinity determine the values of a wetland. If the wetland is filled by a major river, it will fill more often than one which is reliant on local rainfall. Arid zones are also marked by salt lakes and springs caused by up-wellings of the watertable. These can be vital to the ecology of these areas during the periods of prolonged drought.

9. Arid zones of the world are characterised by highly variable rainfall. Rain is spatially and temporally unpredictable, often falling in large amounts. Rivers of the arid zones are the most variable in the world.

10. Plants, and animals which depend on temporary wetlands have adapted to live in these inhospitable environments. Waterbirds are able to utilise the patchwork of unpredictably filled wetlands. Frogs have specific adaptations such as cocooning themselves in water-filled sacs. Invertebrates are able to withstand long dry periods and may have eggs which are resistant to desiccation or embryos which become encysted. Fish species build up into large numbers when arid zone rivers flow.

11. The Ramsar Classification System for Wetland Types includes 35 types of wetland which may occur throughout the world. Of these, five are frequently found in inland arid zones, and are indicated as the principal habitat type in a number of wetlands designated for the Ramsar List:

- Permanent saline/brackish/alkaline lakes (principal habitat type in 30 Ramsar sites)
- Seasonal/intermittent saline/brackish/alkaline lakes (principal habitat in 20 Ramsar sites)
- Permanent saline/brackish/alkaline marshes (principal type in 15 Ramsar sites)
- Seasonal/intermittent saline/brackish/alkaline marshes (principal type in 4 Ramsar sites)
- Freshwater springs; oases (principal type in 3 Ramsar sites)

In total, 336 sites in the Ramsar List of Wetlands of International Importance, of a current total of 888 sites, report the wetland types mentioned above as present in those sites.

Conservation importance

12. The lack of knowledge about the world's arid zone wetlands does not reflect their conservation importance. Some of the most important wetlands of the world are in the arid zone. In Africa, the Okavango Delta in Botswana, Kafue Flats in Zambia, Hadejia-Jama'are wetlands in Nigeria are large freshwater swamps, amongst the more significant wetlands on the continent; both Okavango and the Kafue Flats have been designated for the Ramsar List. Because waterbirds are well documented and a good indicator of biodiversity values, this importance is often expressed in terms of numbers of waterbirds present. Thus, the Okavango Delta is home to significant fauna populations and many bird species. African wetlands are primarily important for the fish populations which they support. These provide food for local populations. As well, tourism makes an important contribution to economies of local areas. Other large African freshwater lakes such as Lake Turkana and Lake Chad have important ecological values. In South Africa, wetlands in the arid zone support significant populations of waterbirds.

13. The prairie potholes of North America are known for their importance to waterbirds. In California, Mono Lake supports millions of birds, including migratory wading birds and breeding gull populations. Many lakes in Australia support large numbers of waterbirds. Wetland plants are an important source of food for Aboriginal communities in Australia. In some wetlands, floodplain eucalypt trees are harvested (e.g. river red gums). On other wetlands, plants provide food for local people as well as providing material for housing and building of boats and fish traps.

Wise use of wetlands by humans

14. Many people make their livelihoods from wetlands in the arid zones of the world. In Australia, aboriginal people often used wetlands in the arid zone. They caught fish, harvested birds' eggs and hunted other freshwater animals. Some aboriginal groups still rely on such practices. Wetlands in Australia's arid zone sustain the livelihoods of pastoralists reliant on the grasses and aquatic plants which flourish with the floods and provide food for livestock. Some farmers plant wheat crops on the floodplains as the waters recede.

15. In other countries, the importance of wetlands for people's livelihoods is crucial. The swamps and lakes of the African continent are critical for sustaining human populations. The Hadejia-Jama'are wetlands provide a significant floodplain fishery: 4,000-5,000 tonnes per year. The Inner Niger Delta south of Timbuktoo provides support for fishing, grazing and flood recession agriculture. Fishing is an important part of the economies of South America (e.g. Parana and La Plata rivers). A major paper industry is supported using the reeds of the freshwater lakes of Bo Hu, in north-western China. And humans are integrally involved in wetland management and wise use of nearly all wetlands in India.

Threats to the conservation of arid zone wetlands

16. There are a number of significant impacts on arid zone wetlands. These include pollution (including run-off from agricultural areas), overfishing, over grazing and erosion and climate change which may affect flooding patterns. The most serious impacts are those which affect the water supply. Inland wetlands at the end of rivers are particularly vulnerable to the impacts of diversions of water or dams in their catchments. Likewise, water extraction from the watertable

threatens salt lakes and springs in many areas. Humans have significantly affected wetland ecosystems in the world's arid zone. The fate of the Aral Sea is a stark reminder of the crucial principles for conserving wetlands in the world's arid lands. The Aral Sea remains one of the world's most notorious ecological disasters. Supplied by the Amu- and Syr-Darya Rivers, the water level in the lake dropped nearly 13 m over 27 years and its area decreased by 40 %. Salinity has increased and local climate has been altered. Twenty of the 24 endemic fish species have disappeared as the commercial catch of fish declined from 48,000 tonnes to zero. The ecological value of the surrounding areas has been reduced. The ecological disaster has had major negative effects on human health and survival in the vicinity.

17. Similarly, the water level in Mono Lake in California dropped 13.7 m, decreasing the lake's volume by half and doubling its salinity. Islands became connected to the mainland, making breeding gull populations vulnerable to predation.

18. Falling water levels in Lake Chad in Africa have probably affected fish populations and other wildlife. Reduction in flooding on the Hadejia-Jam'are floodplain reduced fish yields considerably, resulting in a loss of revenue of about US \$2 million annually.

19. The social cost is considerable as local people dependent on fishing for their livelihood have left. In Mexico, 2,500 km of rivers have dried and 15 fish species are extinct and more than half the fish species are under threat. In Australia the Macquarie Marshes, possibly once flooding 200,000-1,000,000 ha, are now 40-50% smaller than they used to be. Waterbird numbers and diversity declined significantly over a 14 year period.

20. Each case has a common cause: extraction of water upstream. The demise of the Aral Sea was caused by diversion of water for irrigation. Mono Lake's water supply was diverted for the people of Los Angeles. The water of Lake Chad has primarily declined because of shortage of rainfall, although irrigation and diversion of water have certainly played a significant part. On the Hadejia-Jam'are floodplain, the building of Tiga Dam has reduced the extent of flooding.

21. At least 92 springs and 2,500km of river have dried in Mexico. The cause is the extraction of water resources for human use. Removal of as much as half of the water from the Macquarie River (Australia) for irrigation resulted in the halving of the area of the Macquarie Marshes. Whenever new dams are built and water diverted, the impact on downstream wetlands is predictable. They will degrade. Fish populations will decline. Other aquatic wildlife populations and aquatic plants will be similarly affected. If there are people who depend on such food, they will be affected. People who depend on overland flooding for grazing livestock will find their economic livelihood eroded by such diversions (e.g. Macquarie Marshes).

22. Increasingly, there is better understanding that wetlands have an economic value. This is clearly demonstrated for people reliant on wetlands for fishing. Even graziers are able to calculate that their floodplain wetlands have an economic benefit.

23. Tourism is important as numbers of people visiting one of Australia's most spectacular arid zone wetland systems, the Currawinya, are rising rapidly. Wealth comes to local communities as remote towns expand their services to cater for travellers. There is also an understanding about

the long-term cost of water resource development in terms of loss of biodiversity, degradation of water quality, increased salinization of rivers and rising groundwater salinity.

24. The Ramsar Convention Bureau has recently published Economic Valuation of Wetlands - A Guide for Policy Makers and Planners and a brochure for decision-makers with key concepts about this subject.

Future conservation

25. The key conservation issue for most wetlands in the arid zones of the world is the supply of water. Unless this is protected with all its variability, the functions of downstream wetlands will be lost. This presents considerable difficulties for conservation organisations and governments charged with sustainable management of ecosystems. Without restricting the diversion of water from rivers upstream of a wetland, the future for wetland conservation cannot be assured.

26. World population increase and the importance of water for development will all work against effective conservation of wetlands in the arid zone. Difficult decisions will need to be made about ecological sustainability.

27. The Macquarie Marshes stand out as one of the most important case studies in the world. The relevant Australian management authorities made a decision based on the importance of the wetland, listed under the Ramsar Convention. It was important to restrict further diversion of water from the river which supplies this inland wetland. A policy instrument, the Macquarie Marshes Water Management Plan, was implemented. It embraced management of a whole river system, extending about 500km and restricted the diversion of water for irrigation which accounted for most diversions (89%) from the river.

28. International conventions play an important part. The international importance of the Macquarie Marshes certainly contributed to the political momentum for a decision which recognised the impacts of water diversions. Increasingly, governments need to embrace concepts such as real sustainability and reflect these in their implementation of international conventions and in national policies on management of rivers.

29. Two Conventions are particularly applicable to the wetlands of the world's arid zones: the Ramsar Convention and the Convention to Combat Desertification. The latter's importance is derived from its application to arid lands. In addition, the Convention on Biological Diversity is currently giving particular attention to inland water ecosystems, which of course include freshwater, brackish and saline inland wetlands.

Comparison of Ramsar Convention and Convention to Combat Desertification

30. The Ramsar Convention was signed in 1971 and the Convention to Combat Desertification (CCD) was signed in 1994. This is reflected in their complexity. CCD has 40 articles, four annexes with 7-19 articles, compared with only 12 articles in the Ramsar Convention. However, in the 25 years since its adoption, the Ramsar Contracting Parties have adopted many mechanisms to interpret and improve implementation of the Convention: among them, the

definition, guidelines and additional guidance on "wise use"; the criteria for identifying wetlands of international importance; the global classification system of wetland types; the guidelines on management planning for wetlands, and, the Convention's Strategic Plan 1997-2002.

31. Both conventions cover key issues of sustainability and conservation in the context of human livelihood (Table 1). The Ramsar Convention may apply in any country but the CCD is restricted to arid, semi-arid and subhumid parts of the world (Table 1).

32. A central tenet of the Ramsar Convention is wise use of wetlands (defined as "their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem", and considered as synonymous with sustainable use). CCD focuses on sustainable development. Both conventions place significant emphasis on training and research (Table 1).

33. Without understanding of the values (biological, cultural, economic) of wetlands and their processes, then the chances of effective conservation focused on local communities will always be limited. Coupled with this is an understanding of the human causes of impacts. Without this knowledge, little can be done to address conservation issues effectively.

34. The Ramsar Convention concentrates on achieving conservation and wise use of wetlands because of their "great economic, cultural, scientific, and recreational values". All key issues of sustainability are dealt with in considerably more depth in the text of CCD. The key issue for analysis is the treatment of wetlands and water. CCD deals in detail with ecological or threatening processes. The importance of guaranteed water supply for the conservation of wetlands in the arid zone, and indeed in all wetlands, means this issue requires further attention. Ramsar is intensifying contacts with the water resources management community, including the World Water Council and Global Water Partnership.

35. There are four references to water in the main articles of CCD (Table 1). Three of these deal with sustainability of water resources and their management. The fourth is about enhancing water supply. This could affect wetland conservation if supply to downstream wetlands is diminished. This is more clearly articulated in the annexes. The Africa Annex (Article 13) specifies "water resource development", the Asian Annex (Article 4 g) focuses on "enhancement and efficient use of water resources" and the Latin America and Caribbean Annex (Article 4) lists "exploitation and efficient use of water resources".

36. As discussed above, these will affect wetlands and degrade their values. If they are Ramsar wetlands it will affect their ecological character. In recognition of this problem, the Annex for the North Mediterranean (Article 2) clearly identifies this problem: "unsustainable exploitation of water resources leading to serious environmental damage, including chemical pollution, salinization and exhaustion of aquifers; . . . and irrigated agriculture".

Conclusion

37. Increasingly there is recognition of the conservation importance of arid zone wetlands. They are particularly productive environments with high biological diversity. Unfortunately, their

importance is generally not well documented or understood. This is primarily because of the difficulties of working in such areas and the concentration of arid lands in some of the poorer nations of the world.

38. The productivity of arid zone wetlands has sustained many human communities which depend on fish or utilise floodplains for grazing livestock. Increasingly there are development pressures to divert water from rivers or wetlands in the arid zone to feed and cloth the growing population of the world.

39. This represents a real dilemma for communities and their governments. Most water resource developments are now couched in terms of ecological sustainability but they usually involve diversion of water upstream of wetlands. This is known to result in adverse impacts on the animals and plants which live in the wetlands and the people who rely on the wetlands and rivers for their livelihoods.

40. Economic reasons are generally put forward to argue for water resource developments. Increasingly there is recognition that wetlands can have important economic values. Importantly, many water resource developments may have considerable costs in terms of maintenance of infrastructure, rehabilitation of wetlands and costs of rising salinity in river and wetlands.

41. More efficient use of water for agriculture, identification of priority habitats and better economic analysis incorporating long term projections will help to ensure some wetlands in the arid zone remain viable. Governments, including some of the richer nations, which do not have arid zone wetlands need to recognise the importance of arid zone wetlands and assist with research and training which results in effective conservation of these unique ecosystems.

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Table 1. Common and disparate key issues covered by the Ramsar Convention and the Convention to Combat Desertification. Figures in parentheses refer to Articles in the Conventions.

Key Issues	Ramsar Convention	Convention to Combat Desertification
Focus	• All countries of the world	• Arid, semi-arid and dry sub-humid countries of the world, particularly Africa
International responsibilities and cooperation	• Recognition that many waterfowl are international migrants (2) • Cooperation for wetlands which extend over a country's borders (5)	• Cooperation and coordination (2), (3), (4), (12), (18) • Implemented through bilateral or multilateral arrangements
Conservation, wise use and sustainable management by humans	• Wise use and planning for wetlands (3)	• Sustainable development (2) • Conservation (3) • Framework for sustainable management (5) • Strategic planning for sustainable development (6)
Deleterious impacts by humans	• Inform at the earliest possible time if the ecological character of any wetland in its territory and	• Understanding cause and effects of desertification (17) • Development of sustainable irrigation programmes (10) • Science to address particular problems (16)

	included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference. (3)	• Integrated approach to address physical, biological and soci-economic problems (4), (10)
Research and training	• On wetlands, fauna and flora (4) • Training in wetland research, management and wardening (4)	• Importance of appropriate knowledge (6) • Research and training (8), (9), (12), (16) • Committee on Science and Technology (24) • Networking of institutions, agencies and bodies (25) • Review research priority (17) • Capacity building, education and public awareness (19)
Water resources management	• Listing of internationally significant wetlands based on ecology, botany, zoology, limnology or hydrology. Waterfowl particularly important (2)	• Integrated strategies that focus simultaneously, in affected areas, on improved productivity of land, and the rehabilitation, conservation and sustainable management of land and water resources (2) • Establish a better understanding of the nature and value of scarce water resources (3) • Promote cooperation among affected country Parties in the fields of environmental protection and the conservation of land and water resources, as they relate to desertification and drought (4) • Enhance the availability of water resources (17)