CONVENTION ON WETLANDS (Ramsar, Iran, 1971)
CONVENTION SUR LES ZONES HUMIDES (Ramsar, Iran, 1971)
CONVENCION SOBRE LOS HUMEDALES (Ramsar, Irán, 1971)

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B

Reports / Résumés / Informes

Papers / Exposés / Presentaciones

(in their original language only / dans la langue d'origine uniquement / solo en el idioma original)

Summary Report of Technical Session B

"Guidelines on interpretation of Article 3.2 of the Convention: 'ecological character' and 'change in ecological character"

Chair: Dr Yaa Ntiamoa-Baidu (Ghana), STRP Member
Vice-Chair: Mr Peter Kaestner (USA)
Coordinator: Dr Max Finlayson (Australia), STRP Member
Secretariat: Tim Jones (Ramsar Bureau)

Keynote Presentations

"A Global Overview of Wetland Loss and Degradation," Dr Michael Moser, Wetlands International
"The Montreux Record: a Mechanism for Supporting the Wise Use of Wetlands," Dr Max Finlayson

Case Studies

"Influence of Water Hyacinth on the Ecological Character of Shoreline Wetlands of Lake Victoria (East Africa)," Dr Timothy Twongo, Fisheries Research Institute, Uganda.
"Changes in Habitat Condition and the Conservation of Mangroves in Asia," Mr Zakir Hussain, IUCN.
"Laguna Colorada," Lic. Alexandra Sanchez de Lozada, DNCB, Bolivia.
"Wetland Management and Restoration Practices at the Kiskunsag National Park, Hungary," Zoltán Vajda, Nature Conservation Department, Hungary.

The Chair

1. indicated that the expected output of the Technical Session would be a Draft Resolution on Definitions and Guidelines for Interpreting Change in Ecological Character and Operation of the Montreux Record.

The Vice Chair

2. summarized the presentations and asked delegates to bear them in mind when considering the text of Draft Resolution VI.1.

A. Definitions

The Coordinator

3. summarized the STRP's definitions of "ecological character" and "change in ecological character". Considerable debate ensued with numerous interventions by Contracting Parties and observers. **Australia,** concerned by the overall approach to this issue, suggested the need for a wider, well structured appraisal of the operational framework of the Convention with respect to these guidelines. This received support from **Poland, Sweden**, **New Zealand**, and **IUCN**. Interventions were also made by the **UK**, **Philippines, The Netherlands, Niger**, **Brazil**, **Czech Republic**, **Pakistan**, the **Australian Marine Conservation Society,** the **Inland Rivers Network**, and the **International Limnological Society.**

The Vice Chair

4. stressed that definitions were of critical importance and that the final Draft Resolution would note the concerns expressed.

B. Guidance for describing and maintaining the ecological character of listed sites

Interventions

5. were made by **Denmark, USA, The Netherlands, Sweden, France, Senegal, Belgium**, **Wetlands International, Caddo Lake Insitute,** and **the South Australian Department of Natural Resources,** either with specific amendments for consideration in the redraft, or with more general questions and concerns. Wetlands International said that many Listed Sites were lacking data and that they would be offering technical support in this area to Contracting Parties during the coming three years.

The Coordinator and Wetlands International

6. referred to the framework for designing a wetland monitoring programme, developed in parallel with the MedWet programme.

C. Guidelines for operation of the Montreux Record.

The Bureau

7. referred to Addendum II to DOC. 6.17, specifically Draft Resolution VI.13 on Information on Threats to Listed Sites and Draft Resolution VI.16 on Submission of Information Sheets and Maps, and asked delegates to consider them in the context of Draft Resolution VI.1.

Australia

8. responded that Draft Resolution VI.13 was unclear and appeared unnecessary at this time.

Interventions

9. were made by **Denmark, Australia, UK, USA, Hungary, Canada, Brazil, Peru, Italy, the New South Wales Government Department of Land and Water Conservation, IUCN**, and **WWF**. The amendments noted would be considered for the final Draft Resolution.

The Vice Chair

10. proposed a shorter mandatory section of the Montreux Record questionnaire, and a longer optional section. It was agreed that Section One would ask simply for details of site name, listing criteria, the nature of change in ecological character, and the reason for change.

Conclusion

The Chair

11. asked **Australia** to assist with rewording the definitions to be included in the final Draft Resolution. This would indicate that a further three-year period of study and refinement would be needed before firm definitions could be realized. She charged the Bureau with responsibility for producing the final Draft Resolution, taking into account all comments received, including those put in writing and passed to the rapporteur.

Other Business

Denmark

12. tabled a Draft Recommendation on Restoration of Wetlands, to which New Zealand responded favourably subject to the inclusion of various amendments which would be submitted to the Danish delegation. Other Contracting Parties and observers were asked to comment.

Rapporteur: Tim Davis

Abstracts

"A Global Overview of Wetland Loss and Degradation" (abstract)

Michael Moser, Crawford Prentice, and Scott Frazier, Wetlands International, UK

1. The rapid and continuing worldwide loss and degradation of wetlands has been the basis for the development of the Ramsar Convention and other wetland conservation initiatives. Wetland loss is the loss of wetland area, due to the conversion of wetland to non-wetland habitats, as a result of human activity; wetland degradation is the impairment of wetland functions as a result of human activity. The loss and degradation of wetlands reduces their ability to provide goods and services to humankind and to support biodiversity, and are therefore associated with economic costs.

2. This paper provides an overview (but not a full review) of the causes and extent of wetland loss and degradation throughout the world. The proximate and ultimate causes of wetland loss and degradation are discussed, and the types are reviewed. The frequency of different factors causing wetland loss and degradation are compared between different regions of the world using data from published wetland directories and from the Ramsar sites database. Case studies are also presented to show the extent of wetland loss and degradation in certain countries and for certain types of wetland.

3. The paper concludes by assessing how the Ramsar Convention can better address the continuing problem of loss and degradation of wetlands. It concludes that at Ramsar site level, this must be addressed by effective integrated management including restoration and rehabilitation measures, while at national level it must be addressed by effective policies for wetland conservation. The measurement of wetland loss and degradation, and the evaluation of management actions and wetland policies depends, upon baseline information on wetland resources and effective monitoring programmes. Recommendations are made as to how to improve these requisites through the Ramsar Convention.

"The Montreux Record: a Mechanism for Supporting the Wise Use of Wetlands" (abstract)

Max Finlayson, Environmental Research Institute of the Supervising Scientist, Australia

1. The Montreux Record of internationally important sites undergoing or likely to undergo change in ecological character has received increasing attention. It is evident that many wetlands around the world have been or continue to be degraded or even lost – i.e. the ecological character has adversely changed. The causes of these changes have been discussed and described in a plethora of wetland workshops and conferences. Thus, many of the apparent reasons for adverse change (e.g. weed invasion, over fishing, drainage) have been identified. In some instances restoration measures have been implemented, some simple and cheap and some complex and expensive. Restoration has been cast as a management tool and can easily be encompassed in a management plan and/or national policies that seek to make wise use of wetlands and their resources. The very existence of such management plans and policies is evidence of the value that society is increasingly according to wetlands.

2. In many instances the plans and policies not only promote conservation of the wetland and its resources, but they also promote multiple use and sustainable development of the same resources. However, the very fact that these resources are being used raises the spectre of change and we are faced with the dilemma of adjudging limits of acceptable change. To adjudge the extent of change we need a starting base – what is the basic character of the wetland? As a starting point to assist management agencies to address this dilemma, definitions of *ecological character* and *change in ecological character* are proposed. These definitions provide the basis for describing the ecological character of a site. They are not prescriptive. Once a site has been described, the important process of assessing the extent of change and adjudging the ecological significance of this change are addressed and a framework for designing effective monitoring programmes presented. Again, it is not prescriptive; it provides a guide for making decisions on monitoring that are appropriate for individual sites and individual jurisdictions.

3. Recalling that the concept of ecological character is linked to the Montreux Record, guidelines for the operation of this procedure are also proposed. Noting that Contracting Parties have already invested considerable effort in developing criteria for listing sites as important, information sheets for describing these sites, together with national reporting processes, the guidelines proposed are essentially based on existing mechanisms. In doing this, it became evident that the concept of

ecological character was at the very base of the wise use concept that has been embraced by the Contracting Parties. Thus, the operation of the Montreux Record is considered to be inextricably linked to the implementation of wise use policies.

4. The successful utilization of the Montreux Record also encompasses early recognition of the causes of ecological change. Thus, the development of early warning mechanisms that can detect change is encouraged. Similarly, recognition of the underlying socio-economic reasons for ecological change is also encouraged. The guidelines for national wetland policies, wise use and management planning, already developed under the Convention, provide guidance as to how these reasons can be addressed.

"Influence of Water Hyacinth on the Ecological Character of Shoreline Wetlands of Lake Victoria (East Africa): a Case Study" (abstract)

T. K. Twongo and J. S. Balirwa, Fisheries Research Institute (FIRI), Uganda

1. Experiments to determine ecological change as a result of infestation with water hyacinth *Eichhornia cressipes* in the shoreline wetlands of northern Lake Victoria were undertaken during 1994 and 1995. Supplementary data from periodic surveys provides an assessment of the distribution, cover, biomass and movement of the water weed in Uganda. Two modes of infestation with water hyacinth were identified. A resident weed fringe, average width about 15m, was estimated to border over 75% of the shoreline of Lake Victoria (Uganda) and 50% of that of Lake Kyoga. A narrower fringe about 5m average width fringed 80% of the banks of the Upper Nile.

2. Water hyacinth fringes virtually all shoreline wetlands dominated by *Cyperus papyrus*. Other shoreline species, notably *Typha domingesis* and *Vossia cuspidata*, appear to fix water hyacinth which eventually increases in lateral extension. Resident hyacinth had a mean fresh biomass of 60kg/m^3. The second mode of infestation was characterised by various sizes of mobile weed, with expanses of up to 800ha in well protected nutrient rich bays. This mode of weed infestation oscillated about the bays under the influence of diurnally shifting winds and was periodically propelled from bay to bay via the open lake by violent winds. Mobile hyacinth comprised at least 80% of the estimated 2000ha total weed cover of Lake Victoria, Uganda.

3. There were noticeable differences in biota (macrofauna, algae and fish) and physical-chemical factors (oxygen, pH, nutrients, sediments) reflected in distances from 10m into permanent resident mats of water hyacinth and areas outside of the mats. The edge of permanent and mobile water hyacinth mats had a more diverse fish and macrofauna than occurred at the edge of hyacinth-free papyrus or 10m off the permanent weed into the open lake. Permanent hyacinth cover appears to have transformed bottom sediments under the mat into soft mud as shown in an increase in ash-free dry weight, contributed largely by hyacinth debris.

4. Ecological implications of the environmental and biomass data are discussed in relation to water hyacinth cover, biomass and movement.

"Changes in Habitat Condition and the Conservation of Mangroves in Asia" (abstract)

Mohammed Zakir Hussain, IUCN, Bangkok, Thailand

1. Mangroves are sensitive to changes in their habitat conditions. Any significant change in habitat condition may cause stress resulting in poorer growth of species, change in species composition or even a complete elimination of one or more mangrove species and invasion of the site by trees or shrubs which can grow in more stressful conditions. Seedlings of some mangrove species cannot tolerate exposure to direct sunlight and in conditions where stands of such species are clear felled, the emerging regeneration often comprise of species which can withstand exposure to strong sunlight. When a site is cleared of all vegetation or excavated for the construction of shrimp ponds or any other form of development activities, rapid changes take place in the exposed soil. This makes sites

unsuitable for different mangrove species. Because of the high level of acidity and formation of hard pan below soil surface, soils in abandoned shrimp ponds or construction sites are unable to support the growth of almost all mangrove species.

2. Change in habitat conditions may result from natural as well as a number of different kinds of both direct and indirect human induced factors. The paper will discuss these as well as the experience of conservation of mangrove forests and rehabilitation of degraded and depleted mangrove stands in different countries in Asia.

"Laguna Colorada" (abstract)

Alexandra Sánchez de Lozada, Directora Nacional de Conservación de la Diversidad Biológica, D.N.C.B., Bolivia

1. Given its physicochemical and biological characteristics, Laguna Colorada, the first Ramsar site listed by Bolivia, is the only waterland ecosystem of its kind in the world; this Lagoon is part of the series of saltwater lagoons of the desert-like, volcanic South West of Bolivia, which are protected as part of the Reserva Nacional de Fauna Andina Eduardo Avaros (REA). The salinity of these waters and their high arsenic content, their ice islands, low temperatures, strong winds, high levels of radiation, as well as the scarce vegetation in the surrounding area, are all features that restrict the development of life in the lagoon and its surroundings.

2. Laguna Colorada is shallow and therefore has extensive interior beaches where three flamingo species nest: *Phoenicopterus chilensis, Phoenicopterus andinus* and *Ph. Jamesi* and has been a traditional flamingo egg collecting site. At the lagoon there are also scores of two other migratory bird species: *Phalaropus trocolor* and *Calidris bairdii.*

3. A camp for a Geothermal Project was built on the shores of Laguna Colorada, with infrastructure capable of accommodating 60 persons. The project drilled two wells to feed turbines with volcanic steam at a site known as "Sol de Mañana" and an Environmental Impact Assessment study (EIA) covering the entire project area was carried out, but the recommendations have not been applied because the energy production stage has not been implemented.

4. Laguna Colorada was included in the Montreux Record because this geothermic project and the uncontrolled increase in tourism could adversely affect the basin´s ecological character; both aspects made it necessary to anticipate the adoption of more effective control measures in the field.

5. Effective control of the REA and the abandonment of the geothermal project have changed the risk situation of the Laguna Colorada basin and its surroundings, where a single small turbine that supplies energy to a small mining complex remains in operation. The Ramsar Secretariat has been requested to remove Laguna Colorada from the Montreux Record for these reasons.

6. Thanks to the effective control of the protected area (REA), as well as to the importance being given to ecotourism measures as an alternative to protect an ecosystem as fragile and complex as Laguna Colorada, it hasn´t been necessary to apply the Monitoring Procedure in this case.

"Wetland Management and Restoration Practices at the Kiskunság National Park, Hungary" (abstract)

Zoltán Vajda, Head of the Nature Conservation Department, KNP, Hungary

1. The main ecological problem of the Danube-Tisza Interfluve Area, the location of Kiskunság National Park, is the severe lack of water caused by extensive drainage and the long, intense drought of the past decade. This lack of water has interrupted the normal water cycle of many shallow natron (saline) lakes in the Park, threatening the habitat of important breeding and migratory bird populations. In

order to ensure the proper conditions for these birds a water-government system was established in the Upper Kiskunság Saline Lakes area of the National Park. Through the use of this system the following was achieved:

- The water level of Lake Kelemen, the largest natron lake in the park, can be manipulated, adopting the management to the actual weather conditions. The proper water level is maintained to assure the success of the breeding bird community (*Recurvirostra avosetta, Himantopus himantopus, Charadrius alexandrinus, Larus ridibundus, L. melanocephalus, Chlidonias hybridus*), and to serve as a feeding and roosting site during migration.

- A new wetland habitat was created at Lake Fehér, a former natron swamp that had been dry for over a decade. Through active management this lake now serves as a breeding area for *Anser anser, Botaurus stellaris, Porzana parva* and *Circus aeruginosus*. It also serves as a feeding area for migrating avifauna.

- The adjacent grassland serves as a reservoir and "resting area" for the water used to refill Lake Kelemen. When this area is filled with water it is a favourite feeding and roosting habitat for birds, both in the breeding and migration period.

2. The project brought excellent results. The bird populations on the site were significantly increased. There was also a positive effect on other fauna and vegetation found at the lakes. The system required a reasonable initial investment and has low maintenance costs. The results of this project are constantly monitored by Park staff and members of the Ornithological Society.

Rapport Résumé de la Séance Téchnique B

"Lignes directrices sur l'interprétation de l'Article 3.2 de la Convention: «Caractéristiques écologiques» et «changements dans les caractéristiques écologiques»"

Présidence: Yaa Ntiamoa-Baidu (Ghana), membre GEST
Vice-présidence: Peter Kaestner (E.-U.)
Coordination: Max Finlayson (Australie), membre GEST
Secrétariat: Tim Jones (Bureau Ramsar)

<u>Exposés liminaires</u>

"Tour d'horizon mondial de la disparition et de la dégradation des zones humides," Michael Moser, Wetlands International
"Le Registre de Montreux: Mécanisme au service de l'utilisation rationnelle des zones humides," Max Finlayson

<u>Etudes de cas</u>

"Influence de la Jacinthe d'eau sur les caractéristiques écologiques des zones humides riveraines en Afrique de l'Est," Timothy Twongo, Fisheries Research Institute, Ouganda
"Changements dans les conditions de l'habitat et conservation des mangroves d'Asie," Zakir Hussain, UICN
"Laguna colorada," Alexandra Sànchez de Lusada
"Gestion des zones humides et pratiques de restauration au Parc national de Kiskunság," Zoltán Vajda, Chef du Département de conservation de la nature, Hongrie

La Présidente

1. indique que la Séance technique devrait aboutir à la rédaction d'un projet de résolution sur des définitions et des lignes directrices relatives à l'interprétation des changements dans les caractéristiques écologiques et au fonctionnement du Registre de Montreux.

Le Vice-président

2. résume les exposés et demande aux délégués de les garder présents à l'esprit lorsqu'ils examineront le projet de Résolution VI.1.

A. Définitions

Le Coordonateur

3. résume les définitions de "caractéristiques écologiques" et "changements dans les caractéristiques écologiques". Au cours du débat approfondi qui s'ensuit, de nombreuses Parties contractantes et de nombreux observateurs interviennent. **L'Australie**, préoccupée par la présentation générale de cette question estime qu'il serait nécessaire de procéder à une évaluation plus générale et bien structurée du cadre de fonctionnement de la Convention par rapport à ces Lignes directrices. **La Pologne, la Suède, la Nouvelle-Zélande** et **l'UICN** sont du même avis. **Le Royaume-Uni, les Philippines, les Pays-Bas, le Niger, le Brésil, la République tchèque, le Pakistan, Australian Marine Conservation Society, Inland Rivers Network et la Société internationale de limnologie** interviennent également.

Le Vice-président

4. souligne que les définitions sont d'importance critique et que le projet final de résolution tiendra compte des préoccupations exprimées.

B. Orientations relatives à la description et au maintien des caractéristiques écologiques des sites inscrits

Des interventions

5. sont faites par **le Danemark, les Etats-Unis, les Pays-Bas, la Suède, la France, le Sénégal, la Belgique, Wetlands International, Caddo Lake Institute et le South Australian Department of Natural Ressources,** soit pour proposer des amendements spécifiques à examiner au moment de la nouvelle rédaction, soit pour poser des questions et faire part de préoccupations plus générales. Wetlands International déclare que pour de nombreux sites inscrits on ne dispose pas des données nécessaires et que son organisation offre aux Parties contractantes, ses services techniques en la matière pour la prochaine période triennale.

Le Coordonateur et Wetlands International

6. font référence au modèle de conception d'un programme de surveillance continue des zones humides préparé en parallèle avec le Programme MedWet.

C. Lignes directrices sur le fonctionnement du Registre de Montreux

Le Bureau

7. mentionne l'Ajout II à DOC.6.17 et, en particulier, le projet de Résolution VI.13 sur les Informations relatives aux menaces qui pèsent sur les sites inscrits sur la Liste et le projet de Résolution VI.16 sur la soumission de fiches descriptives et de cartes et demande aux délégués de les examiner dans le contexte du projet de Résolution VI.1.

L'Australie

8. répond que le projet de Résolution VI.13 n'est pas clair et lui paraît inutile pour le moment.

Des interventions

9. sont faites par **le Danemark, l'Australie, le Royaume-Uni, les Etats-Unis, la Hongrie, le Canada, le Brésil, le Pérou, l'Italie, le Département du territoire et de la conservation de l'eau**

du Gouvernement de Nouvelle-Galles du Sud, l'UICN et le WWF. Les amendements notés seront examinés dans le projet final de résolution.

Le Vice-président

10. propose de raccourcir la section obligatoire du questionnaire sur le Registre de Montreux et de rallonger la section facultative. Il est décidé que la Section 1 se contentera de détails sur le nom du site, les critères d'inscription, la nature des changements dans les caractéristiques écologiques et les raisons des changements.

Conclusions

La Présidente

11. demande à L'**Australie** d'aider à réviser le libellé des définitions qui figureront dans le projet final de Résolution. Une période supplémentaire d'étude et de mise au point serait nécessaire avant d'aboutir au texte définitif. Elle charge le Bureau de préparer le projet final de résolution en tenant compte de tous les commentaires, y compris ceux qui ont été transmis par écrit au rapporteur.

Divers

Le Danemark

12. présente un projet de recommandation sur la restauration des zones humides auquel la Nouvelle-Zélande se déclare favorable sous réserve de l'incorporation de divers amendements qui seront soumis à la délégation danoise. D'autres Parties contractantes et observateurs sont invités à faire des commentaires.

Résumés

"Tour d'horizon mondial de la disparition et de la degradation des zones humides" (résumé)

Michael Moser, Crawford Prentice, et Scott Frazier, Wetlands International

1. La disparition et la dégradation rapides et permanentes des zones humides de la planète est à l'origine de l'élaborartion de la Convention de Ramsar et d'autres initiatives de conservation des zones humides. La disparition des zones humides est due à l'assèchement des lieux humides par des activités anthropiques; la dégradation des zones humides est due à la détérioration des fonctions des zones humides par des activités anthropiques. Disparition et dégradation réduisent la capacité des zones humides de fournir des biens et services à l'humanité et d'entretenir la diversité biologique; elles peuvent donc être assimilées à des coûts économiques.

2. Le présent exposé présente un tour d'horizon (qui n'est pas une évaluation exhaustive) des causes et de l'ampleur de la disparition et de la dégradation des zones humides dans le monde entier. Les causes immédiates et ultimes de la disparition et de la dégradation sont discutées et leurs types sont passés en revue. La fréquence des facteurs entraînant la disparition et la dégradation des zones humides est comparée entre différentes régions du monde, à l'aide des données contenues dans les Répertoires des zones humides et dans la Banque de données Ramsar. Des études de cas illustrent l'ampleur de la disparition et de la dégradation dans certains pays et pour certains types de zones humides.

3. En conclusion, le document évalue comment la Convention de Ramsar peut mieux traiter le problème de la dégradation et de la disparition des zones humides. Au niveau des sites, il serait bon d'appliquer des plans de gestion réellement intégrée comprenant des mesures de restauration et de remise en état; au niveau national, le problème doit être traité dans le cadre de politiques efficaces pour les zones humides. L'évaluation de la disparition et de la dégradation des zones humides ainsi que des mesures de gestion et politiques pour les zones humides dépend des informations de base sur les ressources des zones humides et de programmes efficaces de surveillance continue. Des recommandations portent sur les moyens d'améliorer ces procédures par le truchement de la Convention de Ramsar.

"Le Registre de Montreux: mecanisme au service de l'utilisation rationnelle des zones humides" (résumé)

Max Finlayson, Environmental Research Institute of the Supervising Scientist, Australie

1. Le Registre de Montreux, où sont inscrits des sites d'importance internationale qui subissent ou risquent de subir des changements dans leurs caractéristiques écologiques, occupe une place de plus en plus grande. Il est évident que, partout dans le monde, beaucoup de zones humides ont été dégradées ou ont disparu – c'est-à-dire que leurs caractéristiques écologiques ont changé pour le pire. Les raisons de ces changements ont été discutées et décrites dans le contexte d'une myriade d'ateliers et de conférences sur les zones humides, de sorte que, bien des causes apparentes des changements défavorables (par exemple, invasion de plantes indésirables, surpêche, drainage) ont été identifiées. Dans certains cas, des mesures de restauration ont été prises, certaines simples et bon marché, d'autres complexes et onéreuses. La restauration est devenue instrument de gestion et peut facilement être incluse dans un plan de gestion et/ou dans des politiques nationales qui cherchent à utiliser rationnellement les zones humides et leurs ressources. L'existence même de tels plans et politiques de gestion est la preuve que, de plus en plus, la société accorde de la valeur aux zones humides.

2. Bien souvent, les plans et politiques ne favorisent pas seulement la conservation de la zone humide et de ses ressources mais aussi les utilisations multiples et le développement durable des mêmes ressources. Toutefois, l'utilisation même de ces ressources pose le problème du changement et nous sommes aujourd'hui placés devant un dilemme: devoir fixer les limites du changement tolérable. Pour cela, il faut avoir un point de référence – quelle est la caractéristique fondamentale de la zone humide? Des définitions de *caractéristiques écologiques* et *changements dans les caractéristiques écologiques* sont proposées afin d'aider les autorités chargées de la gestion à résoudre ce dilemme. Ces définitions, qui ne sont pas normatives, proposent une base à partir de laquelle il est possible de décrire les caractéristiques écologiques d'un site. Vient ensuite la description de processus importants applicables dès qu'un site est décrit: l'évaluation de l'étendue du changement et la détermination de l'importance écologique de ce changement puis la présentation d'un cadre permettant de concevoir des programmes de surveillance continue efficaces. Une fois encore, il ne s'agit pas de règles mais d'orientations permettant de prendre des décisions sur la surveillance continue et qui conviennent à tel ou tel site et à telle ou telle juridiction.

3. Pour rappeler que le concept de "caractéristiques écologiques" est lié aux principes directeurs du Registre de Montreux, des lignes directrices sur le fonctionnement de cette procédure sont également proposées. Les Parties contractantes ayant déjà investi des efforts considérables dans l'élaboration de critères d'inscription des sites, de fiches descriptives de ces sites et de processus d'établissement de rapports nationaux, les lignes directrices se fondent essentiellement sur les mécanismes existants. Il est ainsi devenu évident que le concept de "caractéristiques écologiques" était à la base même du concept d'utilisation rationnelle qu'avaient adopté les Parties contractantes. Le fonctionnement du Registre de Montreux est donc considéré comme inextricablement lié à l'application des politiques relatives à l'utilisation rationnelle.

4. La bonne utilisation du Registre de Montreux suppose également que l'on puisse identifier, le plus vite possible, les causes des changements écologiques. C'est la raison pour laquelle l'élaboration de mécanismes d'alerte rapide permettant de détecter les changements est encouragée. De même, l'identification des facteurs socio-économiques qui sous-tendent les changements écologiques est également encouragée. Les lignes directrices relatives aux politiques nationales pour les zones humides, à l'utilisation rationnelle et aux plans de gestion, déjà préparées dans le cadre de la Convention, fournissent une orientation sur la manière de traiter les causes.

"Influence de la Jacinthe d'eau sur les caractéristiques écologiques des zones humides riveraines en Afrique de l'Est: étude de cas" (résumé)

T.K. Twongo et J.S. Balirwa, Fisheries Research Institute, Ouganda

1. En 1994 et 1995, des expériences ont eu lieu dans les zones humides qui longent les berges septentrionales du lac Victoria en vue de déterminer les changements écologiques imputables à l'infestation de jacinthes d'eau Eichhornia crassipes. Des enquêtes périodiques fournissent des données complémentaires qui donnent une image, à l'échelle de l'Ouganda, de la distribution, de la superficie couverte, de la biomasse et des mouvements de cette plante aquatique indésirable. Deux modes d'infestation par la jacinthe d'eau ont été mis en évidence. On estime qu'une frange permanente, d'une largeur moyenne de 15 mètres, borde plus de 75% des berges du lac Victoria (Ouganda) et 50% de celles du lac Kyoga. Une bande plus étroite, d'une largeur moyenne de 5 mètres, frange 80% des rives du haut Nil.

2. La jacinthe d'eau frange presque toutes les zones humides riveraines dominées par *Cyperus papyrus*. Il semble que d'autres espèces riveraines, notamment *Typha domingesis* et *Vossia cuspidata* fixent la jacinthe d'eau qui finit par croître latéralement. Les jacinthes permanentes ont une biomasse fraîche moyenne de 60 kg/m^3. Le deuxième mode d'infestation se caractérise par des plantes mobiles de taille variable qui peuvent couvrir 800 ha dans des baies bien protégées et riches en matières nutritives. Ce mode d'infestation oscille dans les baies sous l'influence du cycle diurne des vents. Des vents violents propulsent périodiquement l'infestation de baie en baie, à travers les eaux libres du lac. Les jacinthes mobiles constituent au moins 80% des 2000 ha que l'on estime couverts par cette plante dans le lac Victoria (Ouganda).

3. On a constaté des différences marquées dans la flore et la faune (macrofaune, algues et poissons) et dans les facteurs physico-chimiques (oxygène, pH, nutriments, sédiments) jusqu'à 10 mètres à l'intérieur des tapis permanents de jacinthes d'eau et à l'extérieur des tapis. Sur la bordure des tapis permanents et mobiles de jacinthes d'eau, les poissons et la macrofaune étaient plus divers qu'en bordure des papyrus libres de jacinthes ou à 10 mètres au large des tapis permanents, dans les eaux libres du lac. Il semble que, sous les tapis, la couverture permanente de jacinthes ait transformé les sédiments de fond en boues molles ce qui est démontré par l'augmentation du poids sec (hors cendres) à laquelle contribuent largement les débris de jacinthes.

4. Les conclusions écologiques tirées des données environnementales et de biomasse sont discutées en fonction de la couverture, de la biomasse et des mouvements des jacinthes.

"Changements dans les conditions de l'habitat et conservation des mangroves d'Asie" (résumé)

Mohammed Zakir Hussain, UICN, Bangkok

1. Les mangroves sont sensibles aux changements dans les conditions de l'habitat. Tout changement significatif de ce type peut entraîner un stress qui se traduit par une croissance ralentie des espèces, des changements dans la composition des espèces et parfois même, l'élimination d'une espèce au moins et l'envahissement du site par des arbres ou des arbustes mieux à même de se développer dans des conditions de stress. Les plantules de certaines espèces de la mangrove ne peuvent tolérer une exposition à la lumière directe du soleil et, lorsque des peuplements de telles espèces font l'objet d'une coupe claire, la régénération végétale comprend souvent des espèces pouvant tolérer une exposition à la forte lumière du soleil. Lorsqu'un site est totalement défriché ou excavé pour la construction de bassins d'élevage de crevettes ou pour faire place à d'autres formes d'activités de développement, le sol exposé subit des changements rapides. Le site ne convient plus à différentes espèces de la mangrove. A cause du taux d'acidité élevé et de la formation d'une croûte dure au-dessous de la surface, pratiquement aucune espèce de la mangrove ne peut pousser sur les sols des bassins à crevettes ou des sites de construction abandonnés.

2. Les changements qui se produisent dans les conditions de l'habitat peuvent être le résultat de facteurs naturels mais aussi de différentes sortes de facteurs directement ou indirectement induits par des activités anthropiques. Le document traitera de ces facteurs ainsi que de l'expérience acquise en

matière de conservation des forêts de mangroves et de restauration de peuplements de mangroves dégradés et appauvris dans différents pays d'Asie.

"Laguna Colorada" (résumé)

Alexandra Sánchez de Lozada, Directora Nacional de Conservación de la Diversidad Biológica, D.N.C.B., Bolivia

1. Laguna Colorada, le premier site Ramsar de Bolivie, est un milieu aquatique unique au monde de par ses caractéristiques physico-chimiques et biologiques. Ce site fait partie d'un ensemble de lagunes salines de l'altiplano désertique et volcanique du sud-ouest de la Bolivie, protégées parce qu'elles se trouvent dans la Réserve nationale de faune andine Eduardo Avaroa (REA). La nature saline de ses eaux à forte teneur en arsenic, les îlots de glace, les basses températures, les vents puissants la forte radiation solaire et la végétation rare limitent le développement de la vie dans la lagune et autour.

2. Peu profonde, Laguna Colorada abrite de vastes plages intérieures qui servent d'aire de nidification à trois espèces de flamants: *Phoenicopterus chilensi, Phoenicoparrus andinus* et *Ph.. jamasi*, et a été un lieu de récolte traditionnel des œufs de flamants. On y trouve également, en grand nombre, deux espèces d'oiseaux migrateurs: *Phalaropus tricolor* et *Calidris bairdii.*

3. En bordure de la lagune, un campement pouvant abriter 60 personnes a été construit pour le Projet géothermique. Ce dernier a creusé trois puits d'alimentation pour turbines à vapeur volcanique au lieudit "Sol de Mañana" et a réalisé une étude d'impact sur l'environnement dans la zone du projet, étude dont les recommandations n'ont pas été appliquées, la phase de production d'énergie n'ayant jamais commencé.

4. Le site de Laguna Colorada a été inscrit au Registre de Montreux, les caractéristiques écologiques de son bassin versant risquant d'être affectées négativement par le Projet géothermique et par le développement du tourisme incontrôlé, deux facteurs qui exigeaient la prise de mesures de contrôle plus efficaces sur le terrain.

5. Le contrôle efficace de la Réserve nationale et l'abandon du Projet géothermique ont modifié la situation qui régnait dans le bassin versant, dans la lagune et autour, et seule une petite turbine fourni encore de l'énergie à un complexe minier peu important. Telles sont les raisons pour lesquelles il a été demandé au Bureau de la Convention de retirer Laguna Colorada du Registre de Montreux.

6. Dans ce cas précis, l'application de la Procédure de surveillance continue n'a pas été nécessaire en raison des mesures de contrôle effectives prises à l'intérieur de la Réserve, et de l'importance accordée à l'écotourisme, considéré comme une solution de remplacement susceptible de préserver un écosystème aussi fragile et complexe que celui de Laguna Colorada.

"Gestion des zones humides et pratiques de restauration au Parc National de Kiskunság, Hongrie" (résumé)

Zoltán Vajda, Chef du Département de conservation de la nature, Hongrie

1. Le principal problème écologique de la zone interfluve Danube-Tisza, où se trouve le Parc national de Kiskunság, est la grave pénurie d'eau, entraînée par un drainage excessif et par la longue sécheresse qui a sévi durant la décennie écoulée. La pénurie d'eau a interrompu le cycle normal de l'eau de nombreux lacs de natron peu profonds du Parc, menaçant les habitats d'importantes populations d'oiseaux nicheurs et migrateurs. Afin de restaurer les conditions qui conviennent à ces oiseaux, un système de gestion de l'eau a été établi dans la région des lacs salins du haut Kiskunság du Parc national. Ce système a permis d'obtenir les résultats suivants:

- Le niveau d'eau du lac Kelemen, le plus grand lac de natron du parc, peut être manipulé pour adapter la gestion aux conditions climatiques. Le niveau approprié de l'eau est maintenu pour garantir le succès de reproduction de la communauté nicheuse (*Recurvirostra avosetta, Himantopus himantopus, Charadrius alexandrinus*, *Larus ridibundus, L. melanocephalus, Chlidonias hybridus*) et pour servir de lieu de nourrissage et de repos durant la migration.

- Un nouvel habitat de zone humide a été créé au lac Fehér, ancien marais de natron asséché depuis plus d'une décennie. Grâce à une gestion active, ce lac sert maintenant de zone de nidification pour *Anser anser, Botaurus stellaris, Porzana parva* et *Circus aeruginosus*. Il est également zone de nourrissage pour une avifaune migratrice.

- Les prairies limitrophes servent de réservoir et de "zone de repos" pour l'eau qui sert à alimenter le lac Kelemen. Lorsque cette zone est remplie d'eau, c'est un habitat de nourrissage et de perchage qu'affectionnent les oiseaux tant pendant la période de reproduction que de migration.

2. Le projet a obtenu d'excellents résultats. Les populations d'oiseaux du site ont augmenté de manière significative. Il y a également eu un effet positif sur d'autres espèces de la faune et sur la végétation des lacs. Ce système a nécessité un investissement initial raisonnable et des coûts d'entretien peu élevés. Les résultats du projet sont placés sous la surveillance permanente du personnel du Parc et de membres de la Société d'ornithologie.

Informe Resumido de la Sesión Técnica B

"Directrices para la interpretación del Artículo 3.2 de la Convención: 'condiciones ecológicas' y 'cambio en las condiciones ecológicas'"

Presidenta: Dra. Yaa Ntiamoa-Baidu (Ghana), Miembro del GECT
Vicepresidente: Sr. Peter Kaestner (Estados Unidos)
Coordinador: Dr. Max Finlayson (Australia), Miembro del GECT
Secretaría: Tim Jones (Oficina de Ramsar)

Presentaciones principales

"Cambio y Degradación de los Humedales – Perspectiva Global", Dr. Michael Moser, Wetlands International
"El Registro de Montreux – Un Mecanismo de Apoyo del Uso Racional de los Humedales", Dr. Max Finlayson

Estudios de casos

"Influencia del Jacinto Acuático sobre las Condiciones Ecológicas de los Humedales Ribereños de Africa Oriental", Dr. Timothy Twongo, Instituto de Investigación Pesquera, Uganda
"Los Cambios en las Condiciones de los Hábitat de Manglares y la Conservación de Manglares en Asia", Sr. Zakir Hussain, UICN
"Laguna Colorada", Licenciada Alexandra Sánchez de Lozada, DNCB, Bolivia
"Prácticas de Manejo y Restauración de Humedales en el Parque Nacional Kiskunsag, Hungría", Zoltán Vajda, Departamento de Conservación de la Naturaleza, Hungría

La Presidenta

1. indicó que el resultado previsto para la Sesión Técnica era un proyecto de Resolución sobre definiciones y directrices para interpretar el cambio en las condiciones ecológicas y el funcionamiento del Registro de Montreux.

El Vicepresidente

2. resumió las intervenciones y pidió a los delegados que las tuvieran en cuenta al examinar el texto del proyecto de Resolución VI.1.

A. Definiciones

El Coordinador

3. resumió las definiciones del GECT de los términos "condiciones ecológicas" y "cambio en las condiciones ecológicas". Se produjo un considerable debate con numerosas intervenciones de las Partes Contratantes y observadores. **Australia,** preocupada por el planteamiento global de esta cuestión, sugirió que era necesario proceder a una valoración más amplia, y bien estructurada, de lo que significarían estas directrices dentro del marco operativo de la Convención. Esta propuesta recibió el apoyo de **Polonia, Suecia, Nueva Zelandia y** la **UICN.** Hubo también intervenciones del **Reino Unido, Filipinas, Países Bajos, Níger, Brasil, República Checa, Pakistán,** la **Australian Marine Conservation Society,** la **Inland Rivers Network** y la **Sociedad Limnológica Internacional.**

El Vicepresidente

4. subrayó que las definiciones tenían una importancia esencial y que el proyecto de Resolución definitivo reflejaría las preocupaciones que se habían manifestado.

B. Directrices para describir y mantener el carácter ecológico de los sitios incluidos en la Lista

Intervenciones

5. **Dinamarca, los Estados Unidos, los Países Bajos, Suecia, Francia, Senegal, Bélgica, Wetlands International, Caddo Lake Institute** y el **Departamento de Recursos Naturales del Sur de Australia** intervinieron proponiendo enmiendas concretas para que se tuvieran en cuenta en el momento de revisar la redacción o planteando cuestiones y preocupaciones de carácter más general. Wetlands International señaló que se carecía de datos de muchos sitios incluidos en la Lista y que durante los próximos tres años ofrecería ayuda técnica en esta esfera a las Partes Contratantes.

El Coordinador y Wetlands Internacional

6. hicieron referencia en su intervención a las directrices para elaborar un programa de supervisión de los humedales, en paralelo con el programa MedWet.

C. Directrices para el funcionamiento del Registro de Montreux

La Oficina

7. señaló la existencia del Adéndum II al documento DOC. 6.17 y en concreto al proyecto de Resolución VI.13, sobre información relativa a las amenazas para los sitios incluidos en la Lista, y el proyecto de Resolución VI.16, sobre presentación de las fichas informativas y mapas, y pidió a los delegados que las encuadraran en el marco del proyecto de resolución VI.1.

Australia

8. respondió que el proyecto de Resolución VI.13 no era claro y parecía innecesario en ese momento.

Intervenciones

9. **Dinamarca, Australia, Reino Unido, Estados Unidos, Hungría, Canadá, Brasil, Perú, Italia, el Departamento de Conservación de la Tierra y las Aguas del Gobierno de Nueva Gales del Sur, UICN** y **WWF** propusieron enmiendas para que se tuvieran en cuenta al redactar el proyecto final de Resolución.

El Vicepresidente

10. propuso que se redujera la sección obligatoria del cuestionario del Registro de Montreux y se ampliara la parte voluntaria. Se acordó que el primer tramo recabara simplemente información detallada sobre la denominación del sitio, los criterios que cumplía, el carácter del cambio en las condiciones ecológicas y los motivos del cambio.

Conclusión

La Presidenta

11. pidió a **Australia** que ayudara a redactar de nuevo las definiciones que debían incluirse en el proyecto final de Resolución. Pero para poder establecer unas definiciones finales se necesitarían otros tres años de estudio y ajuste. Encargó a la Oficina la redacción del proyecto final de Resolución, teniendo en cuenta todos los comentarios recibidos, incluidos los planteados por escrito y entregados al Relator.

Otros asuntos

Dinamarca

12. presentó un proyecto de Recomendación sobre la restauración de humedales, al que Nueva Zelandia respondió favorablemente bajo la condición de que se incluyeran varias enmiendas que se someterían a la delegación de Dinamarca. Se pidió a las demás Partes Contratantes y a los observadores que expusieran sus comentarios.

Resúmenes

"Visión Global de la Pérdida y Degradación de Humedales" (resumen)

Michael Moser, Crawford Prentice, y Scott Frazier, Wetlands International

1. El desarrollo de la Convención de Ramsar y otras iniciativas destinadas a conservar los humedales se basa en la pérdida y degradación, rápida y continua, de humedales en todo el mundo. La pérdida de superficie de humedales se debe a la actividad humana que modifica el carácter de estos hábitat. La pérdida y degradación de los humedales disminuye su potencial como proveedores de bienes y servicios a la humanidad y base de la biodiversidad y, por consiguiente, tiene unos costos económicos.

2. En este documento se ofrece una visión global (no un análisis a fondo) de las causas y el alcance de la pérdida y degradación de humedales en todo el mundo. Se analizan sus causas próximas y últimas y los tipos de humedal. Se compara la frecuencia con que se presentan en las distintas regiones del mundo los factores que causan pérdida y degradación de humedales, utilizándose para ello datos reunidos a través de los inventarios de humedales publicados y la base de datos de sitios Ramsar. También se ofrecen algunos ejemplos que muestran la intensidad de la pérdida y degradación de humedales en ciertos países, desglosados según el tipo de humedal.

3. El documento concluye examinando la mejor forma en que la Convención de Ramsar puede hacer frente a este problema. Según sus conclusiones, la mejor forma de resolverlo, a escala de los propios sitios Ramsar, es establecer mecanismos efectivos de gestión integrada, con inclusión de medidas de recuperación y rehabilitación, y a escala nacional, establecer políticas efectivas de conservación de los humedales. Para poder medir la pérdida y degradación de humedales y evaluar las medidas de gestión y las políticas de humedales es preciso disponer de una información básica de los recursos y establecer unos programas efectivos de vigilancia. También se formulan algunas recomendaciones sobre la mejor forma de utilizar la Convención de Ramsar para cumplir estos requisitos.

"El Registro de Montreux: un Mecanismo de Apoyo al Uso Racional de los Humedales" (resumen)

Max Finlayson, Environmental Research Institute of the Supervising Scientist, Australia

1. El Registro de Montreux de los sitios de importancia internacional en cuyas condiciones ecológicas se han producido o pueden producirse modificaciones, ha sido objeto de una atención cada vez mayor. Es evidente que muchos humedales del mundo se han degradado, siguen degradándose o incluso se han perdido, o lo que es lo mismo, sus condiciones ecológicas han experimentado modificaciones desfavorables. Las causas de esas modificaciones han sido analizadas y descritas en multitud de obras y conferencias sobre los humedales. Muchos de los motivos a los que parece imputable el cambio desfavorable (invasión de maleza, pesca excesiva, desecación) han sido identificado). En algunos casos se han aplicado medidas de restauración, unas veces sencillas y baratas y otras complejas y costosas. Se ha asignado a la restauración la función de instrumento de gestión, y las medidas de restauración pueden aplicarse sin dificultades en el marco de un plan y/o de políticas nacionales de gestión que traten de conseguir un uso racional de los humedales y de sus recursos. La propia existencia de tales planes y políticas de gestión es prueba de la utilidad que está reconociendo gradualmente la sociedad a los humedales.

2. En muchas ocasiones, los planes y políticas no sólo fomentan la conservación del humedal y de sus recursos, sino también el uso múltiple y el desarrollo sostenible de esos recursos. No obstante, el propio hecho de que tales recursos sean usados evoca el espectro del cambio, y nos enfrentamos con el problema de determinar los límites del cambio tolerable. Para determinar el alcance del cambio precisamos un punto de partida: ¿Cuáles son las condiciones básicas del humedal? Como punto de partida para ayudar a los organismos encargadps de la gestión a hacer frente a este problema se proponen definiciones de las *condiciones ecológicas* y de la *modificación de las condiciones ecológicas.* Tales definiciones proporcionan la base para describir las condiciones ecológicas de un sitio determinado. Esas definiciones no tienen carácter preceptivo. Una vez descrito un sitio se aborda el importante proceso de la evaluación del alcance del cambio y la determinación de su significación ecológica, y se presenta un marco para diseñar programas efectivos de monitoreo. A su vez, ese proceso tampoco

tiene carácter preceptivo; sirve de guía para adoptar decisiones en materia de monitoreo apropiadas para sitios y países concretos.

3. Se propone también que se recuerde que el concepto de condiciones ecológicas está vinculado a las directrices del Registro de Montreux para la aplicación de este procedimiento. Teniendo en cuenta que las Partes Contratantes han consagrado ya considerables esfuerzos a la elaboración de criterios para la inclusión de sitios en la lista de sitios importantes, las fichas de información para describir esos sitios y los procesos de presentación de informes nacionales, las directrices propuestas se basan esencialmente en los mecanismos existentes. De esa forma, se hace patente que el concepto de condiciones ecológicas estaba en la base misma del concepto de uso racional adoptado por las Partes Contratantes. En consecuencia, se considera que el funcionamiento del Registro de Montreux está indisolublemente unido a la aplicación de políticas de uso racional.

4. La utilización satisfactoria del Registro de Montreux abarca también la pronta identificación de las causas del cambio en las condiciones ecológicas. En consecuencia, se propugna al establecimiento de mecanismos de alerta rápida que permitan detectar el cambio. De la misma forma, se promueve también la identificación de las causas socioeconómicas que subyacen al cambio ecológico. Las directrices para las políticas nacionales de humedales, el uso racional y la planificación del manejo ya elaboradas en el marco de la Convención proporcionan orientaciones sobre la forma de analizar esas razones.

"Influencia del Jacinto Acuático sobre las Condiciones Ecológicas de los Humedales Ribereños de Africa Oriental: Estudio de un Caso Concreto" (resumen)

T. K. Twongo y J. S. Balirwa, Instituto de Investigación Pesquera, Uganda

1. En 1994 y 1995 se realizaron experimentos para determinar los cambios ecológicos que produce la invasión de los humedales ribereños de la zona norte del Lago Victoria por el jacinto acuático, *Eichhornia cressipes*. Los datos complementarios que se han obtenido a través de observaciones periódicas permiten analizar la distribución, cobertura, biomasa y movimientos de la planta herbácea acuática de Uganda. Se han señalado dos formas de invasión del jacinto acuático. Se ha estimado que más del 75% de las riberas del Lago Victoria en territorio de Uganda y el 50% de las riberas del Lago Kyoga están cubiertas por una franja de hierbas acuáticas de una anchura media de unos 15 m. El 80% de las riberas del curso alto del Nilo están cubiertas por una franja más estrecha de unos 5 m.

2. El jacinto acuático bordea prácticamente todos los humedales ribereños dominados por el *Cyperus papyrus*. Aparentemente otras especies ribereñas, principalmente *Typha domingesis* y *Vossia cuspidata*, fijan poblaciones del jacinto acuático que se extienden así lateralmente. Las poblaciones asentadas de jacintos tienen una biomasa media, en vivo, de 60 kg/m^3. La segunda forma de invasión se caracteriza por ser atribuible a hierbas móviles de distinto tamaño que ocupan unas 800 Ha en ensenadas protegidas y ricas en nutrientes. Esta forma de invasión es más o menos importante en función de la influencia de los vientos que cambian de dirección en el curso del día y periódicamente es desplazada de ensenada en ensenada, a través de las aguas abiertas del lago, por vientos violentos. Se estima que las poblaciones móviles de jacintos representan al menos el 80% de la superficie total (2.000 ha) cubierta por hierbas acuáticas en el Lago Victoria, Uganda.

3. Las diferencias señaladas en la biota (macrofauna, algas y peces) y en los factores físico-químicos (oxígeno, pH, nutrientes, sedimentos) son visibles en distancias de 10 m, cuando se comparan las poblaciones estables del jacinto acuático y las zonas exteriores a estas poblaciones. La franja de poblaciones de jacinto acuático asentadas permanentemente muestra una mayor diversidad de peces y macrofauna que la zona de papiros que está libre de jacintos, es decir, alejada 10 m de la zona de hierbas permanentes lago adentro. La capa de jacintos permanentes parece haber transformado los sedimentos del fondo en un lodo blando generado en gran parte por los restos de los jacintos, que se refleja en el aumento de su peso en seco, sin cenizas.

4. En este documento se examinan las consecuencias ecológicas de los datos sobre el medio ambiente y la biomasa y su relación con la extensión del jacinto acuático, su biomasa y sus movimientos.

“Los Cambios en las Condiciones de los Habitat de Manglares y la Conservación de los Manglares en Asia” (resumen)

Mohammed Zakir Hussain, UICN, Bangkok

1. Los manglares son vulnerables a los cambios en las condiciones de sus hábitat. Cualquier cambio significativo en las condiciones de los hábitat puede generar tensiones que provocan un crecimiento deficiente de las especies, cambios en la composición de éstas o incluso una eliminación completa de una o varias especies de manglares y la invasión del sitio por árboles o arbustos que pueden crecer en condiciones mas difíciles. Los plantones de algunas especies de manglares no pueden tolerar la exposición directa a la luz del sol, y en los casos en los que se talan masas de esas especies, la regeneración subsiguiente de la vegetación incluye con frecuencia especies capaces de resistir la exposición a una fuerte luz solar. Cuando se elimina toda la vegetación de un sitio o se excava en él para construir viveros de camarones o realizar cualquier otra actividad de desarrollo, se producen rápidos cambios en el suelo expuesto, que hace a los sitios inapropiados para diversas especies de manglares. Debido al elevado grado de acidez y a la formación de una capa dura bajo la superficie del suelo, el suelo de las lagunas de cría de camarones o de obras de construcción abandonados no puede sustentar el crecimiento de casi ninguna de las especies de manglares.

2. Los cambios en las condiciones del hábitat pueden ser fruto de factores naturales o de una serie de factores inducidos, directa o indirectamente, por acciones humanas de diversa especie. En el documento se examinarán todos esos factores, así como las experiencias en la conservación de manglares y en la rehabilitación de masas de manglares que han sufrido un proceso de degradación y agotamiento en diversos países de Asia.

“Prácticas de Manejo y Restauración de Humedales en el Parque Nacional Kiskunsag, Hungría, Europa” (resumen)

Zoltán Vajda, Jefe del Departamento de Conservación de la Naturaleza, Hungría

1. El principal problema ecológico de la zona situada entre los ríos Danubio y Tisza, donde se encuentra el Parque Nacional Kiskunság, es la grave carencia de agua provocada por la desecación en gran escala y la grave y prolongada sequía del último decenio. Esta carencia de agua ha interrumpido el ciclo hidrológico normal de muchos lagos natrónicos de aguas poco profundas del Parque, amenazando el hábitat de importantes poblaciones de aves en la etapa de reproducción y migratorias. Con el fin de garantizar las condiciones adecuadas para esas aves, se ha establecido en el área de lagos de agua salada de Kiskinság, en el Parque Nacional, un sistema de ordenación de las aguas. La aplicación de ese sistema ha permitido obtener los resultados siguientes:

- Puede manipularse el nivel del agua en el lago Kelemen, el mayor lago natrónico del Parque, adaptando el manejo a las condiciones climáticas reales. Se mantiene el nivel del agua adecuado para garantizar condiciones satisfactorias a las poblaciones de aves en reproducción (avocetas, zancudas, chorlitos, diversos tipos de gaviotas y golondrins de mar) y para que el área pueda servir de sitio de alimentación y estancia durante la migración.

- Se ha creado una nuevo hábitat de humedales en el lago Fehér, un antiguo pantano natrónico que había estado seco durante más de un decenio. Gracias a una gestión activa, ese lago sirve ahora de área de alimentación a ansares, avetoros, rascones y arpellas de agua. Sirve también de área de alimentación a la fauna avícola migratoria.

- Las praderas contiguas sirven de reservorio y "área de remansamiento" del agua utilizada para rellenar el lago Kelemen. Este área, cuando está llena de agua, es un hábitat de alimentación y estancia preferido por las aves, en los períodos de cría y de migración.

2. El proyecto ha dado excelentes resultados. Las poblaciones acuáticas del sitio han experimentado un sensible aumento. Se ha producido también un efecto positivo en la fauna y flora restantes de los lagos. El sistema requirió una inversión inicial razonable y sus costos de mantenimiento son bajos. Los resultados de este proyecto son continuamente supervisados por los funcionarios del Parque y los miembros de la Sociedad Ornitológica.

PAPERS / EXPOSES / PRESENTACIONES

(in their original language only / dans la langue d'origine uniquement / solo en el idioma original)

"A Global Overview of Wetland Loss and Degradation"

Michael Moser, Crawford Prentice, and Scott Frazier
Wetlands International

This paper provides a global overview, but not a full review, of the issue of loss and degradation in wetlands; it defines these terms, looks at the consequences, describes the types and causes of loss and degradation in wetlands, and examines the extent of these changes around the world. The presentation aims to provide a background to the many issues that are to be covered in this workshop, and to suggest how the Ramsar Convention might be improved to address this paramount issue.

Some definitions

"Wetland loss" is the loss of wetland area, due to the conversion of wetland to non- wetland areas, as a result of human activity.

"Wetland degradation" is the impairment of wetland functions as a result of human activity. In practice, wetland loss is rarely independent of wetland degradation, since loss of part of a wetland is likely to impair the functions of the remaining wetland area. Conversely, wetland degradation frequently occurs without the loss of wetland area, through upstream impacts on hydrology and water quality, etc.

Generally, wetland loss is difficult and costly to reverse, although wetland restoration (the reinstatement of some, or all, pre-existing functions to "lost" wetlands (Hollis 1993)) and wetland creation (the introduction of some wetland functions to formerly non-wetland areas) are increasingly popular applied sciences and conservation tools. Changes resulting from wetland degradation are more easily reversed through rehabilitation (the enhancement of the remaining functions and the reintroduction of past functions to degraded wetlands) than is wetland loss.

Thus, both wetland loss and degradation relate to the change in quantity and/or quality of the wetland resource around a baseline.

Some consequences of wetland loss and degradation

The processes of loss and degradation reduce the ability of wetlands to provide goods and services to humankind and to support biodiversity. Examples of the impacts of the loss and degradation of wetlands have been graphically portrayed by Davies & Claridge 1993, and these may include impaired or reduced:

- water supply directly to people, to an aquifer, or to another wetland;
- water flow regulation and flood control;
- prevention of saline intrusion to both ground and surface water;
- protection against natural forces (coastal erosion and hurricanes and flooding);

- ability to retain sediments and nutrients;
- ability to remove toxins from effluents/polluted water;
- availability of natural wetland products;
- opportunity for water transport;
- gene bank for future commercial exploitation or maintenance of wildlife populations;
- significance for conservation of species, landscapes or habitats;
- recreation and tourism opportunity;
- socio-cultural significance;
- opportunity for research and education;
- contribution to the maintenance of existing processes and natural systems at global, regional and local levels (e.g. microclimate, carbon cycling, etc.).

All of these impacts are associated with economic costs, and with a reduction in the opportunities for sustainable economic development. The subject of the economic evaluation of wetlands (and therefore of wetland loss and degradation) is covered elsewhere in the proceedings of this conference.

In industrialized countries, the consequences of the loss and degradation of wetlands have often been mitigated with expensive artificial constructions, such as major flood protection schemes or water purification plants. However, losses of wetlands in developing countries are likely to have a more direct impact than in richer countries, because mitigatory measures are less likely to be implemented due to financial and technical constraints. In addition, the consequences of wetland loss and degradation are likely to be more severe in arid and semi-arid countries (Kotze, Breen and Quinn 1995) because of the scarcity of wetland resources.

Principal Causes of Wetland Loss and Degradation

The vast majority of the world's wetlands are being used by people in a broad spectrum of activities. Through these activities, and factors emanating from activities occurring outside the sites, wetlands are subject to a range of factors which can lead to loss of wetland area and degradation of wetland quality. Not all activities performed in a wetland or its catchment are necessarily wise or sustainable, and it is these activities which can lead to loss and degradation.

Apparent and underlying causes

While it is important that the proximate causes of wetland loss and degradation are identified, the underlying causes are largely socio-economic and political (Kotze, Breen and Quinn 1995, Hollis 1992, Anon. 1996). These include: poverty and economic inequality; population pressures from growth, immigration and mass tourism; social and political conflicts; sectoral demands on water resources; centralized planning processes; and financial policies. The apparent causes are merely the outward expression of the underlying causes. It should be remembered that success in addressing the proximate issues of ecological change is unlikely if the underlying processes are not also addressed.

Types of ecological change

At a workshop on ecological change in 1992, IWRB (1993) found that the main categories of processes producing ecological change were:

- loss of wetland area
- changes in the water regime
- changes in water quality
- unsustainable over-exploitation of wetland products
- introduction of new species

Analyses of the causes of wetland loss and degradation must be considered at two levels: the direct loss and degradation that occurs to the wetland itself; and the indirect loss and degradation which occur as a result of changes outside (upstream) of the wetland. It should be noted that while a protected area or an effective management plan may be able to tackle those threats occurring within the wetland; such measures will be totally ineffective for threats whose origins are outside the wetland.

The types and frequency of ecological change factors leading to wetland loss and degradation vary in relation both to region and to wetland type.

Scott and Poole (1989) in their *Status Overview of Asian Wetlands* analysed the frequency of major threats recorded in wetlands of international importance in Asia, and similar data were presented by Scott and Carbonell (1985), based on the *Directory of Neotropical Wetlands*. In the Asian study, threats were recorded at 85% of the 734 sites for which information was available, and in the Neotropics the figure was 81% of 620 wetlands. Hunting, pollution, drainage and settlements/urbanization all occurred within the top five major threat categories in both regions.

Dugan and Jones (1993) calculated that data provided by the Ramsar Contracting Parties showed that 84% of Ramsar sites had undergone or were threatened by ecological change. Since Ramsar sites are probably better protected against wetland loss and degradation than most other wetlands with a lower conservation status, there can be few wetlands today which are not under some form of anthropogenic threat.

The analysis of Frazier (1996) (based on the Ramsar Database) shows that the frequency of occurrence of ecological change factors at Ramsar sites varies between each Ramsar region. In every region, agricultural and pollution impacts, and factors adversely affecting habitats (general habitat loss, conversion, certain species invasions/infestations) figured prominently, albeit at different positions within the top categories.

Extent and rates of loss and degradation

While the threats of change or potential change in ecological character described above affect most of the remaining wetlands in the world, this is just a "snapshot" of the current situation. Current threats very rapidly turn into wetland loss, and in a historical perspective, these losses have occurred on a massive scale.

In most industrialized countries, extensive losses have already occurred; as a consequence, public awareness of wetland values is increasing, and legislative and policy measures to reduce wetland loss are being introduced. In certain parts of the developing world, particularly those with lower population densities, the losses have been less extensive, but the potential for future loss and degradation remains great.

Measuring loss and degradation of wetlands

Unfortunately, much of the published information on wetland loss and degradation cannot be compared because of the different definitions and techniques employed by the various studies. There is an urgent need to adopt criteria which will enable standard measures of wetlands. For example, where does a wetland start and finish? How often must an area be flooded before it is classified as wetland? The most comprehensive study is that of the US National Wetlands Inventory, on account of its rigorous scientific approach to the identification and description of wetland habitats, standardized protocols for data collection and interpretation, and comprehensive coverage of all wetland habitats across the entire country. This system has been developed over two decades and has cost millions of dollars, an investment outside the immediate reach of most other countries.

Satellite remote sensing techniques, data management based on Geographical Information Systems, and improved international communication systems for data exchange and dissemination continue to make advances. However, the most recent studies (Silveira 1996) still suggest that the complexity of wetlands means that satellite data alone is usually not adequate for detecting change in wetlands, and that extensive ground truth data or mapping from aerial photographs is required.

These problems in assuring comparability between studies are even more severe when it comes to comparing regional and temporal differences in wetland quality.

Wetland losses by region

This section provides a brief overview of existing published quantitative studies of wetland loss, according to the Ramsar regions. Information was collected by keyword search from the Wetlands International library, and through contacts for different regions. Undoubtedly, the review is incomplete. At present, information for individual sites has been excluded, and the studies include those for whole regions, catchments, countries or wetland types. The studies differ in terms of time periods, and may also be biased toward regions where the greatest losses have occurred, and to industrialized countries which have greater resources to undertake such studies. Outside North America and a few European countries, very little effort has been made to document wetland loss on a systematic basis (Scott 1993). In a very generalized overview, OECD (1996) states:

> "Some estimates show that the world may have lost 50% of the wetlands that existed since 1900; whilst much of this occurred in the northern countries during the first 50 years of the century, increasing pressure for conversion to alternative land use has been put on tropical and sub-tropical wetlands since the 1950s.
>
> No figures are available for the extent of wetland loss worldwide, but drainage for agricultural production is the principal cause; by 1985 it was estimated that 56-65% of the available wetland had been drained for intensive agriculture in Europe and N America; the figures for tropical and subtropical regions were 27% for Asia, 6% for S America and 2% for Africa, making a total of 26% worldwide. Future predictions show the pressure to drain land for agriculture intensifying in these regions."

North America

By far the most comprehensive and comparable information on wetland losses are available for this Ramsar region when compared to all other parts of the world.

For the United States, Dahl and Allord (undated) describe the history of wetland losses since settlement of Colonial America in the early 1600s. The unique US National Wetland Inventory provides a wealth of detail on the quantitative scale of wetland losses, by region, by wetland type and over time.

The extent of wetland losses in the US makes depressing reading, by the fact that the losses are both widespread and severe. An analysis of losses between the 1780s and the 1980s (Dahl, 1990) indicates that a 53% loss occurred in the conterminous US (i.e., excluding Alaska and Hawaii). The least impact has occurred in Alaska, where the state's massive 170 million acres of wetland resources have only suffered a 1% loss. Next lowest losses occurred for Hawaii (12%), New Hampshire (9%) and Rhode Island (37%). Ten states have lost over 70% of their wetlands, Ohio and California having lost most at 90% and 91% respectively. Florida has lost approximately 9.3 million acres (46%).

For Canada, a high level of quantitative information on losses is also available (National Wetlands Working Group 1988). Since settlement, ca. 65% of Atlantic tidal and salt marshes, 70% of the lower Great Lakes-St. Lawrence River shoreline marshes and swamps, up to 71% of prairie potholes and sloughs, and 80% of Pacific coast estuarine wetlands are estimated to have been converted to other uses. Primarily, this is due to agricultural drainage and diking, to urban and industrial expansion, to construction of port, road and hydroelectric facilities, and to increased demands for recreational properties (National Wetlands Working Group, 1988). The intense conflict over the use of prairie wetlands for wildlife and waterfowl habitat versus their use for agricultural purposes is the most extensively documented wetland issue in Canada. The Minnedosa pothole region of SW Manitoba has been well studied, where 71% of wetlands have been lost in the period 1928-1982 due to clearance and cultivation of surrounding basins; infilling and road construction; and complete or partial drainage. Canada's boreal wetlands have primarily been influenced by conversion for hydro-electric power reservoirs and corridors, peat extraction for agriculture and energy, and forestry harvesting practices.

The information available for Mexico is less detailed, although Cervantes (personal communication) quotes losses of ca. 35% of original wetland area.

Neotropics

In the insular Caribbean, many wetland sites are degraded due to a long history of wetland reclamation and alteration, coupled with uncontrolled resource exploitation and general neglect. The current poor status of wetlands seriously influences the perception of their values, so governments have been reluctant to invest in their management. Furthermore, the small size of many of the region's wetlands has entailed their neglect by most international programmes. A survey of 220 Eastern Caribbean coastal wetlands (predominantly mangroves) between 1989 and 1991 revealed that virtually every site visited in the 16 islands showed evidence of damage, and over 50% showed severe damage (111 sites). (Bacon 1993)

Throughout the continent of South America, most wetlands remained more or less intact until recent decades, and it is only within the last few years that serious concern has been expressed concerning wetland loss. A few recent studies have revealed the alarming rate at which wetlands are disappearing in some areas, but reliable data over large areas and over many years are generally lacking (Scott, 1993).

In the Cauca River Valley system (Colombia), 88% of mapped wetlands were lost between the 1950s and 1980s. Land reclamation, drainage, river regulation, and pollution (Restrepo and Naranjo 1987) were cited as the major causes. In the Magdalena River delta (Colombia), 80% of mangrove forests died between 1970 and 1987 due to changes in the hydrological cycle (Naranjo 1993).

Europe

The most recent overview on the extent of wetland loss in Europe was provided by Jones and Hughes (1993), and little new information has been published since. While many published accounts exist at national and local scales, this was the first attempt to collate information at a Pan-European level. Some wetland types have been well covered in recent years, however, such as peatlands and lowland wet grasslands. Overwhelmingly, the available data comes from western Europe. A striking feature of the studies from Western Europe is the diversity of methodologies used to measure wetland loss, and the lack of coordination between studies in different countries or for different wetland types. This prohibits any overview at regional level.

Overall wetland losses exceeding 50% of original area have been reported by the Netherlands, Germany, Spain, Greece, Italy, France and parts of Portugal (see references in Jones and Hughes (1993) and European Commission (1995). In the UK, loss rates of 23% of estuaries and 50% of saltmarshes since Roman times (Davidson et al. 1991), and 40% of wet grasslands (RSPB 1993) have been reported. The only study allowing broad comparisons for a particular wetland type across the whole of Europe is that of Immirzi et al. (1992), which reports loss rates for peatlands in excess of 50% for 11 European countries).

Africa

The situation concerning wetland losses in Africa is characterized by an extreme paucity of published quantitative studies, similar to South America. This may reflect both the generally lower rates of losses than in industrialized regions, but also the lack of capacity to undertake such studies in many countries.

A review of wetland inventories in Southern Africa (Taylor et al. 1995), gives some information on the extent of wetland resources in 10 countries in the region. Loss figures are given for two areas in Natal – the Tugela Basin, where over 90% of the wetland resources have been lost in parts of the basin; and the Mfolozi catchment (10,000 sq.km), where 58% of the original wetland area (502 sq.km) had been lost.

The only other quantitative information arises from the wetland inventory of Tunisia, which reports an overall loss of 15% of wetland area, and 84% loss in the Medjerdah catchment (Hollis 1992).

Asia

The situation in the densely populated regions of southern and eastern Asia is very different from Africa and South America, in that here wetland loss has been occurring for thousands of years. Lowland rice cultivation began in SE Asia about 6,500 years ago, and sophisticated drainage and irrigation systems had been developed in parts of the Middle East by the 4th millenium BC.(Scott, 1993)

Over the centuries, vast areas of wetland in southern and eastern Asia have been converted into ricefields or drained for other forms of agriculture andhuman settlement. In some areas, this conversion or destruction of wetlands has been total. For example, no trace remains of the natural floodplain wetlands of the Red River delta in Vietnam, which originally covered 1.75 million hectares. Likewise, there is virtually nothing left of the one million hectares of natural floodplain vegetation which once covered most of the Sylhet Basin in Bangladesh or the six million hectares of floodplain wetlands in the lowlands of central Myanmar. Much of the 40 million hectares of rice cultivation in the central plains of India must have been developed at the expense of natural wetlands, and the same is true of the 1.9 million hectares of rice cultivation in the central plains of Thailand. In all of these regions, very little natural wetland vegetation has survived into the present century. (Scott 1993)

In his review, Scott (1993) quotes an overall loss of 31% of wetlands in Indonesia, with loss of mangroves in Singapore, Philippines and Thailand being 97%, 78% and 22% respectively. In their review of peatlands, Immirzi et al. quote losses for Israel (100%), Thailand (82%), West Malaysia (71%), Indonesia (18%), China (13%), Sarawak in East Malaysia (11%).

Oceania

Little published quantitative information exists for the extent of wetland loss in the small south Pacific islands, despite the recent wetland inventory for this region (Scott 1993).

For New Zealand, Cromarty (1996) estimates a loss of 90% of the original wetland area. For Australia, loss estimates are given for Victoria (26.8%), the southeastern part of South Australia (89%) and the Swan Plain Coast of South Australia in the recently published national wetland directory (Usback & James 1993). The most detailed study for Victoria shows losses of fresh water marshes exceeding 70%, whilst there have been gains through the creation of artificial wetlands such as sewage ponds and saltworks.

Strategies to Reverse Loss and Degradation

Wetland loss and degradation and the Ramsar Convention

The Ramsar Convention was established to address the issue of the loss and degradation of wetlands through concerted and coordinated action by the Contracting Parties, so that wetlands can contribute to the process of sustainable development. Almost the entire suite of obligations that are undertaken by the Contracting Parties relate to addressing this issue: the designation of sites to the Ramsar list, maintaining the ecological character of listed Ramsar sites; the establishment of reserves on wetlands, and making wise use of wetlands. Undoubtedly, the Ramsar Convention has succeeded in raising awareness and the level of actions for conservation of wetlands; yet wetlands continue to be lost and degraded at a rapid pace in many parts of the world. The remainder of this paper focuses on how the Ramsar Convention could be made more effective to address these issues, both at a national policy level and at the level of individual Ramsar sites. The paper concludes with a number of specific recommendations for consideration by the Ramsar Convention.

A strategic approach is required

The adoption of a strategic plan by this conference, represents a clear indication of the increasing maturity of the Ramsar Convention, and a realization that such a strategic approach is the only way to address the issue of the global loss and degradation of wetlands. A comprehensive strategy should incorporate the following vital steps, which are applicable both to sites (through a management plan, as covered well by the Ramsar guidelines) and to whole countries (through a national wetland policy):

1. Set a measurable goal

Larson (1993) recommends that a measurable goal should be included in all national wetland policies. Goals that have been adopted or proposed to date include the "No Net Loss" goal of national wetland policies in the United States and Canada, which relate both to wetland area and function (see discussion in Larson 1993), and the goal of stopping and reversing the loss and degradation of Mediterranean wetlands, which is the goal of the Mediterranean Wetlands (MedWet) Initiative.

At present, the Ramsar Convention contains a measurable goal for the listed Ramsar sites, which is "to maintain their ecological character". While potentially measurable, the issue of "change in ecological character" is still poorly defined.

Unfortunately, at the national and international levels, neither the Convention text nor the draft Strategic Plan set measurable goals, making it difficult to measure the success of the Convention in future years. It is strongly recommended that each Contracting Party, and perhaps the Ramsar Convention as a whole, should include a measurable goal as it develops and adopts its national wetland policy.

2. Measure the resource baseline

Whether the goal is to maintain the ecological character of a wetland site, or to stop the loss and degradation of wetlands across the landscape as a whole, it is essential to measure the baseline of the wetland resource under consideration. This is achieved through a wetland inventory programme. A wetland inventory is one of the key elements in a conservation strategy for wetlands (WWF 1992). This is because (Costa et al. 1996) such inventories:

- identify where the wetlands are;
- assist in identifying priorities;
- provide the baseline for status and trends reports;
- provide a tool for planning and management;
- permit comparisons at national and international levels;
- provide information for awareness programmes;

The Convention, through the wise use guidelines, already calls upon Contracting Parties to execute national wetland inventories. However, recent regional reviews such as Hecker and Tomas Vives 1995 (the Mediterranean), Taylor et al. 1995 (Southern Africa), and national reports to (former) IWRB suggest that such programmes are, as yet, poorly developed.

MedWet Monitoring Guide. The most comprehensive national wetland inventory programme to date has been that of the United States. Building on this and other experiences, and in order to assist the development of wetland inventories internationally, Wetlands International and the Instituto da Conservacao da Natureza (Portugal), as part of the MedWet initiative, have prepared comprehensive national wetland inventory tools for the Mediterranean region including: a Reference manual; Datasheets and their guidelines; a Habitat Description System; Photointerpretation and cartographic conventions; and a MedWet database and manual.

Two important issues have emerged during the preparation of these tools:

- The need to develop specific criteria for the identification and delineation of wetland areas. This issue is not adequately covered by the Convention's definition of wetlands, and it is recommended that the STRP should examine the option of developing further guidelines or criteria on this subject. The criteria developed in the United States by Cowardin et al. 1979, provide an important basis, and these have been adapted for use under the MedWet methodology.

- The importance of managing the information collected through a national wetland inventory through wetland databases was emphasized. Experience indicates that published directories of wetlands are extremely hard to use and update as working tools.

3. Identify operational objectives, and 4. Prescribe and undertake actions

These two critical steps are the main subject of the Ramsar Convention Strategic Plan, and are not discussed here in any further detail.

5. Monitor performance against baseline

Monitoring the effects of the conservation actions undertaken should be an important feedback mechanism within any site management plan or national wetland policy. It is only through such monitoring programmes that the extent and causes of loss and degradation of wetlands can be determined, and the success of conservation actions be measured. However, the complexity and diversity of wetlands has been a serious constraint to the development of effective monitoring schemes, and it is notable that it is only after 25 years that the Convention is now beginning to address this issue systematically.

Monitoring programmes need to address both the issue of wetland integrity (i.e. change in wetland area) and change in wetland quality. While the Convention is addressing these needs at the level of individual Ramsar sites, a serious gap remains in the lack of quantitative information on changes in these parameters at national and therefore international level. Very few countries, with the notable exception of the United States, are able to provide information on the status of their wetlands or temporal trends in the rates of loss and degradation.

Given this lack of knowledge, it is recommended that Contracting Parties be encouraged to establish programmes to gather such information. Further investigation of the possibilities of using remote sensing to achieve these aims may provide the most cost-effective solution in the long term.

6. Report the results

The quality and quantity of information about the state of wetlands must be increased and communicated more effectively at all levels. Information on the loss and degradation of wetlands, and the consequences of this for people and for biodiversity, provide powerful tools for influencing public opinion and decision-makers. Thus, awareness of the US status and trends reports led to the Emergency Wetlands Resource Act of 1986 (Thompson and Tapson 1994).

It is strongly recommended that at both national and international levels, formal mechanisms are established for reporting on the status of the wetland resources. At international level, a first step would be to compile and publish a review of all the quantitative studies of wetland loss/gain.

Conclusions

1) There is a lack of information about loss and degradation in most countries; much of the information that does exist cannot be compared.

2) A global overview indicates that massive historical losses of wetlands have occurred worldwide, much of this prior to the launch of the Ramsar Convention. There are wide variations between regions, between wetland types and over time.

3) The majority of the remaining wetlands are degraded, or under threat of degradation. The intensity of these problems is closely related to the intensity of human activity in and around the wetland.

4) The loss and degradation of wetlands has severe economic consequences, and removes opportunities for sustainable development. Restoration and rehabilitation measures are very expensive, and unlikely to restore full natural functions.

5) We are not in a position to measure the global wetland resource baseline, nor to monitor the success of national and international programmes, including the Ramsar Convention.

6) Information on the loss and degradation of wetlands is essential to influence policy, through public awareness.

Recommendations – Actions Required

At international level

- Adopt the proposed Strategic Plan for the Ramsar Convention.
- Produce materials detailing the historical loss and degradation of wetlands, and the social and economic consequences.
- Harmonize wetland inventory and monitoring methodologies to enable temporal and spatial comparisons.
- Adopt objective criteria to identify and delineate wetlands.
- Locate technical and financial assistance to carry out national wetland inventory and monitoring programmes, where needed.
- Produce triennial "Status and trends of the world's wetlands" reports – starting in the year 2000?

At national level

- Establish national wetland policies, incorporating a measurable goal concerning the loss and degradation of wetlands.
- Undertake a full national wetland inventory, according to international standards. The results should be stored and regularly updated through establishment of a national wetland database, including GIS.
- Establish national programmes to monitor changes in the extent and quality of wetland resources.
- Publish and disseminate information from national inventory and monitoring programmes.

At (Ramsar) site level

- Adopt a strategic approach to site management, including a management plan which is regularly reviewed and updated.
- Measure the baseline wetland resource through a detailed wetland inventory.
- Establish programmes to monitor change in ecological character.
- Publish and disseminate the information from inventory and monitoring programmes to raise awareness.

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"The Montreux Record: a Mechanism for Supporting the Wise Use of Wetlands"

C. M. Finlayson
Environmental Research Institute of the Supervising Scientist
Jabiru, Australia

An important obligation under the Ramsar Convention is for each Contracting Party to "designate suitable wetlands within their territory for inclusion in a List of Wetlands of International Importance" (Article 2.1 of the Convention). The text of the Convention (Article 2.2) states that wetlands should be listed according to their "international significance in terms of ecology, botany, zoology, limnology or hydrology". To assist the Contracting Parties in listing sites, a set of criteria was drawn up in Heiligenhafen, Germany, in 1974, revised and accepted in Cagliari, Italy, in 1980 (Recommendation 1.4), with further revisions at Regina, Canada, in 1987 (Recommendation 3.1) and at Montreux, Switzerland, in 1990 (Recommendation 4.2). Further, in Kushiro, Japan, in 1993, there was a call to investigate further changes to the criteria with an emphasis on fish habitats with regard to biological diversity and fishery yields (Recommendation 5.9). Thus, the process of recognizing wetlands as sites of international importance has been an evolving one and has still not reached a steady-state.

Whilst listing a site as internationally important is an important obligation under the Convention, it may not constitute anything more than a passive step for conserving wetlands. Thus, the Convention also obliges the Contracting Parties to "formulate and implement their planning so as to promote the conservation of the wetlands included in the List" (Article 3.1) and inform the Ramsar Bureau "if the ecological character of any wetland in their territory and included in the List has changed, is changing, or is likely to change as the result of technological developments, pollution or other human interference" (Article 3.2). Thus, the Contracting Party is obliged to undertake active conservation steps (and management planning) to prevent the site from being degraded and to restore the value of any degraded sites.

Whilst the issue of change in ecological character of listed sites has been recognized for some time and is a fundamental feature of the Convention, there have been no official definitions or guidance to Contracting Parties as to what constitutes a change in ecological character. Recognizing the fundamental nature of these issues the Contracting Parties, Standing Committee and Bureau of the Convention have requested the Scientific and Technical Review Panel of the Convention (STRP) to develop guidelines for interpreting "*ecological character*" and "*change in ecological character*" and review the operation of the Montreux Record (Resolutions 5.4/5.5 and Recommendation 5.2).

The Montreux Record and ecological character

The Contracting Parties of the Ramsar Convention have addressed the policy aspects of change in ecological character in a number of recommendations and a resolution at Conferences spanning two decades. These pronouncements form the basis for addressing the important and, at times, sensitive policy issues within the framework of the Convention, although various critics have argued that requests for further consideration of these issues are indicative of the inability or unwillingness of Contracting Parties to really "grasp the nettle" and resolve them. Similar attention has not been given to the technical issues of monitoring and assessing the extent of change in ecological character at Ramsar sites. Thus, not only are the policy and conceptual issues dealing with effective monitoring unresolved, but we do not have a solid technical base for the active management steps that are required once the policies are in place.

Adverse change in the ecological character of Ramsar sites has been noted "*with regret*" since the 1987 Regina Conference of the Contracting Parties to the Convention. In Recommendation 3.9 it was noted that "a number of listed sites have been severely damaged or are under imminent threat of degradation". This recommendation further urged "all Contracting Parties to take swift and effective action to prevent any further degradation of sites and to restore, as far as possible, the value of damaged sites". The issue was taken further in Montreux 1990 in Resolution 4.8 which instructed "the Convention Bureau, in consultation with the Contracting Parties concerned, to maintain a record of Ramsar sites where such changes in ecological character have occurred, are occurring or are likely to occur, and to distinguish between sites where preventive or remedial action has not as yet been identified, and those where the Contracting Party has indicated its intention to take preventive or remedial action or has already initiated such action". The Annex to this resolution established the basis of the so-called Montreux Record of Ramsar sites where changes in ecological character have occurred, are occurring, or are likely to occur.

The Montreux Record has attracted considerable debate, with some Contracting Parties taking a very firm stance on the mechanisms for placing sites on the Record. These mechanisms were confirmed at the 1993 Kushiro Conference of the Contracting Parties (Resolution 5.4 annex). The critical part of the mechanism is that a site can only be placed on the Montreux Record on the basis of information provided by the Contracting Party. Where information comes from other sources, the Ramsar Bureau is required to consult with the Contracting Party and to obtain the agreement of this Party before adding the site to the Record. Needless to say, this clause has attracted considerable adverse comment from non-government sources, whilst governments are equally forthright in their determination not to relinquish any sovereign rights in this matter.

Given the many caveats within the 1990 recommendation (Recommendation 4.8) and 1993 resolution (Resolution 5.4) which established and then confirmed the basis of the Montreux Record, there is every chance that many sites undergoing adverse ecological change will not be placed on the Montreux Record. Thus, except for the fact that sites on the Record may receive priority attention under the Ramsar Monitoring Procedure (recently renamed the Management Guidance Procedure) and possibly attract financial support from the Ramsar Small Grants Fund, there would seem to be little effective reason for having the Record. This conclusion is supported by the analysis of Dugan & Jones (1993) which ascertained, on the basis of information supplied by Contracting Parties, that some 289 sites could potentially be on the Record. This disparity raises some questions about the process of placing sites on the Montreux Record and stresses the clear need for guidelines for interpreting "*change in ecological character*". This requirement was recognized in Kushiro 1993 (Recomendation 5.2).

Clarification of these concepts and the development of guidelines would seem to be essential if the Montreux Record is to be a meaningful mechanism for bringing attention to the status of the world's wetlands as represented by those sites designated as internationally important. Given this situation, it is not unreasonable to assume that the very integrity of the Convention and its Contracting Parties will be questioned if this issue is not tackled and resolved in a transparent and effective manner.

Ecological character

The ecological character of a wetland generally refers to the characteristics that make the wetland of local, national or international importance. Thus, at the international level the Ramsar criteria for listing wetlands of importance could be used to describe the ecological character of Ramsar sites, although except for the waterbird criteria these lack precision.

Due to the dynamic nature of environmental and evolutionary processes the ecological character of a wetland changes with time, the rate of change varying among different types of wetlands. Thus, when determining the ecological character of a site some account of temporal change is needed. In relation to Ramsar sites, the date of listing as being of international importance could provide a suitable reference point. However, even this is a subjective measure and is heavily influenced by societal values at that particular time. Given that the Ramsar criteria for listing as internationally importance are generally imprecise and strongly biased towards waterbirds, some caution should be exercised in rigidly accepting these criteria as an unequivocal measure of the ecological character of a wetland. Thus, if the criteria are adopted as the basis for describing the ecological character of a Ramsar site, it may be necessary to supplement the criteria with specifically chosen information on the overall description of the site. Thus, whilst the existing criteria could form part of the description, they may not always be adequate by themselves.

The present descriptions of Ramsar sites vary greatly and should be reassessed with the objective of ensuring that they are standardized and provide a suitable baseline description of the ecological character of the site (Finlayson 1994). The adoption of the Ramsar Information Sheet (Recommendation 4.7 and Resolution 5.3) has provided a standardized mechanism for describing sites, but the response by Contracting Parties to using this sheet has not been overly encouraging. Again, unless the Contracting Parties can provide the basic data at the time of listing a site as internationally important, the basis for adjudging whether or not change has occurred will not exist. As with the operation of the Montreux Record this failure to comply with past decisions of the Convention raises serious questions of credibility.

Whilst it is not unreasonable to expect that a competent wetland scientist could describe the ecological character of a wetland at a particular moment in time, it is not as reasonable to expect that the extent of natural variability and evolutionary change could be described. A description that presents a 'snap-shot" in time has value, but for assessing changes in ecological character resulting from anthropogenic factors it may not be adequate. The ecological character of a wetland is often not static in either the short or the long-term.

Noting the above comments on the difficulty of obtaining an adequate description of the ecological character of a wetland site, a basic definition of the concept was devised by Dugan & Jones (1993) and adopted by the STRP. This definition is presented below:

> The ecological character of a wetland is the sum of the wetland's functions, products, and attributes that are derived from the individual biological, chemical , and physical components of the ecosystem and their interactions.

The definition reflected an international consensus, given technical input to STRP from regional delegates (Ramsar's global base is divided into seven broad geographic regions) and observers from IWRB and IUCN. It has been presented as a working definition that could be changed following further discussion.

The definition refers to wetland functions, products and attributes (values and benefits) that have been previously described within the Ramsar context (Dugan 1990, Davis 1993, 1994) and were also developed with international input, including that from IWRB and IUCN. These terms are given in Table 1 and provide a theoretical basis for describing the ecological character of a wetland, but do not assist with the practical and perplexing problem of interpreting the significance of a change in the ecological character of a wetland. Thus, we have achieved some level of consensus (but not complete agreement) on key concepts (i.e. definitions), but we still have not resolved the harder questions relating to the ecological meaning of change when it is detected. Monitoring can provide the information, but it does not necessarily provide the answer. Assessment of the information must follow if we are to provide guidance to those who are earnestly attempting to use wetlands wisely.

Change in ecological character

Changes in ecological character occur when the biological and physical components, and the interactions between them, are enhanced or diminished as a result of both human and natural processes. Thus, change in ecological character can be considered to either enhance or diminish the value of a site. In the context of listing sites on the Montreux Record, it is the latter that is of concern, i.e, adverse ecological change. This concept is captured in the definition of change in ecological character proposed by Dugan & Jones (1993) and modified by STRP:

> The alteration of the biological and/or physical components of the ecosystem, and/or the interaction between them, in a manner which results in a reduction in the quality of those functions, products and attributes which give the wetland value to society.

The ecological character of wetlands can be adversely altered in a diverse number of ways: drainage, pollution and eutrophication, overfishing and hunting, dam and barrage construction, water extraction, canalisation and diversion of waterways, and the introduction of pest species, to name a few. Dugan & Jones (1993) also concluded that the processes that lead to ecological change could be combined into three general groups:

i) Changes in the water regime: dams and water extraction, including groundwater, alter the hydrological regime; eutrophication and pollution alter the cycling of energy and productivity capacity of the wetland; and dykes and canals have increased flow rates along channels, reduced seasonal inundation of floodplains and increased the risk of floods.

ii) Physical alteration: specific activities that replace wetlands with agricultural, urban or industrial land; drainage, infilling, polder construction and conversion to aquaculture ponds are all intentional changes that can destroy wetlands.

iii) Biological change: overutilization of specific plant and animal species through fishing, hunting and harvesting can be devastating; additionally, the purposeful or accidental introduction of exotic species can result in intractable change.

All of these processes reduce the value of wetlands. Accepting this basis, the IWRB workshop on ecological change reiterated that only adverse ecological change was being considered.

However, the situation for Ramsar sites is not simply one of measuring adverse changes in ecological character, given that in Kushiro 1993 it was agreed (Resolution 5.4 Annex) that "the Convention Bureau . . . shall remove a site from the Montreux Record upon receipt of documents detailing either the remedial actions implemented successfully at the site, or the reasons why the ecological character of a site is no longer likely to change." Thus, there is also a need to consider processes that enhance or restore the ecological character of the site. This moves the discussion into the realms of wetland restoration as considered in Montreux 1990 (Recommendation 4.1) and wetland wise use and management planning as considered in Kushiro 1993 (Resolution 5.6 and Annex and Resolution 5.7 and Annex respectively).

When considering changes in the ecological character of wetland sites, it is therefore necessary to enter fully into the realm of wetland management planning on a holistic basis. Unfortunately, it would appear that holistic planning for Ramsar sites is even more elusive than comprehensive descriptions of said sites!

Guidance for describing the ecological character of listed sites

At the time of listing a site as internationally important, a Contracting Party is required to describe the site and submit an adequate map. The Information Sheet on Ramsar Wetlands forms the basis of this description, although a number of changes have been suggested by the STRP in order to increase the value of the information collected for assessing the ecological character of the site. New headings have been proposed to:

i) establish a baseline for describing the functions, products and attributes of the site that give it benefits and values of international importance (necessary as the existing Ramsar criteria do not cover the full range of wetland benefits and values which could be considered when assessing the possible impact of change at a site);

ii) provide information on human-induced factors that have affected or could significantly affect the benefits and values of international importance;

iii) provide information on monitoring and survey methods in place (or planned) at the site;

iv) provide information on the natural variability and amplitude of seasonal and/or long-term "natural" changes (e.g. vegetation succession, episodic/catastrophic ecological events such as hurricanes) that have or could affect the ecological character of the site.

It is recognized that, for many sites, such information will not be known at present, nor be readily available. The sheets will also only provide a snap-shot in time. However, the level of information in the Ramsar Information Sheet is the minimum necessary for determining management steps to maintain the ecological character of a listed site.

Sources of information which might be consulted by Contracting Parties in describing the ecological character of a site include international, national and regional scientific inventories of wetlands. It is realized, however, that many inventories may not contain sufficient information (see papers in Finlayson & van der Valk 1995). Existing management plans and other site specific scientific surveys or reports may also be useful sources of information. In gathering new data or assembling existing data, Contracting Parties should give emphasis to sites where there appears to be a high-medium risk of human-induced change with a high-medium ecological impact. International technical and/or financial cooperation may be needed to assist in gathering information about listed sites, particularly in developing countries.

Noting the need to keep the data on listed sites up-to-date, the Contracting Parties are further requested to verify the data on the Ramsar Information Sheets every six years. This could be done through the triennial National Reports submitted to the Convention Bureau, or during the intervening period urgent information on changes could be conveyed to the Bureau using the existing mechanisms of regular, day to day contacts. Provision of timely information will further enhance the value of the Ramsar site database and the credibility of the Convention.

An effective monitoring and survey programme is a prerequisite for assessing whether or not a wetland has undergone an adverse change in ecological character. Such a programme is an integral component of a wetland management plan (Resolution 5.7 Annex) and should enable full consideration of the values and benefits of the wetland when assessing the extent and significance of change. Monitoring should establish the range of natural variation in ecological parameters at each site, within a given timeframe. Change in ecological character occurs when these parameters fall outside their normal range. In addition to monitoring an assessment of the extent and significance of change is required, taking into account the need for each wetland to have a favourable conservation status.

Monitoring has been defined in the Additional Guidance for the Implementation of the Wise Use Concept (Resolution 5.6 Annex) as "the process of measuring change in ecological character in any wetland over a period of time". It differs from general surveillance in that there is a specific reason and method for collecting particular data or information. Further, monitoring does not automatically require sophisticated technology or high investment and can be carried out at different levels of intensity. There are many different techniques for monitoring and Contracting Parties should select the most appropriate to its priorities and available resources.

A framework for designing an effective monitoring programme is given in Figure 1. This is based on that presented by Finlayson (1994) and developed further for the Mediterranean wetland programme (Finlayson 1996). The framework is not a prescriptive recipe for any particular monitoring programme. It simply provides a series of steps, in a logical sequence, that can be used by wetland managers and planners to design a programme based on their particular circumstances and needs. Feedback links in the framework emphasize the dynamic nature of planning and implementing a monitoring programme where assessment and adjustment of the programme are an iterative process.

Guidelines for operation of the Montreux Record

As discussed above, the Montreux Record is the principal tool of the Convention for highlighting those sites where an adverse change in ecological character has occurred, is occurring, or is likely to occur. The steps outlined in Tables 2 and 3 are presented as guidance for the operation of this procedure as requested by the Contracting Parties (Recommendation 5.2). These guidelines cover both the inclusion and removal of a site from the Montreux Record. A questionnaire (Table 4) is also presented as further assistance. Implementation of these guidelines is encouraged in order to eliminate confusion and unevenness in the operation of this important mechanism for wetland conservation.

The guidelines and questionnaire reflect the attitude of the STRP with modifications requested by the Standing Committee of the Convention. The latter expressed comment on the issue of national sovereignty, the role of the STRP ,and the optional use of the questionnaire. The recommended guidelines therefore now represent a broad consensus of attitudes from technical and policy experts. The STRP also discussed the implications of more compulsion within the guidelines, but these were not deemed operable. However, it is anticipated that such questions will arise in the future if Contracting Parties are not seen to be using the Montreux Record in a transparent and constructive manner.

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Table 1 : Terms used in the working definition of "ecological character" recommended by STRP. These terms have been previously described within the Ramsar context (Dugan 1990, Davis 1993, 1994).

Functions performed by wetlands include the following: water storage; storm protection and flood mitigation; shoreline stabilization and erosion control; groundwater recharge; groundwater discharge; retention of nutrients, sediments and pollutants; and stabilization of local climatic conditions, particularly rainfall and temperature. These functions are the result of the interactions between the biological, chemical and physical components of a wetland, such as soils, water, plants and animals.
Products generated by wetlands include the following: wildlife resources; fisheries; forest resources; forage resources; agricultural resources; and water supply. These products are generated by the interactions between the biological, chemical and physical components of a wetland.
Attributes of a wetland include the following: biological diversity; geomorphic features; and unique cultural and heritage features. These have value either because they induce certain uses or because they are valued themselves.
The combination of wetland functions, products and attributes give the wetland ***benefits and values*** that make it important to society.

[Editor's Note: Table 2 (Procedure to observe when considering the possible inclusion of a listed site in the Montreux Record), **Table 3 (**Procedure to be followed when considering the removal of a listed site from the Montreux Record), **Table 4** (Questionnaire to be voluntarily used by Contracting Parties when considering using the Montreux Record), and **Figure 1** (Description of the framework for designing a wetland monitoring programme) were adopted by the Contracting Parties as an Annex to Resolution VI.1 and published in Volume 4/12 of these *Proceedings*, and are thus omitted here.]

"Influence of Water Hyacinth on the Ecological Character of Shoreline Wetlands of Lake Victoria (East Africa)"

T.K. Twongo and J.S. Balirwa,
Fisheries Research Institute (FIRI)
Jinja, Uganda

Preliminary data from experiments to study the influence of infestation with water hyacinth *Eichhornia crassipes* (Martius) Solms in the shoreline wetlands of northern Lake Victoria in Uganda were used to evaluate aspects of the environments indicative of ecological change. Results were supplemented with field data from periodic surveys of distribution, cover and biomass *E. crassipes* which identified a permanent fringe of the weed 15m average width along about 85% of the shoreline of Lake Victoria in Uganda and about 50% along the shores of Lake Kyoga.

Among the euhydrophytes of the shoreline wetlands in the experimental area, water hyacinth spread rapidly from an "occasional" frequency rating in 1993 to dominant status in 1996. Then, the cover score of the water weed had increased by 200% while that of other euhydrophytes had dropped from "frequent" to "rare" or even "absent". By 1995 a resident fringe of *E. crassipes* about 10 to 15m wide had become established along most of the wetland shores in the experimental area which were lined with *Cyperus papyrus*, *Phragmites mauritianus, Vossia cuspidata* and *Typha domingensis*. The water weed smothered most patches of the associated indigenous euhydrophytes previously dominated by *Pistia stratiotes, Nymphaea cearulea* and *Ceratophyllum demersum*.

Dissolved oxygen measured at the edge of the above emergent vegetation types was lowest at the fringe of resident *E. crassipes*, declining to less than 35% only 10m into the weed mat. Data on diversity of macrofauna associated with hyacinth indicated a marked decline with distance into the mat. Further, data indicated that infestation with resident *E. crassipes* depressed fish biomass along the shores of *C. papyrus.*

The experimental data supplemented with the survey results are discussed in relation to possible change in the ecological character of shoreline environments due to infestation with the noxious *E. crassipes*. The final results of the experiments will be presented elsewhere.

Introduction

A large part of eastern and central Africa is occupied by water bodies which are often bordered by extensive emergent wetland vegetation usually referred to as swamp. Under altered land use and climatic regimes, native wetland vegetation may attain prolific growth and become a weed problem. For instance, the rapid proliferation of *Typha* around lakes Nyumba Ya Mungu and Jipe in Tanzania turned this native plant into huge expanses of undesirable weed. However, classic and more striking examples of aquatic weeds have been alien introductions like *Salvinia molesta* in lakes Kariba and Naivasha, and the water hyacinth *Eichhornia crassipes*. These have been introduced into many aquatic systems throughout the world including Africa (Harley, 1993). Under warm, moist conditions and ample nutrients, the two weeds attain prolific growth to form dense floating or submerged mats which become an environmental and socio-economic nuisance in a variety of ways. The mats chock waterways and navigation routes and smother lakeshores, river banks and small water bodies, particularly ponds and dams. Such water weeds thus cause mostly undesirable effects on: navigation, fishing activities, hydro-power generation, industrial and potable water abstraction and public health. Most of those effects are quickly noticed and easily appreciated by the user communities of the environments impacted by the weeds.

The impact of aquatic weeds may also be evaluated in terms of their ecological influence in the new environment. Such ecological impacts may be slow, subtle and difficult to characterize, particularly in aquatic habitats. However, in the long run the impacts on the environment and resources infested can be far reaching. In response to the rapid proliferation and spread of *E. crassipes* in the shoreline wetland zones of lakes Victoria and Kyoga, the Fisheries Research Institute of Uganda initiated research into the ecological influence of the weed in 1993. This paper presents initial data from the above ongoing studies in an attempt to facilitate discussion by this Technical Session which is evaluating "ecological character" and "change in ecological character" of Ramsar sites as could be influenced, for instance, by human activities through species introduction.

Water hyacinth in eastern Africa

Water hyacinth, probably the most noxious aquatic weed, is already present in some river or lake of virtually all the countries of Eastern Africa where it appears to have preferentially established along shoreline wetlands (Twongo *et al.* 1992). The weed existed in the Nile in the Sudan since the early 1950s; it was reported in Sigi River, Tanzania, in 1955; in Lake Naivasha, Kenya, in 1988; in Lake Kyoga, Uganda, in 1988; and in tri-national Lake Victoria (Kenya, Uganda and Tanzania) in 1989, having entered the lake down River Kagera from the Republic of Rwanda (Harley, 1993; Taylor, 1993). Though seldom a problem in its native range of South America, water hyacinth has become one of the most noxious weeds in new environments (Gopal and Sharmer, 1981). The rapid spread of the weed in lakes Victoria and Kyoga and the River Nile (Fig 1), and the attendant negative social economic impacts, have been systematically followed (Twongo, 1991a; 1991b; Thompson, 1991; Twongo *et al.* 1992; Taylor, 1993; Willoughby *et al.* 1993; Twongo and Balirwa, 1995; and Twongo *et al.* in prep.). In some of the studies, Twongo *et al.* (1992) and Willoughby *et al.* (1993) established that the shores of Lake Victoria in Uganda were the most severely infested with water hyacinth due to the large number of shallow, sheltered, mostly papyrus-fringed bays and inlets. The above studies, plus further in-depth ecological research in Uganda and elsewhere, are expected to facilitate an assessment of the environmental transformation due to the invasion and proliferation of the noxious water weed along shoreline wetlands.

Shoreline wetlands of Lake Victoria

The length of the shoreline of Lake Victoria in Uganda, excluding islands, is about 1000 kilometres. It is highly convoluted and includes many large sheltered bays with numerous shallow inlets. The bays are often fringed with wide expanses of wetlands dominated by *Cyperus papyrus*. Since 1992, water hyacinth has become a common feature in such bays, often smothering the scuttered mats of associated indigenous euhydrophytes and disrupting traditional inshore fisheries. Because of the assumed importance for the fisheries of this ecological zone, there is need to find out about the impact of the water hyacinth on structural aspects of the zone. This paper therefore focuses on this lakeward portion of the land-lake wetland transition zone or ecotone. The paper is based on preliminary results from ongoing studies in northern Lake Victoria on the influence of water hyacinth on the distribution of indigenous euhydrophytes; the water quality; the diversity, distribution and relative abundance of macrofauna, as well as on fish biomass. The global ecological influence of the introduced water weed would then be evaluated against the background of previous data on distribution, areal cover, movement and biomass of water hyacinth (Twongo *et al.* 1992; Willoughby *et al.* 1993; Twongo and Balirwa, 1995; Twongo et al. in prep.). The paper seeks to demonstrate the influence of water hyacinth infestation as a potential agent of change in the ecology of shoreline wetland environments.

Materials and methods

Experimental study area and sites

Studies were carried out in an area along the northern shores of Lake Victoria in Uganda, near Jinja town (Latitudes 0^{o} 22N; 0^{o} 30N and Longitudes 33^{o} 10E; 33^{o} 26'E. Sampling sites were located along the shoreline of wetland-fringed bays adjacent to Napoleon Gulf above the source of the Nile. Selection of the sites was based on the stability of a given emergent wetland vegetation type, undisturbed by human activity. The experimental zone covered a shoreline length of about 110km (including islands) and had an open water surface area of about 133km^2. The hinterland stands at an average altitude of 1200m above sea level characterized by flat-topped hills with steep slopes and an extensive agricultural landscape including a large sugar cane plantation to the north and northwest. To the west lies Jinja municipality with a population of 290,000. Numerous fishlandings dot the highly irregular and deeply indented shoreline, which is associated with several sheltered bays such as Fielding, Kafunda and Thruston. The landscape to the east of the study area still contains extensive enclaves of natural forest and woodland.

Vegetation characterization

Surveys and experiments along the shoreline were made using a fibreglass canoe powered by a 15Hp outboard engine. Characterization of shoreline vegetation was made in 1993, at a slow speed within 5m of the shore. A satellite image of the area was used to map the shoreline wetlands, and the associated plants were identified and located on the image. A taxonomic inventory of the common species of wetland plants was made and their cover, abundance and prominence assessed. Continuous stands of natural shoreline vegetation were named, guided by numbered polygons on the satellite image. In each of the stands, 15-30 minutes were spent scrutinizing and identifying the different plants usually down to genus. The majority of the species were given an index of cover abundance according to the scale: RARE, OCCASIONAL, LOCALLY FREQUENT, FREQUENT, LOCALLY ABUNDANT, ABUNDANT, LOCALLY DOMINANT and DOMINANT. Quantification of the importance of plant species in terms of cover took into account size, numbers of individuals, spatial coverage and homogeneity of stands; hence in scoring the importance from the scale above, different species in each polygon were assigned points from + to 5 corresponding to the scheme in Table 1.

Table 1. Plant cover classification scheme (bases on individual species) used in vegetation characterisation in the study area*

+ species sparsely present (cover small) < 1% of area = R

1 any number of individuals covering > 1 < 5% of area = OC.

2 any number of individuals covering 5-25% of area = LF

3 any number of individuals covering 26-50% of area = F

4 any number of individuals covering 51-75% of area = Lab.& A
5 any number of individuals covering 76-100% of area = LD & D

* R = Rare, OC. = Occasional, LF = Locally Frequent, F = Frequent, Lab = Locally Abundant, A = Abundant, LD = Locally Dominant, and D = Dominant.

For the purpose of this paper, emphasis was placed on selected wetland patches of the shoreline, some of which were associated with indigenous euhydrophytes, particularly *Pistia stratiotes, Nymphaea caerulea, Ceratophyllum demersum,* and the alien *E. crassipes*. *E. crassipes* was also regarded as part of the mosaic of floating and submerged shoreline vegetation. The selected habitats were identified by five most characteristic emergent macrophytes in the study area, namely *C. papyrus*, *P. mauritianus, V. cuspidata* and *T. domingensis*. In 1996, an updated inventory was made to compare the spread, proliferation and impact of *E. crassipes* since the initial survey of 1993. This was in relation to the native euhydrophytes and to *V. cuspidata*, whose cover had clearly increased.

Dissolved oxygen and algal biomass

Sampling stations were sited to border *C. papyrus, P. mauritianus, V. cuspidata, T. domingensis* and *E. crassipes* in order to facilitate comparison of the influence of the water weed. Dissolved oxygen was measured at the edge of each vegetation type and again at 10m off the vegetation stands using a Hydrolab Surveyor II. Dissolved oxygen was also measured at a distance of 10m and 20m into the mats of *E. crassipes*. Indices of algal biomass (mg of chlorophyll-a per litre) were determined at Om, 10m, and 20m into the water weed as well as at 10m off the mat. Samples were taken from under the weed mat using a hand pump and the water was sieved to remove coarse debris. Filtration of algae was done on Whatman glass fibre filter paper and the chlorophyll extracted in 90% methanol. Chlorophyll-a was determined by Spectronic 601 Spectrophotometer.

Macrofauna sampling

Bottom samples for macrofauna assessment were collected using a Ponar Grab with a jaw size of $245.05cm^{-2}$; macro-invertebrates associated with water hyacinth roots were sifted from the material collected in quarter-metre square quadrat. Sorted macrofauna material for each sample was emptied in a black polythene bag and transported to the laboratory for further analyses. In the laboratory, samples were washed several times through a macrofauna sieve of 0.5mm mesh, all invertebrate organisms retained by the mesh size being regarded as macrofauna. All samples for dissolved oxygen, algal biomass and macrofauna assessment were taken in triplicate at each sampling point.

Fish sampling

Two habitats (shoreline patches dominated by either *C. papyrus* and *E. crassipes*) were systematically fished to compare the influence of the two vegetation types on the distribution and abundance of fish along the shoreline. Data on fish composition and abundance were collected using multi-mesh, multi-ply gill nets of sizes (25mm, 33, 37, 50, 60, 76, 90 up to 125mm i.e. - 1", 1.5", 2", 2.5", 3", 3.5", 4", 4.5", 5" stretched meshed) at 0.5 hanging ratio and 45m panel lengths. Each mesh size comprised of 2 nets. The full sets were arranged in alternating sizes with the 5" mesh set closest to the vegetation followed by 1", 4.5", 1.5" and so on till the 18^{th} net of 5". These nets were set one parallel to the next with an approximate distance of 1.0 - 1.5m in between, depending on weather conditions. The inshore distance fished was determined by tying a rope to shoreline vegetation and moving perpendicular to the shoreline till the last net was set. Fishing was done between 1800 hours and 600 hours, i.e. left overnight. A major assumption of the method was that immigration during the period of exposure equals emigration, and that 1.5m spacing was adequate space for fish and exposure to fish activity as was present during the periods that fish were assumed to be present or not.

Results

Change in vegetation cover

The dominant indigenous euhydrophytes in the experimental area in 1993 were the rooted *N. cearulea*, the floating *P. stratiotes* and the submerged *C. demersum* occasionally mixed with *Eutricularia sp*; these occurred in occasionally frequent patches (see Table 2), except in Thruston Bay where extensive patches of *C. demersum* covering several hectares adjacent to the wetlands were noted. At that time (1993), the occurrence of water hyacinth was rated occasional, being in small mats or as individual plants hidden among the emergent vegetation. By the end of 1994, virtually all the beds of indigenous euhydrophytes close to the shore had been smothered by a resident fringe of water hyacinth about 10 to 15m wide. A comparison of cover abundance of selected euhydrophytes, the introduced *E. crassipes* and the emergent macrophyte *V. cuspidata* is given in Table 2. Data indicate a dramatic increase of 60 and 200% in the cover of *V. cuspidata* and *E. crassipes*, respectively. Conversely, the cover index of the indigenous euhydrophytes declined drastically to near disappearance. The increase in cover abundance of *E. crassipes* over the 110km shoreline of the study area is also illustrated in Figure 2B.

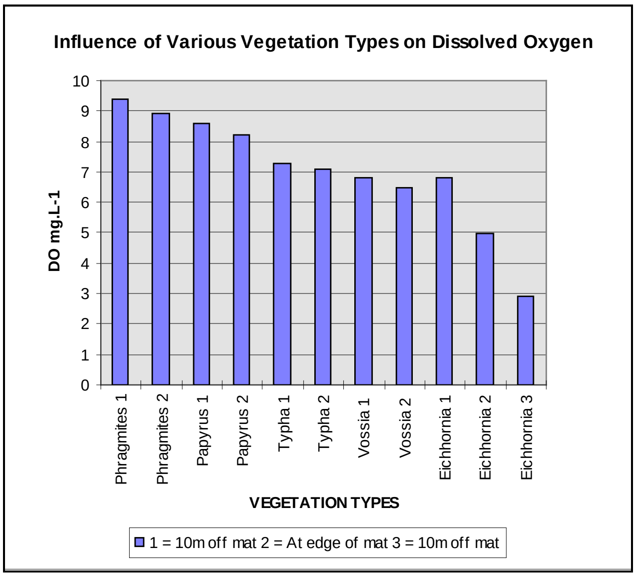
Table 2. Percentage Change (1993/1996) in cover abundance from the total score in 38 sites

Species:	1993 (cover score)	1996 (cover score)	% Change
Vossia cuspidata	52.6	83.5	58.6
Eichhornia crassipes	11.5	163.5	217.5

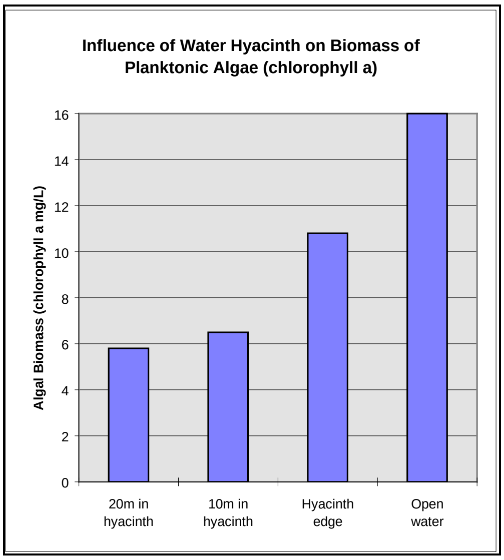
Pistia stratiotes	6.1	0.1	-98.4
Nymphaea caerulea	8.6	0.1	-99.9
Ceratophyllum	0.55	0.0	-100

Dissolved oxygen, algal biomass and macrofauna diversity

The influence of resident water hyacinth mats on dissolved oxygen regimes along the shores of various wetland macrophytes is illustrated in the figure at right.



Dissolved oxygen at the *E. crassipes* margin was lowest compared to records at the other three macrophytes; it was 61% of that recorded at the edge of *C. papyrus*, declining to less than 35% only 10m into the alien weed mat.



The next figure compares the biomass index of planktonic algae as chlorophyll-a determined at various distances from the lakeward edge of *E. crassipes*. The quantity of algae under the mat declined markedly with distance into the weed mat.

Preliminary data on diversity and distribution of macrofauna associated with the mat of *E. crassipes* at both sampling sites (Table 3) indicated a marked decline in diversity with distance from the lakeward edge of the weed. However, Coleoptera, chironomid larvae and *Caridina nilotica* were recovered as deep as 20m into the mat. The diversity of macrofauna in the sediments under *E. crassipes* was about 50% of that recovered in the weed mat although the location into the mat appeared to have no effect on macrofauna diversity at both sampling sites.

Table 3. Diversity and distribution of various macrofauna (Nos m^2)in the roots of *Eichhornia crassipes* and the sediments under the weed mats at two shoreline sites in northern Lake Victoria

	Among Hyacinth roots			**In sediments under hyacinth**			
	20m into	**10m** into	**mat** edge	**20m** into	**10m** into	**mat** edge	**Off edge** 10m
a. Kakira							
Hirudinea	0	32	160	0	0	37	0
Oligochaetae	0	0	16	37	37	74	37
Chironomidae	32	32	288	0	0	37	37
Ephemeroptera	0	16	1424	0	0	74	0
Odonata	0	96	80	0	0	0	0

Coleoptera	32	48	208	0	0	0	0
Hemiptera	0	0	16	0	0	0	0
Caridina (genus)	16	32	192	0	0	0	0
Gastropoda	52	66	99	22	46	162	114
Bivalvia	0	0	32	34	103	37	37
b. Kiryowa							
Hirudinea	0	32	32	0	0	0	0
Oligochaetae	0	48	0	37	37	37	0
Chironomidae	0	96	16	0	0	147	0
Ephemeroptera	0	0	16	0	0	0	37
Odonata	0	16	48	0	0	37	0
Coleoptera	32	32	16	0	0	0	0
Hemiptera	0	0	16	0	0	0	0
Caridina (genus)	0	0	16	0	0	0	0
Gastropoda	0	3	3	7	15	19	160
Bivalvia	0	15	0	0	35	94	182

Fish yield

Seasonal variations in fish yield harvested using a block of multimesh gill nets set against extensive stands of *C. papyrus* and *E. crassipes* for a one year cycle are compared in Figure 5. Fish yield from the papyrus fringe was at least twice that from in front of hyacinth during all the seasons except the July-September period, when the two yields were almost equal. It was assumed that the yields obtained using the block fishing method approximated fish biomass associated with the environment fished.

Discussion

The ecological character of a given environment may be described by the diversity, distribution and abundance of the biota in balance with the abiotic components of the environment which, in turn, have specific physical and chemical characteristics. Fundamental qualitative and quantitative changes in those environmental characteristics constitute change in the ecological character of the habitat. In this regard, the preliminary results of the experiments described in this paper, illustrating transformation of the shoreline wetland environments of northern Lake Victoria infested with *E. crassipes*, appear to constitute change in the ecological character of portions of the shoreline. Consequently, results from this study, when extrapolated to the extent of cover and biomass of resident *E. crassipes* along the shores of lakes Victoria and Kyoga (Table 4), and in other aquatic environments in Eastern Africa, illustrate the influence of infestation by the noxious weed on the ecology of shoreline environments.

Successional displacement of indigenous euhydrophytes

At the start of the experiments in 1993, cover abundance of *E. crassipes* was minimal and the weed was widely scuttered amongst emergent macrophytes along the shoreline. Native euhydrophytes in the wetland ecotones of the experimental zone were intact, dominated by *N. caerulea*, *P. stratiotes* and *C. demersum*. However, after about two years and, certainly, three years later, when a systematic vegetation survey was conducted in the same area, virtually all the beds of indigenous euhydrophytes close to the shore had been smothered by a resident fringe of *E. crassipes* about 10 to 15 m wide. While the resident weed did not cover the shores of all wetland patches, there appeared to be a striking similarity in the habitats preferred by native euhydrophytes and *E. crassipes* in the study period of only three years (Table 2).

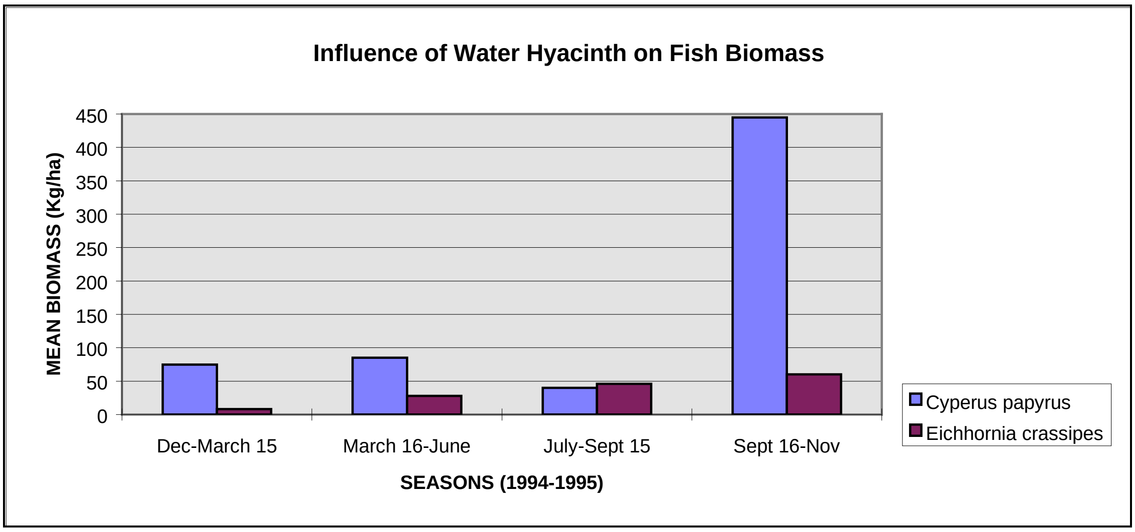
However, data from previous studies (Twongo et al, in prep.) and observations in this study indicate further transformation of pure stands of resident *E. crassipes* through macrophyte successions which probably changes aspects of the original ecological character even further. For instance, fundamental successional transformation in shoreline vegetation cover following invasion of Lake Kyoga and Lake Victoria by *E. crassipes* has been under way since 1992 (Twongo et al. 1992;): pure stands of the water weed in most shore environments of Lake Kyoga were invaded in succession by sedges, ferns and finally by *V. cuspidata* which often eventually overpowered the *E. crassipes* to extend large expanses of the emergent macrophyte into the lake. In Lake Victoria, on the other hand, the succession proceeds largely through direct colonization of *E. crassipes* by *V. cuspidata*, a process well illustrated in this study by the rapid increase in cover abundance of *V. cuspidata* over a period of about three years.

Impact on water quality, algal biomass and macrofauna diversity

The influence of cover by the biomass of *C. crassipes* on dissolved oxygen is clearly demonstrated in the figure above, where the effect of distance into the mat is shown. However, a more detailed demonstration of the impact of cover by the alien weed on water quality was given in an earlier study in northern Lake Victoria (Willoughby et al, 1993). Depressed pH and temperature regimes and the much lower percent oxygen saturation under *E. crassipes* indicate a changed water environment which would probably contribute to changes in other aspects of the ecological character of the environment under the resident weed. Though not comparative, the progressive decline in diversity of the macrofauna associated with the mats of *E. crassipes* at the weed edge, 10m and 20m from the open water (Table 3), probably illustrates response by the organisms to a changed environment. Further studies in this area would clarify on the impact of *E. crassipes* on the ecology of shoreline macrofauna.

Influence on fish biomass

While it is assumed that most fish species would not survive under resident mats of *E. crassipes* due to degraded environmental conditions of, for instance, very low dissolved oxygen, the assumption was not proven experimentally due to the difficulties of fishing in the habitat. However, fishing experiments through a full year cycle adjacent to stands of *C. papyrus* and *E. crassipes* showed a reduction of at least 50% (in three out of the four seasons of the study) in the biomass of fish in environments bordering the alien weed (see figure). Although the cause of the negative influence was not established, it is probably due to environmental impacts including change in abundance and availability of potential food resources for the fish.



Extent of change in ecological character

The results from experimental studies in northern Lake Victoria presented above indicate a transformation in the physical and chemical environment as well as in the diversity and distribution of the biotic resources in the study habitats. The observed transformations constitute a significant change in aspects of the ecological character along the shore. However, the implications of the observed changes are even more significant when considered in conjunction with information from earlier studies on the global distribution and areal cover of *E. crassipes* in Uganda (Twongo and Balirwa, 1995; Table 4; Twongo et al. in prep.).

Table 4. **Areal cover of mobile mats (June to July, 1995) and mean biomass of resident and mobile water hyacinth *Eichhornia crassipes* in the bays of Lake Victoria, Uganda, and Lake Kyoga.**

Location - Bay	**Weed Cover (ha)**	**Mean Biomass $kg.m^{-2}$**
Pringle	15	-
Macdonald	13	42.9
Hannington	96	58.8
Thruston	108	59.5
Fielding	6	57.3
Grant Bay	-	40.8
Buka	-	68.0
Bay of Kome Island	-	39.9
Inner Murchison	620	63.9
Entebbe Peninsular	257	-
Busi	-	59.6
Katonga	-	74.2
Kapiokolo (Kyoga)	-	80.2
Kyankole (Kyoga)	-	55.5
Zengebe (Kyoga)	-	62.8
Mean biomass rate:	56.5 $kg.m^{-2}$	i.e., 565 ton/ha

Total Areal cover*

	Lake Victoria-Uganda	Lake Kyoga
mobile	1,146 ha	**
resident	1,200 ha	574 ha

* Data from Twongo et al (in prep.)
** Mobile hyacinth on Lake Kyoga is often in small widely scuttered mats.

Extensive shoreline habitats such as those traditionally occupied by shoreline euhydrophytes and associated fauna in lakes and rivers in Uganda and elsewhere in eastern Africa already infested with the weed have been or would probably be smothered under cover of mats of the weed. Successional vegetation changes in lakes Victoria and Kyoga have driven the transformation even further by creating and facilitating the extension of semi-terrestrial environments into the lake environment. While the stability of such new habitats along the shores of large lakes is unclear, even doubtful, the process constitutes a definite change in the original ecological character of the impacted environments.

Conclusions

Ecological impacts due to invasion by water hyacinth *E. crassipes* in lakes and rivers are likely to be severe along the shoreline and could be accompanied by significant deleterious environmental transformations. Results from the study on the invasion of the shores of Lake Victoria by water hyacinth could be used to illustrate aspects of the concepts “ecological character” and “change in ecological character”. The study would serve as an illustration while defining the two concepts for use in broader context, in relation to Ramsar sites.

From an ecological point of view, the study illustrates the urgency of the need to control proliferation of water hyacinth in Eastern Africa.

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"Changes in Habitat Conditions and the Conservation of Mangroves in Asia"

Mohammed Zakir Hussain
Head, IUCN Regional Coordination Office, Bangkok, Thailand

Mangrove formations of different sizes occur in different countries in Asia from the Arabian Peninsula on the west to Japan in the east. Large areas of mangrove forests can be found in Pakistan, India, Bangladesh, Myanmar, Thailand, Vietnam, Malaysia, Cambodia, Philippines and Indonesia. Indonesia has the largest area of mangrove forest in the region, while the Sundarbans, located in the Gangetic delta in India and Bangladesh, is the largest single chunk of continuous mangrove forest in the world. About 46% of the mangrove forest of the world occur in Asia (Aksornkaoe, 1995).

Mangroves play an important role in the lives and economies particularly in the coastal regions of different countries in Asia. Mangroves yield timber, fuelwood, poles, thatching material, grass, honey, wax and industrial raw materials for cellulose-based industries. Mangroves are major sources of employment and income generation, and many coastal communities are principally dependent on mangrove. Mangrove waters are very rich in fishery resources and act as nurseries and spawning grounds for a large number of species of fish, molluscs and crustaceans. Mangrove forests are also very rich in biodiversity.

Mangroves grow in intertidal zones along coasts and estuaries in areas sheltered from strong tidal action and wind/sea storm. The occurrence and distribution of mangrove species are governed by parameters like temperature, wind, tidal range and frequency, availability of fresh water, soil type, terrain and salinity. On a local scale, factors like salinity, temperature, frequency and duration of tides, topography, sedimentation, and freshwater influx and light regime interact to produce the environmental settings for the growth, zonation and sustainability of mangrove.

The mangrove ecosystem is a very dynamic one, where changes are taking place regularly, and within the range of mangrove habitats most major species grow within a given set of conditions. Any major changes in these conditions may start to bring about changes in the growth pattern of different species, a complete elimination of one or more species resulting from changes in the composition of the forests, or in extreme cases a complete disappearance of the forest. Because of this severe sensitivity to change in habitat conditions, mangrove forests are very susceptible to destruction.

Causes of changes in mangrove habitat conditions

Changes in mangrove habitat conditions may occur because of natural as well as human-induced factors. Both natural and human-induced factors may bring about extensive changes in the habitat conditions, resulting in far-reaching environmental and ecological consequences.

Fresh water supply. Mangrove species can thrive well in conditions where there is a steady infusion of fresh water. Any reduction in the supply of fresh water results in an increase in salinity, thereby restricting the growth of mangrove species. Shifting of the course of a river, siltation or complete drying of rivers can result in reduction or complete stoppage of fresh water supply to the mangroves, causing serious changes in the conditions for growth of different species. The shifting of the main course of the river Ganges eastward over the past few centuries and the silting up of some smaller rivers feeding fresh water to Western Sundarbans have caused a major reduction in fresh water supply to the western portion of the Sundarbans, and this has not only influenced change in the composition of the vegetation but has also been responsible for stunted trees with shorter branches, thicker and smaller leaves (Rao, 1987).

Increase in harvesting and dimension of water from most rivers in the region is resulting in a steadily decreasing flow of fresh water to coastal areas, particularly in the drier months. This problem is becoming acute in the cases of rivers like the Ganges, Mekong and Indus. The impact of decreased flow of fresh water into the mangroves of the deltas of these rivers has become quite clear.

Siltation and raising of a riverbeds and forest floor. The siltation of river beds by waterborne particles often decreases the water-carrying capacities of rivers, causing a lesser supply of fresh water in lower riparian areas. The natural process of deposition of silt on forest floors results in a rise of the forest floor. Thus at one stage the forest floor may rise above all or most high tide levels. In the absence of flushing of the forest floor by tidal water, the habitat conditions change and new species may start establishing themselves. This is quite pronounced in parts of Irrawwaddi Delta in Myanmar.

The siltation rate increases when water carries more silt from denuded catchment areas of other disturbed areas, including mangroves areas which have been converted to shrimp ponds, agricultural land or areas which have been mined.

Through a process of natural development of sites and siltation of forest floor over a long period of time, some sites attain heights which are above high tide level. In such cases, soil undergoes gradual changes and non-mangrove species colonize such sites.

Reclamation of mangrove land. Reclamation of mangrove land for agriculture, aquaculture, horticulture urbanization, human settlement, establishment of port and industries salt production, etc., has been continuing for a long time.

Agriculture. In the past, the largest area of mangrove has been reclaimed for agricultural production and the associated human settlements. The Sundarbans in India and Bangladesh, for example, was more than twice its current size at the advent of the British rule less than two and a half centuries ago (Curtis, 1933). Similar reduction in the areas under mangrove has taken place in most countries in the region. In the last few decades the transmigration of people in Indonesia and resettlement of people from densely populated areas in Vietnam have resulted in the reclamation of large areas of mangrove forest.

Mangrove forest land has also been reclaimed for horticulture, particularly coconut and oil palm plantations in countries like Sri Lanka and Malaysia. Efforts have also been made to raise other cash crops in mangrove areas with very limited success.

Salt is produced in countries in the region by impounding sea water in salt pans and allowing the water to evaporate under sunlight, so that a deposition of salt is left behind. Mangrove lands are often converted into salt pans as can be seen in many countries in the region.

Aquaculture. Conversion of mangrove forest land into shrimp ponds has become common in most countries in the region. The situation has become very serious in Thailand, Cambodia, Sri Lanka and Bangladesh. The area under mangrove forest in Thailand has shrunk from 367,900 ha in 1961 to 168,682 ha in 1994 (Kongsanchai, 1995) primarily because of the conversion of mangrove forest into shrimp ponds. Likewise, the area under mangrove forest in Vietnam is reported to have shrunk from 250,000 ha in 1943 to about 50,000 ha in 1995 (Hussain, 1995), with most of the cleared forest land being brought under shrimp cultivation. Shrimp pond construction not only strips away the vegetation cover, exposing large areas of soil to erosion and oxidation, but dramatically alters water drainage patterns, as water supply and drainage canals are dug to service producers who are developing areas several hundred meters from the shoreline (Flaherty and Karnjanakesorn, 1995). Tambak Sari, a traditional fish-mangrove production system, has also been in practice in reclaimed land in Indonesia for a long time (Soemodihardjo and Soeiarta, 1995). However, under the system the main emphasis is on fish production and the mangroves are marginal.

Urbanization. With an increase in population, particularly in coastal cities, mangrove lands have been reclaimed and appropriated for the expansion of cities/towns. Many cities, including Singapore, Karachi, Bombay and Calcutta, have extended into mangrove areas. In tourist resort areas, mangroves have often been cleared to make room for the establishment of tourist facilities. Smaller cities like Port Klang and Kuala in Malaysia have been established in areas after clearing mangrove vegetation (Chan & Ng, 1985). Industrial development in mangrove areas has been taking place in the region. A number of ports and harbours have also been established in mangrove areas in countries like India, Bangladesh, Thailand, Malaysia and Cambodia.

Mining. Tin mining has been responsible for the destruction of large mangrove areas in Thailand. In addition to the earth work that is carried out during mining, which causes erosion in the mined area and siltation in other nearby areas, the mining results in serious deterioration in the habitat condition which occurs because of the complete removal of the topsoil and the nutrients contained in that layer.

Waste disposal and pollution. Domestic and industrial wastes are also discharged or disposed in mangrove areas in different countries. This may result in the degradation or loss of mangroves and, in addition, toxic leachates from the garbage and solid waste can find their way into the downstream ecosystem, causing extensive damage and health hazard. Chemicals from agricultural fields and nutrients and chemicals from shrimp ponds also cause serious harm to the environment.

Oil spills, large and small, cause damage to the mangrove ecosystem. Oil deposition on aerial roots which function as "breathing roots" may reduce oxygen diffusion to the underground root system which depends on the aerial roots for oxygen supply. Oil in the sediments may also damage roots and so interfere with the ultrafiltration process which the mangroves use to desalinize saline water for its use (Baker, 1983).

Natural disasters. Natural calamities like cyclones and typhoons have caused extensive damage to mangroves in countries like India, Bangladesh, Myanmar and the Philippines. Pests and diseases have also caused damages to mangrove forests, but these are not very significant.

Improper management. Improper management practices, as well as over-exploitation of mangrove, has been another major cause of degradation and destruction of mangroves. Large-scale harvest of mangroves for timber and fuelwood over ages and, in recent years, the large-scale charcoal manufacture and harvest of mangrove species for export to Japan and Taiwan for the rayon industry, have added a new dimension to the on-going process of destruction of mangroves.

Ecological Implications of destruction/depletion of mangrove resources

Acidification of soil. As has already been mentioned, the largest areas of mangrove forests have been reclaimed for agriculture/aquaculture production and human settlements, both urban and rural. However, the experience in the case of forests which have been reclaimed for agriculture and aquaculture has been far from satisfactory. In the case of agriculture, particularly paddy crop production, the level of production has been low from the beginning, and often after a few years the level of production reaches such a low level that it was not economically viable to continue the practice. The experience in the case of shrimp farming has been similar. The production of shrimps continues to decrease until within a span of 3-6 years the yield reaches such a low level that the endeavour does not remain economically viable.

Mangrove soils developed from sea water sediments contain high sulphides which occur in the form of iron sulphide (FeS) and pyrites (FeS_2). A high amount of sulphidic material in the soil can be obtained if sulphate from the sea water is reduced by microorganisms which depend on organic matter in the soil for their energy. Drainage of mangrove soil for agricultural purposes and the exposure of the pyretic sediments during excavation of ponds lead to their oxidation, resulting in the formation of sulphuric acid which is released in the soil, thereby increasing the acidity of the soil, and in such cases pH may drop below 3.0. Under conditions of severe acidity, solubility of aluminium, iron and manganese increases and this may cause phytotoxicity. Aluminium can be phytotoxic in concentrations as low as 1 to 2 ppm and is considered to be a most important growth limiting factor for plants in strongly acid soils (Musali and Smide, 1994). This creates a situation where the substrate becomes toxic to the growth of any organism. At low pH the availability of nutrients also decreases greatly and important nutrients become unavailable to plants, and as a result, soil fertility is greatly reduced.

It may be mentioned here that these acid sulphate soils are produced under conditions where drainage or exposure helps in the process of the oxidation of pyrites into sulphuric acids. The acidification normally does not occur under natural conditions, primarily because of the lack of scope for oxidation.

Acid sulphate soils with low pH are toxic to the growth of both plants and animals, and most plants and animals, invertebrates and fish die at high levels of acidity. At moderate levels of acidity, the rate of growth of plants and production of fish and other organisms are substantially reduced. In case of reclaimed rice fields, the production of rice decreases gradually with each crop while acidity steadily increases. The same is true in the case of fish and shrimp ponds, where with increased acidity the production level falls steadily. At some point soon the agriculture/aquaculture practices do not remain viable and are abandoned, because of unfavourable growing conditions created by the toxicity. As strongly acid sulphate soil is unable to support any vegetation, the barren soil becomes highly degraded and is prone to erosion.

Change in the composition of vegetation

Most mangrove species grow within narrow range of habitat conditions. Any major change in the habitat conditions may result in change in species composition. The mangroves in the Indus delta originally included a number of species, including *Rhizophora mucronata, Ceriops tagal, Bruguiera conjugata, Aegiceras corniculatum* and *Avicennia marina.* Most of these species except *A. marina*, which can grow in strongly saline condition, have become rare or have disappeared completely, and this change in species composition is often attributed to the change in habitat condition. Selective over-exploitation of some species has also contributed to the disappearance of some species (Meynell and Quraishi, 1993).

The shifting of the main flow of the Ganges eastward has cut off the main source of supply of fresh water to the western portion of the forest, resulting in the loss of growth or vigour or disappearance of species like *Heritiera fomes* from most of the western Sundarbans. This species is still the predominant species in the freshwater zones in the eastern Sundarbans (Karim, 1988), but the species has become very rare in the western portion of the forest, and whenever it is present the growth is very stunted.

The degree of exposure of the forest floor during harvesting also brings about changes in the composition of the vegetation. Drastic opening in the case of plants which are more shade-loving in early stages of establishment often results in the occupation of the site by more light-demanding species. In the eastern Sundarbans, the predominant species *H. fomes* is often replaced by other more light-demanding species in areas where the tree crop has been destroyed by natural calamity or some forestry has been undertaken for timber storage or temporary accommodation construction.

In abandoned tin-mined areas in Thailand, the naturally regenerated mangrove species consisted predominantly of *Avicennia* in areas which were under *Rhizophora* before the mining operation was initiated (Aksornkoae, Personal Comm.), while in the areas where *Rhizophora-Bruguiera* forest in Southern Vietnam were destroyed during the Vietnam War, the colonizing tree vegetation consisted mainly of *Avicennia* species. In drier areas, *Phoenix Paludosa* and *Acrostichum aureum* were more common in Southern Vietnam (Hong, 1991). In raised mangrove forests in the Irrawwaddi Delta in Myanmar, which receive very limited inundation, *Phoenix Paludosa* has become a very dominant species.

Rehabilitation. It is almost impossible to rehabilitate a completely destroyed mangrove forest to its original condition. The changes that the ecosystem undergoes and the absence of the conditions under which mangroves can readily flourish make any quick rehabilitation of forests to its original state impossible. However, some efforts have been made in countries like Malaysia, Philippines, Vietnam, Indonesia, Bangladesh and India and some good results have been obtained.

Reforestation. As a quick fix, efforts have been made to establish plantations, and a different degree of success has been achieved. In most countries in the region, the practices for reforestation with mangrove species have been standardized and are successfully implemented in sites which have not been too badly degraded. Establishment of plantations with desirable species which produce long tapering propagules have been difficult, particularly in cases where soil has become badly desiccated and hard and similarly, in areas where pan formation has taken place below the soil surface, the establishment of species which have long roots has been difficult. In such areas, a two step approach is required, with the establishment of plantation first with species like *Sonneratia* and *Avicennia* which spread roots closer to the soil surface and are not deep rooted. The establishment of these species results in covering of the area and the presence of plants accelerates the process of silt deposition and better moisture retention. This helps the improvement of the site and leaching out of some acid which, depending on the condition of the site, can take several years. Thus once a mud substrate of reasonable thickness has been developed, more desirable species which were present in the original crop can be introduced successfully. The original species can also re-establish themselves naturally, but the process may take a long time. The restoration of original vegetation, however, does not mean that the ecosystem has been restored to its original state, because with the destruction of the forest cover, other components of the ecosystem are very adversely effected and may disappear permanently.

The success of plantation establishment on degraded land depends on several factors. However, areas where the clear filling of vegetation has taken place and the land has not been used for agriculture or aquaculture, the sites seem to respond better to the efforts to establish plantations primarily because of the prevailing better habitat conditions.

In the sites which have not been completely degraded and denuded of top soil, protection for several years results in the regeneration of different species. The composition of species in such sites depends on the suitability of the site for different species and in the initial stages may not contain species which are thought to be desirable economically and ecologically. Enrichment planting with such species can be useful, once the condition of the site has improved.

Succession. The process of secondary succession in different areas is complex, depending on the composition, structure of the plant community, and the extent of human impacts in the area, and the main factors affecting the regenerative process are inundation level, characteristics of soil substrate, availability of seed and the level of biotic interference (Hong & San, 1994).

In the mangrove forests in Vietnam which were destroyed by herbicides during the second Indo-China War, where *Avicennia alba* regenerated in areas which were previously occupied by *Rhizophora, Ceriops decandra* was established as an understory after several years. *Rhizophora Mucronata* has already started establishing themselves on the mud flats, which might replace the *A. Alba* as the predominant species in the due course of time. The process of succession has continued without any problem in newly accreted mud flats adjoining the destroyed mangrove forest.

In mined mangrove forests in Thailand, the process of secondary succession has been slow to establish and the composition of species has been limited to only a few. Aksornkoae and Saraya (1987) reported that they observed 34 mangrove species in a undisturbed mangrove area near a mined forest which was supporting only three species. The growth of these species were also observed to be far from satisfactory.

In the Bangladesh portion of the Sundarbans, secondary succession in disturbed areas seems to exclude *Heritiera fomes,* which is the predominant species in the freshwater zone, and is mainly composed of species like *Avicennia officinalis* and *Excoecaria agallocha.*

Conservation of mangrove. Harvest and utilization of mangrove resources have been in practice, particularly in Asia, for a very long time. In old days very little attention was given to the conservation and sustainable management of mangrove resources. This, however, was not unique as all forest formations were treated similarly. As communities are dependent on mangrove forests for a vast array of goods and services, it is not possible to impose a moratorium on harvest of mangrove resources by mangrove-dependent communities. Under the circumstances, sustainable management of mangroves offers the best scope for the conservation of mangrove resources.

Sustainable management

The scientific management and, thereby, conservation of mangroves in Asia was initiated in British India almost at the same time when all other important forest formations were brought under administrative and scientific management in the country during the last century, and as a result, mangrove forest like the Sundarbans has been under scientific management for more than 125 years.

The major mangrove forests of South and Southeast Asia can be divided into two broad groups. The mangroves of South Asia are dominated by non-rhizophore species while that of Southeast Asia is dominated by members of the family *Rhizophoraceae*. The silvicultural requirement of these two groups of species are different and as a result, two different sets of management regimes have been developed and successfully implemented, resulting in the sustainability of the vegetation for decades.

In the Sundarbans, a management regime has been developed and implemented for the past 100 years. Under this regime, one twentieth of the forest is harvested each year. All trees above a certain predetermined diameter are removed as long as such removals do not create any permanent gaps in the canopy. Once the timber harvest is completed, an improvement felling is undertaken to remove all diseased, dead and deformed trees as well as any congestion in the tree crops. Under this selection-cum-improvement system, each section of the forest is harvested once in each 20 years and a result, forest is allowed to grow without any disturbances for 20 years at a time (Hussain and Ahmed, 1994). A portion of the Sundarbans has been set aside as protected area where no harvest is permitted. This allows *in situ* conservation of ecosystem of part of the Sundarbans and this is practiced in both India and Bangladesh (Chaudhuri & Chaudhury, 1994; Ali, 1994).

In the southeast Asian countries, a clear felling system has been more successful in the case of forests consisting predominantly of members of the family *Rhizophoraceae*. In Thailand a system of clear felling in alternate strips has been standardized and the forest is divided into 30 strips. Alternate strips are cut once in 15 years, giving a rotation of 30 years (FAO, 1985). In Matang, Malaysia, a system of clear felling with the retention of standards is being practiced. The practice involves the retention of a small number of trees per hectare when all trees except very small ones are removed. The forest is currently worked on a 30-year rotation with two intermediate thinnings. Enrichment planting is also undertaken wherever necessary to augment natural regeneration (Hasan, 1981). A system of clear felling with artificial regeneration has also been successfully implemented in Vietnam, Thailand and some other countries in the region.

Technology is now available for the sustainable management and conservation of mangrove forests in Asia. The systems described above can be used successfully in different types of mangrove forest formations which have different silvicultural requirements. It may be mentioned here that the Sundarbans and Matang forests are being managed sustainability from 1890 and 1920 respectively (Hussain, 1985), and the forests are still in very satisfactory condition.

The main problem for the conservation of mangroves in Asia is not the lack of technology/knowledge of how mangroves should be treated to ensure sustainable management and conservation of the forest formation. It has been proved beyond all doubts that the management systems which have been developed in Asia are adequate. There is enough understanding and knowledge of mangroves available in the region, and many countries have the required institutional capacities for management, while in others it is not difficult to improve management capabilities.

Government policy and regulations

The main problem. however, is the lack of adequate initiatives in different countries to ensure the conservation of mangroves. In these countries the opportunities of short-term large-scale benefits have prevailed over not-so-large long-term sustainable gains. In many countries, the conversion of mangroves into other land uses has been encouraged as matter of policy and practice by respective governments. At the same time, policy and regulations have been formulated in some such countries (ITTO, 1993). The implementation of these policies and regulations would have ensured a much better conservation of mangrove resources in these countries.

In addition to formulation of policy and regulations which will help in the conservation of mangrove resources, it is important that different countries ensure that the existing regulations and policies aimed at the conservation of mangrove resources are implemented, identify mangrove resources as an important ecosystem which needs to be preserved, and follow this up with appropriate actions which, in reality, will result in conservation of mangrove resources.

Conclusion

Mangroves provide extensive goods and services. In addition to the ecological implications, the destruction of mangroves causes serious environmental and socio-economic problems. The erosion from mining areas, as well as the nutrients and other chemicals from shrimp ponds and agricultural land, etc., could have very adverse effects on the quality of water in surrounding localities and as a consequence have very adverse effects on a large number of organisms which use mangrove forests for shelter, spawning and nurseries.

For ages, coastal communities have been dependent on mangroves for food, income generation and protection from sea storms. The destruction of mangroves directly affects their lives and, in addition, the loss of mangroves has a serious adverse impact on the productivity of inshore and nearshore fishery, on which large coastal communities are dependent for a livelihood.

Mangrove ecosystems support a wide variety of plants and animals, and the destruction of the forest eliminates habitats for many endangered and threatened species and has serious impact on the biotic diversity of an area.

It is very important that adequate steps are taken for the conservation of the remaining mangrove forests in Asia and elsewhere. This will require strong will on the part of the government to curb the greed of a small section of people, implement the existing policies, guidelines and legislation and where necessary formulate and implement them, raise awareness about the importance of the conservation of mangrove and help foresters and mangrove-dependent communities to manage mangrove forests sustainability.

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"Wetland Management and Restoration Practices at the Kiskunság National Park, Hungary"

Zoltán Vajda
Head of the Nature Conservation Department
Kiskunság National Park, Hungary

"Change in ecological character": Is it a result of the natural processes, or a result of technological developments, pollution, or other human interference, or both? Sometimes it is very difficult to determinate which were, or are, the key factors of the change.

One of the best examples **change in ecological character** where both natural and unnatural factors contribute to the processes is the fate of the East European natron lakes. Most of these lakes are situated in Hungary, between the two main rivers the Danube and Tisza.

The natron lakes in the Danube-Tisza Interfluve Area developed through two different natural processes. The natron lakes found in the sand ridges were formed by the wind through deflation. In this process the sand was blown away from the clay strata at the foot of the dunes, and here the water from precipitation was retained. Those in the Danube Valley originate primarily from the Danube. During the floods, the river would leave large deposits of water on the floodplains, and in the deeper deposits the water would remain after the river returned to its original bed.

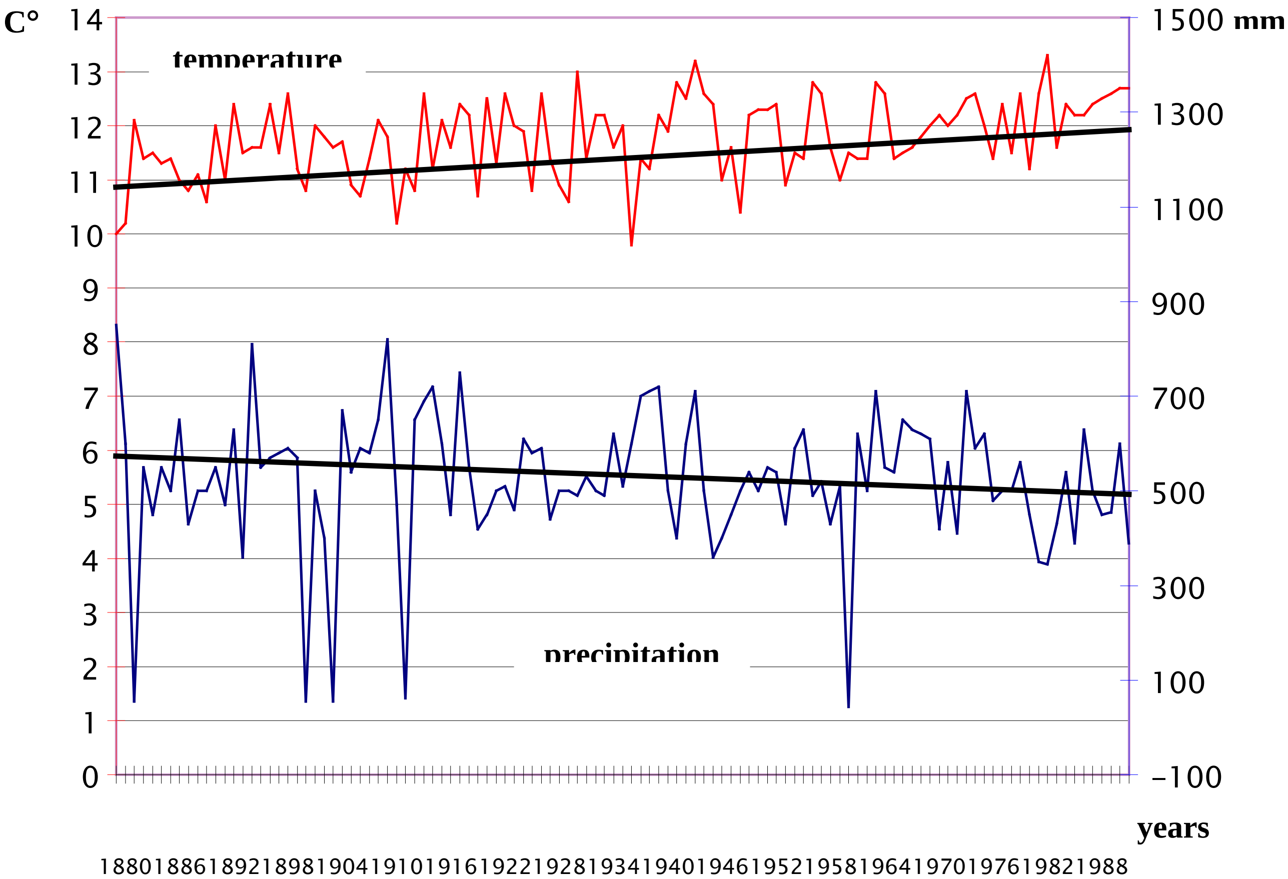
This yearly cycle of flooding changed, however, due to human interference after the big river regulations were carried out at the end of the last century. The cycle of these lakes then became similar to the natural cycle of the lakes found in the sand ridges. The natural cycle for the lakes in both areas is now a result of the fact that they do not have either inlets nor outlets. The water is provided only by autumn, winter, and spring precipitation and high salt content groundwater seepage. During the very arid and hot summers, they lose their water, partially or totally drying out. A process of sodification started, induced by the evaporation which is much higher than the amount of precipitation (average evaporation is 1100 mm/yr., precipitation 500-650 mm/yr.). These are shallow lakes (average depth 25 cm), so given the amount of evaporation a large amount of their water evaporates quite easily.

This cycle of filling up and drying out has led to the forming of salt deposits on the soil surface and the upper layer of soil due to the high salt content of the groundwater. This in turn makes the water in the lakes highly saline (e.g. average pH between 10-11, and salinity of 15-32.000 mg/l in summer). Due to this cycle, this habitat now maintains special and very fragile wildlife communities.

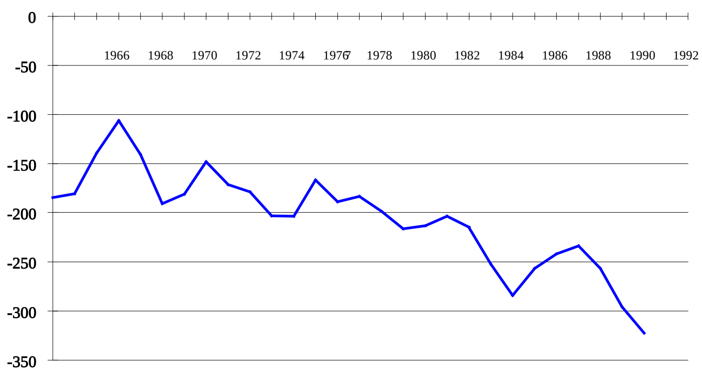
These natron lakes can also turn into salt-affected temporary wetlands and marshes due to the process of eutrophication. The eutrophication of these lakes is thought to be a natural process, but it is also thought that the process has been greatly accelerated by increased inorganic pollution of the surrounding areas caused by human influences. Most of these natron lakes, however, have dried out in the last 15 years, a process which once again may be caused by events that are natural, unnatural, or a combination of the two.

The reason for the disappearing of these lakes has been attributed to two main causes. One is the changing annual precipitation in parallel with the increasing average temperature which is shown in the graph below.

The variation of temperature and precipitation since 1880 in Duna-Tisza interfluve area



The diagram clearly shows that the average yearly precipitation has been going down, while the average temperature has been going higher and higher. It is uncertain whether this drop in precipitation is normal variability in the long-term precipitation cycle for this region or a result of climate change due to increased pollution and possible "Greenhouse" effects.



Ground water level change in the Duna-Tisza interfluve area /Kerekegyhaza/

The second reason for the disappearing of these lakes is extensive drainage. In the past 60 years approx. 2500 km of canals have been established in the region. As a result of this "well designed" canal system most of the inland water flows away very rapidly.

The natural processes coupled with human interference (e.g. extensive use of the water-table for irrigation) has resulted in the water-table dropping 0.5 to 6 m in the last decade, creating a severe lack of water.

Due to the water-table dropping, the forming of the salt layer on the soil surface has stopped. The results are the following: 1) a change in the natural vegetation composition (decreases in the population size of the halophytic species), and 2) encroachment of invasive plant species (e.g. seebrush *Bolboschoenus maritimus*)

The management problems of the protected areas are the following:

- Drying out of the wetlands due to extensive drainage and drought.

- The lack of a proper water-government system on most sites in order to maintain the required water-quantity and quality for each wetland.
- Succession due to lack of water has created unfavourable changes which now require active management.
- A decrease in the population of important species.
- Disappearance of proper habitats for migratory birds.
- Encroachment of invasive species (e.g. *Bolboschoenus maritimus*).
- Lack of proper biodiversity monitoring.
- The lack of aerial photographs from every 3-5 years, to monitor successional and hydrological changes.

The problems which have been presented clearly show that something must be done to stop this process of change. This need for action is further supported by the fact that the total area of open water in the region has dramatically decreased over the past 50 years.

Change in the area of the lakes in the Duna-Tisza interfluve area			
Year:	**1913**	**1970**	**1995**
Area /ha/:	**30.000**	**15.000**	**<5000**

In addition, the number of natron lakes in the region has also dramatically decreased over the past 15 years.

Number of the natron lakes in the Duna-Tisza interfluve area		
Year:	**1970**	**1995**
#	**63**	**14**

The natron lakes of the sand ridges have completely disappeared and, due to the geographical location of these former lakes, the only way they can be restored is with an increase in the amount of precipitation in this region.

Of outstanding importance are the natron lakes and marshes. On the edge of these areas nest the species of a special breeding bird community: avocet, black-winged stilt, and kentish plover. The open water found at these water bodies also assure roosting and feeding areas for numerous migratory birds on passage (geese, ducks, and waders).

In the Danube Valley are found the last remnants of the natron lakes. Below is a case study of two of these natron water-bodies: **Lake Kelemen**, which is one of the last typical natron lakes, and **Lake Fehér**, a natron swamp.

Objectives of the management practice for these natron water bodies:

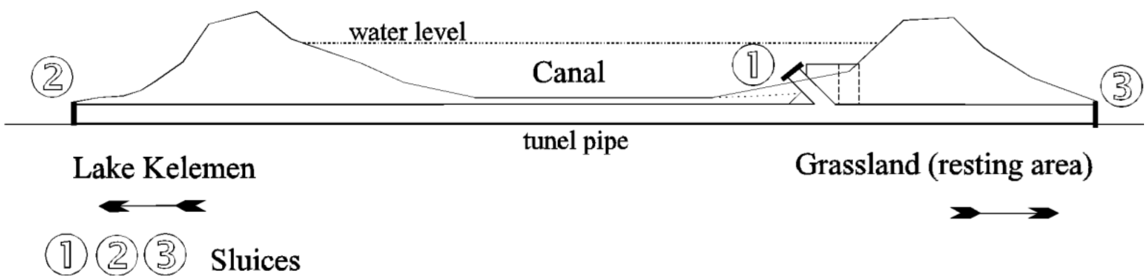
- To manipulate the water level of Lake Kelemen to assure the breeding success of the avifauna.
- To re-create Lake Fehér to assure breeding areas for several rare birds and invertebrate species (bittern, grey-lag goose, marsh harrier, and dragonflies).

The method we adopted to carry out these management objectives was to create a water governing system utilizing a canal found on the site. The canal was built for an artificial fish pond planned well before the park was established, but never carried out. We planned on using the water from this canal to fill both Lake Fehér and Lake Kelemen.

The need to use the canal water to fill these lakes can be understood when the properties of a saline lake and the present climate conditions of Hungary are taken into account. The evaporation rate of a saline lake is 200 mm per month during the summer (a large body of water in a windy, very hot, arid climate). This high evaporation rate coupled with rainfalls below the 450 mm average (384 mm in 1994), and a water table that has dropped 2 to 3 meters in the last decade, have created a severe lack of water. The use of the canal water is necessary to maintain this aquatic habitat.

The key to the use of the canal is the fact that its bed is at a higher altitude than the surrounding area. The water can flow into the lake by gravity, no pumping is required. The water in the canal, however, having originated from the Danube, is chemically different than that of the natron lakes, and has some fertilizer and chemical content. It was necessary to take this fact into account when designing our management plan for the two lakes.

Lake Kelemen has maintained its distinct qualities as a natron lake, despite the drought conditions. The micro-flora and fauna that inhabit the lake, and form the base of its ecological web, would not adhere to a change in the chemical properties of the water. Therefore, it was essential that we design a management plan that would utilize the water resources of the canal in such a way that the chemical properties of the lake were not dramatically altered. Below is a diagram showing a cross-section of the canal with the system of sluices that was developed for releasing water into the lake.



OPERATION/ SLUICE NUMBER	1	2	3
Direct refillment	open	open	closed
Filling of the resting area	open	closed	open
Filling of the lake with rested water	closed	open	open

In years with favourable weather (good winter and spring precipitation, with some rain in summer), the manipulation of the water-level might not be necessary. In years with unfavourable conditions and a situation that isn't proper for the avifauna, two solutions exist:

a.*) Rapid refilling of the lake directly from the canal.*
This situation is only a security system. It is used when small quantities of water must be added such as when the nestlings of birds need several more days before fledging and moving to another feeding area.

b.) *Refilling with rested water.*
The water from the canal can be "rested" on a section of saline grassland which is separated from the lake by the canal itself on the northern side. The water is drained from the canal onto the grassland and allowed to rest there for at least two weeks. This resting period lowers the eutrophic level of the water and assures a salt-exchange which results in water that is chemically closer to that of the lake itself. This rested water can then be let into Lake Kelemen through the tunnel pipe that runs below the canal (see diagram).

The situation with **Lake Fehér** is different. It was once a small natron lake nearly completely covered by vegetation (mostly reeds and Bolboschoenus) due to the accelerated eutrophication. This lake, however, dried out completely in 1982. Thus, the aquatic micro-flora and fauna have been lost at this site for over a decade. Therefore, water from the canal would not endanger the properties of this habitat and would in fact create a new wetland area with less saline water. We felt the creation of a new wetland habitat at this site would be of great benefit to the wildlife of this region.

At Lake Fehér intensive management is required involving manipulation of the water level and vegetation control. The changing of the water level has simulated the natural cycling of the water in the natron lakes.

The vegetation around the lake (mostly Bolboschoenus maritimi) must be mowed during the summer dry period (end of August) and transported out in order to reduce eutrophication and stop succession. Therefore, after July 1st, further inputs of water are not desirable in order for the harvest of vegetation to take place. In early September the refilling of the lake starts again to assure proper feeding and resting areas for migratory birds. The reed-bed occupying the middle area of the lake should be cut during the winter frosts, but two irregularly shaped patches of old reed (each of approx. 1 ha) must be maintained to maintain breeding areas for geese and herons.

Monitoring of the results

The results of the management practice were assessed by bird-counts done by the officers of the National Park and members of the Hungarian Ornithological Society. The initial surveys were part of studies conducted which led to the distinction of this area as an Important Bird Area. This data was used as our baseline to measure the success of the project. After the manipulation of the water level in the lake in 1993 and 1994, additional surveys were conducted. The following chart shows the results of these surveys, listing the occurrence of the most important bird species for the region before (IBA), and after (1993-94) the manipulation of the water level.

BIRD SPECIES **BREEDING SPECIES (pairs)**	**IBA (**1)	**1993**	**1994**
Bittern (Botaurus stellaris)	-	4-5	4-5
Little crake (Porzana prava)	-	2-3	2-3
Ferruginous duck (Aythya nyroca)	5	2	4
Marsh harrier (Circus aeruginosus)	4	3	2
Kentish plover (Charadrius alexandrinus)	-	0	2
Stone curlew (Burchinus oedicnemus)	2	1	0
Black-winged stilt (Himantopus himantopus)	-	0	18
Avocet (Recurvirostra avocetta)	14	5	110
Black-tailed godwit (Limosa limosa)	40-50	14	11
Lapwing (Vanellus vanellus)	-	50	60
Redshenk (Tringa totanus)	-	15	20
Grey-lag goose (Anser anser)	-	20	25
Mediterranean gull (Larus melanocephalus)	1-5	10	16
Black-headed gull (Larus ridibundus)	1500-2000	2000	4000
Whiskered tern (Chlidonias hybrida)	-	0	28
Common tern (Sterna hirundo)	4	5	11
Red-necked grebe (Podiceps griseigena)	-	0	1
MIGRATION (individuals)+			
Grey-lag goose (Anser anser)	-	200 a	500 a
Great white egret (Egretta alba)	25 a	10 s	32 s
Bean goose (Anser fabalis)	2000-3000 s	150	400 s
Whitefronted goose (Anser albifrons)	1000-2000 s	3000	12000 s
Mallard (Anas plathyrhynchos)	10000 s	2000 a	5000 a
Ferruginous duck (Aythya nyroca)	45 a	5 s	12 s
Marsh harrier (Circus aeruginosus)	15 a	15-20 a	15-20 a
Black-tailed godwit (Limosa limosa)	200-250 s	200 July	600 July
Black-necked grebe (Podiceps nigricollis)	-	5 s	156 s
Red-breasted goose (Branta ruficollis)	-	0	12 s
Golden plover (Pluvialis apricaria)	-		230 s

(+ : s = spring, a = autumn period)

The IBA data refers to bird data for the entire area that was collected before 1989, and the bird counts from 1993 and 1994 consider only the managed site.

The project brought excellent results. The bird populations on the site were significantly increased. There was also a positive effect on other fauna and vegetation found at the lakes. The system required a reasonable initial investment and has low maintenance costs. The results of this project are constantly monitored by Park staff and members of the Ornithological Society.