AGREEMENT ON THE CONSERVATION OF AFRICAN-EURASIAN MIGRATORY WATERBIRDS

Doc: AEWA/MOP Inf. 5.4
Agenda item: 24
Original: English

Date: 27 March 2012

5th SESSION OF THE MEETING OF THE PARTIES

14 – 18 May 2012, La Rochelle, France
"Migratory waterbirds and people - sharing wetlands"

SUMMARY, SYNTHESIS AND REPORT OF PROJECT COORDINATION: REHABILITATION OF IMPORTANT MIGRATORY WATERBIRD SITES WHICH HAVE BEEN DEGRADED BY INVASIVE AQUATIC WEEDS

A large number of wetlands (including many of international importance to migratory waterbirds), particularly in tropical Africa, have been degraded by invasions of species of aquatic weeds. Such weed infestations greatly affect the ecological character of these wetlands. The impacts on migratory waterbirds may occur either through the direct removal or alteration of their habitats, or by effects on the food chain.

In addition to the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), the Convention on Biological Diversity (CBD), the Ramsar Convention, and the Convention on the Conservation of Migratory Species of Wild Animals (CMS) have all given a high priority to the issue of invasive species of aquatic weeds. The International Union for Conservation of Nature (IUCN) has also been strongly involved in this issue worldwide and in Africa.

This report describes work done under a contract with the UNEP/AEWA Secretariat, which has been co-funded by the Government of the United Kingdom, and administered by the IUCN Environmental Law Centre (ELC). The work was undertaken by IUCN's East African Regional Programme (EARP) and IUCN's Regional Office for Southern Africa (ROSA), each of which examined and assessed the impact of aquatic weed problems on migratory waterbirds in a particular waterbird habitat area, through a combination of desk/literature surveys, field questionnaires and other inquiries. EARP studied these issues as they have arisen in Lake Naivasha in Kenya, and ROSA in Kafue Flats (including parts of Lochinvar National Park) in Zambia.

This Summary and Synthesis provides a brief overview of the work at these two venues, addressing both the substantive issues and practical operation of the project. It also offers a partial list of recommendations regarding further work and case studies. This document also contains the Report of Project Coordination, detailing the manner in which these reports were contracted, overseen and completed.

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1. Background

The studies included in this report address areas that are, in some respects, very similar and, in other aspects, quite divergent. As such, they offer a very useful basis on which AEWA can begin to develop a broader programme of study, information development, and action relating to invasive weeds and other invasive species impacting on migratory waterbird habitat areas.
The site studies are

- the Lake Naivasha Ramsar Site in Kenya, focusing on a wetland complex consisting of one main lake, several subsidiary lakes and surrounding wetlands as well as a floodplain and delta of the inflowing Malewa and Gilgil Rivers; and

- three designated areas within the Kafue Flats flood plain – one of the major wetland areas in Zambia.

Geophysically, the sites are, of course rather different; however both include large, seasonally inundated wetland areas and are significantly impacted by widely varying annual rainfall. Both sites are home to well-known and diverse avian fauna, and have been affected by alien invasive waterweeds over the last decades.

Both sites are also populated and used by humans, but differ from one another in the nature of land tenure afforded to local residents, and thus the nature of their presence on and use of these areas.

Lake Naivasha is described as the only privately-owned Ramsar site, with lands around the Lake being privately owned since early in the 20th century (at least.)

By contrast, most of the residents in the **Kafue Flats** are indigenous and itinerant people. Having no acknowledged private tenure in the lands, most of the human occupation in the area has been transient. As further discussed below, this distinction may have made a major difference in management of the area, particularly with regard to control of invasive species.

2. Bases of the Studies

The primary basis of these case studies was expected to be existing literature relating to the issues of invasive species infestations, invasives control measures, migratory bird populations, and the relationships between the three, in each of the study areas. There is a definite difference between the two areas, with regard to the extent of available locally oriented literature.

Thanks in part to the long efforts and involvement of the LNRA and the Government of Kenya in examining this issue, there has been considerable study and research on various aspects of the ecology of wetland birds around **Lake Naivasha** and its environs. Official studies and other information relating to invasive weed infestations in the lake are available at least as far back as 1964. In addition, studies dating back to the 1980s have examined the relationship between the abundance of bird species and critical ecosystem factors (proliferation of submerged macrophytic growth and diverse plankton at feeding and breeding sites) which have since been shown to be impacted by infestations of aquatic weeds at the site.

In **Kafue Flats**, however, the availability of scientific and monitoring data, and relevant data analysis was significantly less. The consultant notes, for example, that there is data on species inventories, including invasives incursions, but "there is currently information void on the weeds bloom problem. More specifically, the relationship between weeds infestations and their impact on wildlife habitats and the overall ecosystem has not been studied." Researchers in the area have stated that "the whole question of growth of undesirable plants in the Kafue Flats rangeland has not been investigated", that "the status of most birds remains unknown" and that "there seems to be limited information specific to the impacts of the various invasive alien species on the diversity/ecology of bird life on the lake and its immediate environs." Finally, "this is the first report to bring out concerns on the conservation of the Kafue Flats wetland as special habitat for aquatic birds."

Even where data exists it often does not cover critical areas. For example, within Kafue Flats, there have been no detailed studies on weeds in the Lochinvar National Park. Site visits and questionnaires under this project offer the first information relevant to this issue.

As a consequence of this deficiency, much of the analysis provided by the consultant reviewing the situation in Kafue Flats utilises international materials discussing the species found in Kafue, as they have been studied in other regions. While perhaps appropriate for the present, this choice underscores the need for direct study within the region, particularly when compared with the Naivasha results in which some alien species which have been expected to be invasive have not resulted in any noticeable infestation, even many years after the first individuals were noted in the field.

The Kafue Flats case study also asks whether relevant species have or can change their diet, but has not found any available data relating to this issue. In Lake Naivasha, this answer has been demonstrated, based on locally generated data indicating that some species have successfully transferred their food dependence from former species that have now disappeared or become unacceptably scarce, to the invasive weeds themselves.

3. Substantive Analysis

This summary cannot substitute for the full analysis provided by these case studies, to which the reader is referred. Rather, it seeks to give an initial basis for comparison between the two studies, and limited synthesis of their results.

3.1 Legal Status

There are three components of the legal status of the area that appear most relevant to these reports:

3.1.1 Legal Status – Land Ownership and Tenure

One of the most important differences between the two studies involved the nature of the surrounding lands and landholders/land-users. While the Kafue Flats areas are surrounded by rural communities (fishermen, farmers, and forest users), much of the land around Lake Naivasha is owned by individuals and institutions, many of which engaged in commercial, or entrepreneurial activities. This difference may bear a strong relationship to the significant difference in the level of action that has been taken at the two sites.

In essence, **Lake Naivasha** is generally described as the only privately-owned Ramsar site, with lands around the Lake being privately owned since early in the 20th century (at least.) The lake-ward boundary of the riparian landholders' titles is defined by map elevation (the 6,210 feet contour). Below this contour, the shore above the water line is deemed "riparian land" – that is although it is government land; the landward riparian owner has certain rights over it. Below the water line, the lake is state property, and subject to state management.

The Lake Naivasha Riparian Association (LNRA) has existed since 1929, and has more recently been a major motivating force behind efforts to address the invasives problems on the lake. Its 150 members (all owners of land contiguous to the lake) are described as "representing close to 100,000 people." By agreement with the Government of Kenya (ratified by the new government after independence), the LNRA has been responsible for the management of riparian land surrounding Naivasha for over 72 years.

In some situations, such as where governmental coffers have proven insufficient to meet the needs of weed reduction programmes, the LNRA has undertaken fundraising to cover the shortfall. LNRA members have also been directly involved in remedial activities. It is fair to say that the LNRA has attempted to be a nucleus around which weed control efforts of many parties have been coordinated with regard to the Lake.

By contrast, most of the residents in the ***Kafue Flats*** are indigenous and itinerant people (fishermen and others dependent on resource extraction, rather than settled land uses). Having no acknowledged private tenure in the lands, for much of the human occupation in the area the consultant notes that "the settlements are permanent but most of the residents are temporary." At the fringes of the area, settlements consisting of permanent communities can be found in areas that can be utilised by pastoralists and agriculturalists.

In addition, the human population in the Kafue Flats study area is increasing at an accelerated rate (overall, more than 3.2% per year). Over 60% of the 1.2 million adult residents have lived in the area less than 10 years, with only 25% having lived there more than 20 years. It is possible that these habitation distinctions and particularly the lack of land tenure may have made a major difference in management of the area, particularly with regard to control of invasive species.

3.1.2 Legal Status – Legal Protection/Conservation

With regard to their legal status as protected areas, there are many parallels between the two sites.

The ***Lake Naivasha*** has been designated as a wetland of international importance under the Ramsar convention. Although not a national park itself, the lake is surrounded by national parks (including Hell's Gate and Mt. Longonot).

Almost half of the ***Kafue Flats*** are covered by Zambia's protected area system. The sites studied in this project include two National Parks (Lochinvar National Park and Blue Lagoon National Park) that are also Ramsar Sites, as well as several designated 'game management areas,' most of which provide a basis for communal use and management of wildlife.

Discussing this protection, the consultant notes that "protection of national parks in Zambia is concerned mostly with wildlife" (apparently referring to wild fauna conservation) and does not cover fisheries, water resources and forests in the designated areas. This is, to some extent a legal problem arising out of the colonial history of Zambia, under which the primary laws that underpin many of the current environmental provisions were (and are) focused on extractive rights and licensing of users, rather than on integrated conservation and sustainable use decision-making at the ecosystem level.

The legal structures applicable to the two areas are very different. As noted above, ***Lake Naivasha's*** management is focused by the LNRA. Although it remains subject to a broad array of legislation, this focusing structure, combined with the commitment exhibited by the LNRA members, has helped it to operate effectively within the broader system of laws and institutions governing wetlands, water and species.

By contrast, Zambia law imbues over 30 agencies with some level of responsibility for environmental management, including over ***Kafue Flats***. With no specifically authorised primary focal entity, "issues of conflict of power, coordination and integration in a specific geographical area with multiple land-uses are complicated. The prevalence of this situation works against the achievement of positive returns of any effort." To address problems of governance in Kafue Flats, the consultant identifies the needs for (i) greater attention to community involvement and decentralisation, (ii) recognition of conservation values, (iii) multi-sectoral cooperation, (iv) capacity-building, (v) enforcement and, (vi) flexibility to address changing economic, social and physical conditions. The national government recognises these concerns and has initiated review and evaluation of relevant laws and policies.

3.1.3 Legal Status – Water Sources

Like all wetland areas, both Lake Naivasha and Kafue Flats are dependent for their survival on water catchment basins that include and are affected by a variety of areas and uses. ***Lake Naivasha*** is dependent on the Malewa River, while ***Kafue Flats*** receives the drainage from the Kafue River and tributaries including the Mbuma, Mwembeshi, Nkala, Lukomezi, Nansenga, Lutale, Nanzhila, Sikaleta, Itu, Nangoma, Banza, Banga and Kaleya streams.

Water users that potentially impact the sites may be extremely distant, both geographically and philosophically, from the site. At the same time, local and downstream water users are significantly impacted by activities in the study areas. For example, in addition to its biodiversity importance, ***Lake Naivasha*** is a significant national freshwater resource in an otherwise water deficient area. It supports an outstanding horticulture/floriculture sector that provides employment and generates significant amounts of foreign exchange as well as a thriving fishery, livestock farming and a growing tourism sector. It influences geothermal power generation. Accordingly, in both cases, national water management programmes and legislation are a critical element of site conservation.

The full range of applicable laws and legal arrangements that define these catchments and their relationship to Naivasha and Kafue was not within the scope of these case studies. As underscored by both case studies, however, upstream conservation and sustainable use, which recognizes the ecological importance of downstream areas, is essential to the future of either of these sites.

3.2 Conservation Importance

Like all wetland areas, both Lake Naivasha and Kafue Flats are important in many ways, including for freshwater, groundwater recharge, flood control, water quality (filtration), sediment control (in associated navigation areas), and nutrient retention, in addition to their primary conservation roles as ecosystems/habitats for a broad range of species. The reports note the role of all of the above functions in invasive infestations; however, this summary will focus only on their importance to migratory waterbird conservation.

Each of these sites is particularly important, both to their region and to the world. Both are critical habitats for a great many species, including migratory waterbirds. In ***Kafue Flats***, at least 52 of the 428 identified species of avi-fauna are migratory. Some (*e.g.*, the Wattled Cranes (Bugeramus carunculatus)) are very rare. ***Lake Naivasha*** is a wetland possessing a variety of unique ecological values and a rich biodiversity, including some endangered species. There are hundreds of species of birds recorded, about 90 of which are waterbirds.

Both areas are important for other reasons as well. As noted, both have been designated under the Ramsar Convention as Wetlands of International Importance. They are also critical habitats for a wide variety of other endemic species of animals and plants, including some that are rare and endangered.

3.3 Assessing the Relationships between Aquatic Weeds and Waterbirds

3.3.1 Assessment of Aquatic Weed Problems

The studies appear to indicate both similarities and differences relating to the species involved and the extent and nature of incursions; with the first recorded information regarding the presence of these weed species having been noted more than four decades ago.

In ***Lake Naivasha***, the primary invasive weeds are water fern (*Salvinia molesta*), water hyacinth (*Eichhornia crassipes*), and water lettuce (*Pistia stratiotes*). Significant impact study and weed control efforts have been directed at *S. molesta* and *E. crassipes*, however, little has been done about *P. stratiotes*, which is less prevalent, and not thought to be particularly invasive in that context. *S. molesta* and *E. crassipes* continue to be very prevalent in the lake.

A number of animals (primarily fish, invertebrates and rodents) have been introduced into Lake Naivasha in various ways. Some of these also appear to be invasive. At least two, the Louisiana red swamp crayfish (*Procambarus clarkii*) and a large water rodent, the Coypu (*Myocastor coypus*) are anecdotally blamed for the loss of the indigenous water lilies, formerly important as a food species for many of the waterbirds using the lake, now replaced in that role to some extent by invasive weeds.

In ***Kafue Flats***, there are at least 12 plant species regarded as weeds and threats to the Kafue Flats wetland and of these nine are aquatic, while three occur in the flood plain. The primary known invasive water weeds include *Eichhornia crassipes* (water hyacinth, also identified as an invasive in Lake Naivasha as in many other African aquatic areas), *Salvinia molesta*, *Mimosa pigra* (Cat claw – a woody shrub), *Typha latifolia*, and *Cyperus papyrus*. Interestingly, the latter is a native plant in Lake Naivasha, essential to many elements of the aquatic environment, which has been negatively impacted by other invasives in the Lake. The consultant focused on *S. molesta*, *E. crassipes* and *M. pigra*, which have been identified as "the most serious problem plants."

3.3.2 Impact on Migratory Waterbirds

Although they vary in the level of specific data available, both case studies identify relationships between the weed infestations and waterbird populations. Predictably, where the available data is more detailed (Naivasha), it presents a more complex picture of those relationships, demonstrating that, in some cases, the invasive weeds have actually improved the lot of at least some species of waterbird.

Another common factor that should be noted is the fact that, in both areas, weeds negatively impacted other uses of the lake (boat movement, fishing, industrial intakes, etc.) This impact created strong commercial incentives for their removal, and may have helped fuel rehabilitation efforts.

More specific information on the waterbird situation and the impacts of weed infestations can be summarised as follows:

It is estimated that **Lake Naivasha** and its environs support at least 350 bird species of which 90 are aquatic or semi-aquatic. Waterbird counts and other census and survey data for Lake Naivasha, covering more than 20 years have been studied; however this data is not particularly useful in assessing the impact of both invasives on waterbird populations. Comparison of the acreage of the various habitat types within the Lake, numbers of nesting sites, choice of food species, and other factors affecting distribution (rather than population) may be more informative, and in this case suggest a decline or at least significant change, for some species.

Lake Naivasha's ecosystem is dependent to a large extent on the water purification and sediment/nutrient retention properties of papyrus, which is also a key habitat species. The coverage of this species within the lake has significantly declined, due to human activities, such as land-clearing, in combination with drops in water level that allow key invasive species (*S. molesta*) to become established, preventing natural re-establishment of papyrus. Invasive weeds have a competitive advantage when the water level rises (an occurrence that can "drown" papyrus rooting areas.) The loss of the papyrus-centred ecosystems along the shoreline has seriously altered this ecosystem, with consequent impacts on dependent species populations.

The abundance of birds in Lake Naivasha has been correlated with prolific submerged macrophytic growth and diverse plankton at feeding and breeding sites. A study in 1981 established that the abundance of waterfowl coincided with macrophytic bed development. Congruently, in 1982-84, the absence of submerged macrophytes resulted in a reduced presence of wildfowl. Submerged waterplants are probably a major influence of Lake Naivasha's avian community.

Data on the site indicates that the primary invasives tend to form mats of floating aquatic weeds that have brought about significant alterations in the physical condition of the lake. In places, these mats affect temperature and pH; interfere with affecting photosynthetic production with consequent increases in CO_2 levels and declines in macrophytic vegetation.

This decline in macrophyte growth offers initial evidence to suggest a negative impact on Naivasha's waterbird communities. For some waterbirds, however, the data suggests that the species has successfully transferred to the new habitat conditions, living off the *S. molesta* mats. This fact may complicate future eradication programmes.

The **Kafue Flats** area is reported to be the most ecologically disturbed wetland in Zambia, despite the ecological importance, rich natural resource base, economic significance of these resources, and functional values of its ecosystem. One aspect of the area's degradation is weed infestation. There is anecdotal evidence suggesting that invasive weeds combined with other factors (such as recent dam construction, management/co-ordination – caused problems, land-use and resource utilisation conflicts, and pollution/eutrophication) to have a significant impact on the ecology of bird and mammal life. It is indicated, for example, that the fish-eating species, such as Pelicans and Storks, may have been displaced from the waterline and shallow waters of ox-bow lakes and lagoons, as a result of the invasion of mimosa which eliminates the open and muddy waterline these species depend on.

On a more general level, however, the Kafue Flats case study notes that much data is lacking and "the exact impact of weeds on birds needs to be studied." It identifies possible impacts that need to be confirmed, including: loss or nesting sites, loss of feeding sites, loss of cover exposure to predation and failure to mate. The consultant notes, that "it is obvious that both water hyacinth and *Mimosa pigra* are potential threats to birds," but recognises the need for further study to confirm whether these threats have been realised in the area.

3.4 Weed Control and Site Rehabilitation Activities and Proposals

The two studies provide significant information regarding various types of weed reduction activities, and the extent to which such efforts have proven successful. In this connection, it should be noted that some of the sites examined in Kafue Flats (especially Lochinvar) had not been the subject of any direct efforts at weed removal.

Among the methods used, were

- Application of aquatic herbicides:
    - *paraquat* partially successful against water fern (*Salvinia molesta*) in Lake Naivasha (1964),
    - the same used again, less successfully, in 1968,
    - used in the Kafue Flats area only in ponds on private lands, with no data available on the particular herbicides used, their effectiveness or their side effects.

- Pollutant reduction (introduction of mechanisms to reduce pollutants that alter the chemical balance of the water, promoting weed growth and inhibiting native plants). Primary mechanisms:
    - setting and enforcement of pollution guidelines and methodologies (settling ponds and aerators for retention of wastes, neutralization ponds, rehabilitation of sewerage treatment facilities and recycling);
    - training of industry in cleaner production technologies;
    - provision of education awareness to communities and industry; and,

    Found to be effective in the end expressed in quantity of weed removed compared to the other methods (Kafue Flats).

- Biological control:
    - the aquatic grasshopper *Paulinia acuminate*, unsuccessfully against water fern in Lake Naivasha (1980s);
    - the weevil *Cyrtobagous salviniae* successfully against water fern in Lake Naivasha (1986);
    - the *Sameodes albuttalis* and *Orthogulma terebrantis* unsuccessfully against water hyacinth (*Eichhornia carssipes*) in Lake Naivasha in 1995 and 1997;
    - a combination of four agents in used in one area within Kafue Flats between 1995 and 1997, of which three are named in the report -- Mottled Water Hyacinth Weevil (*Neochetina eichhoniae* Warner), Chevroned Water Hyacinth Weevil (*Neochetina bruchi hustache*), and Water Hyacinth Leaf-sucking Mirrid Bug (*Eccritotarsus catarinensis*, Calvalho). The programme did not include a post-application monitoring component, however, so it is not possible to determine whether biocontrol or other factors (*e.g.* unusually cold weather and water-level manipulation) were responsible for a subsequent temporary decline in weeds in the area; and
    - the beetles *Nerchetina bruchii and Neochetina eichhornia* used against water hyacinth in Lake Naivasha in 1998, with as yet un-noticed results.

- Manual/mechanical control:
    - in support of herbicidal application and otherwise in Kenya;
    - producing early successes against water hyacinth in Zambia in the late 1960s and early 1970s, but later failing as specimen replacement seemed to outpace removal activities.

- Promoting or intensifying the use of invasive weeds. Nascent programmes in Kafue Flats promote the use of aquatic weeds, as a disguised incentive for their regular removal from the water area. Potential uses include:
    - hut construction;
    - stock feeds;
    - compost;
    - medicinal herbs; and
    - coolant for fish (by fishmongers).

  As the programme has not been fully implemented, results and evaluation of effectiveness as a weed control measure are not yet known.

Problems: Problems associated with some of these methods were also noted, such as (i) the impact on dissolved oxygen levels of a large mass of dead organic matter resulting from herbicide spraying, (ii) the impact of herbicide use on native flora and fauna. Other possible impacts of control measures were noted, including alteration of adapted habitat areas, displacement of birds due to changes in the level of human disturbance, and sensitivities to herbicides, including bioaccumulation. No direct data on any of these impacts was presented.

In the **Kafue Flats** study, mechanical controls and pollution reduction were believed to have one primary advantage – minimal impact on wildlife. Pollution reduction was also preferred because it was thought to "not only attack the symptoms of the weed problem but also acts as a long term prevention program by reducing nutrient loading into the Kafue River." Moreover, these programmes are more generally recognised as beneficial to the country, and to critical factors such as human health and agriculture.

A similar proposal in Kafue Flats would address another artificial condition that has enhanced weeds at the expense of native flora – flow control in the rivers on which the Flats depend. Proposals for artificial flood control, to return the Flats to their traditional flooding patterns, have so far not been possible, in light of the importance of collected waters to other users, and other relevant costs and limitations.

The consultant noted that there have been no systematic efforts to control *M. pigra*, as yet. He noted that this species is possibly the most serious invasive problem in the area.

Effectiveness: The net effectiveness of removal activities appeared to vary according to many factors. Although this could not be studied as to **Kafue Flats** due to the lack of post-removal monitoring data, it was directly addressed in the Naivasha study.

It was clear that some efforts were more successful than others, but perhaps only hindsight can identify which methods will be most successful in a particular place and time. For example, in **Lake Naivasha**, a variety of geophysical factors, including natural barriers, weather conditions (high winds and waves) often aided in the initial control measures. However, over time, some of these factors changed, whether permanently or temporarily, causing formerly contained invasives to suddenly burst forth into new infestations.

Ultimately, after examining the history of weed control efforts on the lake, the **Lake Naivasha** study concludes that:

> "mechanical and chemical control are (often) not successful in the long-run when used alone or together. Biological control can be much more effective, less damaging to non-target organisms and self-sustaining over time. The concept of "integrated control" of invasives is even more likely to be effective, especially when there are problems establishing a biocontrol agent."

In addition, in **Lake Naivasha**, it was noted that cooperation between riparian users and government in weed control activities was a major component of successful efforts. This was also notable in **Kafue Flats**, where mechanical weed control activities that were identified as successful (or initially successful) were in part carried out by major commercial users (sugar manufacturer and energy plants) in the area.

3.5 Awareness

Both studies, through general questionnaires and interviews, considered both local input into the primary questions, and local awareness of the relationship between invasive weeds and the health and prevalence of waterfowl (and other fauna). In both studies, the awareness relating to invasive weeds was relatively low. On the other hand however, the studies also indicate a strong general interest in the ecology of the aquatic system, a desire to preserve and foster a healthy ecosystem, and other incentives that may help fuel decisions relating to the removal of aquatic weeds.

In the latter connection, however, it should be noted that in some cases (as mentioned above) intensive weed-removal programmes may have negative impacts on waterbird species and local communities. In particular, some species have converted to use of the weeds as replacements for lost native plants. In addition, concerns suggest that some remedial methods may have impacts on other elements of the ecosystem.

It is worth noting that, the Zambia case study team undertook significant analysis of livelihood and socio-cultural issues, including extension to many issues outside of the direct scope of the Terms of Reference of that case study. Their report includes a detailed and rather wide-ranging examination of socio-economic issues in the region, and significant inquiry into the state of community involvement. It evidences the importance of ensuring that people resident in the area understand that efforts to eradicate invasive plants are directed at more than species conservation and can ultimately have a significant positive impact on the entire ecosystem, and the communities using it.

4. Summary Conclusions

In combination, the two case studies offer a great deal of food for thought on many topics. Both compellingly establish the biological, social, commercial and scientific breadth of the invasives problem, and the complexities involved in addressing control of invasive weeds as a conservation strategy.

The **Kafue Flats** study demonstrates clear limitations that have arisen in this connection, including particularly limited data gathering, and lack of post-remedial monitoring. The limitation of invasives control efforts to water hyacinth, among the nine aquatic plants and three shoreline plants that have been identified as invasive weeds does not appear to have been based on a formal need analysis, and may have been opportunistic (based on availability of funds and technology). It is particularly telling that no efforts have been made to address the invasive problem (*M. pigra*) that is considered to be most significant within a study area that is so important nationally and internationally.

Disjointed administration may also be a key limiting factor and strong recommendations regarding the use of an ecosystem-level coordination and planning mechanism as a basis for further control and rehabilitation work.

Finally, invasives control measures in the **Kafue Flats** area may be highly dependent on local communities. This is in part because the most effective measures identified in this study were pollution control measures and local use and hand removal, all of which depend on the active cooperation of local communities. Moreover, community and local-user support may provide a strong political basis on which an invasives control and monitoring programme can be built.

The **Lake Naivasha** study offers a broader analysis of the specific issues addressed by this project, but also underscores the conclusions of **Kafue Flats** regarding the need for and value of data gathering and analysis, as well as the value of coordination at all levels, with particular attention to the involvement of local residents.

Of the three major alien water weeds in Lake Naivasha, the most serious invasion, *Salvinia molesta*, has been successfully controlled. Water hyacinth (*Eichhornia crassipes*) is much more prevalent than formerly, but not yet a serious problem, and biocontrol agents have been introduced (although their probable success in controlling the spread of this weed has not been established.) The third weed, water lettuce (*Pistia stratiotes*), is apparently not invasive in this lake for geophysical or biological reasons that have not been identified.

In this connection, the Conclusions of the **Lake Naivasha** study note that the study

> "…also shows that the control of this one invasive species does not prevent the appearance of a second candidate for the same niche (in this case the open waters of the lake and its edges) or even a third (viz *salvinia*, followed by water hyacinth with water lettuce "waiting in the wings")."

Although it cannot be proven from the case studies alone, aquatic ecosystem that has been invaded may be somewhat destabilized following remedial activities, perhaps even enhancing the possibility of secondary invasion.

> "This is further support for the need for regular and persistent monitoring of wetland sites for invasive species - especially when one has appeared and been seen to be controlled…. [T]his monitoring should be related to the wetland ecosystem and its function - rather than just to survey for a particular species. In other words, the "ecosystem approach" is just as appropriate for the understanding and control of alien invasive species in wetlands as it is for general wetland management and conservation."

While examining various control mechanism, the **Naivasha** study also notes that, so long as they remain under control, introduced species can provide critical elements to replace or supplement components of the ecosystem that have been lost to other factors.

Perhaps most important, the **Naivasha** study notes that where "there is a wetland management plan in place and an organisation that has taken (or been given) responsibility for the conservation of the lake ecosystem," there is a much better chance of controlling (or even preventing) alien invasions, particularly when all relevant organisations and control efforts are coordinated.

5. Future Work and Case Studies

An important conclusion of this study relates to the need for further work.

As they were conceived, these two papers were intended to provide both an understanding of the extent of available data and literature, and an analysis of that material. In both areas they identify both strengths and weaknesses, areas of developing knowledge and areas in which little information is available. In this respect, they have fulfilled their task as 'initial studies' by demonstrating the areas in which more productive study is needed and valuable.

The **Lake Naivasha** study notes that

> "What this study has shown is that it is also important to monitor such invasive species over time - not only to follow their course of invasion and (hopefully) control, but to record any short- or long-term impacts on the ecosystem that was invaded. This should be part of any wetland management strategy. We hope that it will become a part of the Monitoring Programme of the LNRA in future and of other wetland management plans in the AEWA area."

Many issues that have arisen in these case studies are worthy of significant further attention. It seems important both

- to assist in the development of data and monitoring programmes in **Kafue Flats**, where available data is limited; and

- to provide additional support to the efforts of the LNRA, which has developed an admirable basis of data on which more focused or detailed research can be based, enabling a more definite understanding of the relationships among waterfowl, weeds and residents in this ecosystem.

At both venues, it is clearly important to develop and coordinate/analyse data about migratory bird populations and habits; aquatic weeds; and the application, effectiveness, and impacts of control measures. Beyond these, the studies have indicated a number of other areas of inquiry which might also have a bearing on the basic objectives of this study. Among these are:

- The relationship of water resource management in upper catchment basins to invasives problems and their remediation in wetland areas, and to various wetland restoration projects and objectives;
- It is important that special attention is given to the pattern of settlements as opposed to birds' major habitats;
- Alternative approaches such as intensifying the use of the invasive plant species as a means of promoting their removal.

6. Project Implementation

Following completion of primary negotiation of an agreement combining three activities to be undertaken by IUCN in furtherance of AEWA's work plan, the ELC negotiated internal agreements with ROSA and EARO for the work under this activity. Subsequently, at the request of the UNEP/AEWA Secretariat, the original single contract was broken up into five contracts. One for a separate project on Guidelines for Legislation, and two each for another project (Traditional Knowledge of Waterbird Management) and this work on Rehabilitation of Important Migratory Waterbird Sites, which have been Degraded by Invasive Aquatic Weeds. The work on this project was thus under two contracts, one for the first year, and another (which was not to be executed until after the first year was over) for the second. This created a number of internal difficulties in IUCN, where organisational requirements relating to accounting and project management were multiplied fivefold, and the ability to manage the funds of the three collectively was prevented.

After accommodating AEWA's request in this way, the project incurred significant problems when AEWA was not able to transfer the final payment on the first year contract or the initial payment on the second year contract until October of the second year, by which date the work under the contract should have long been completed.

As a consequence, in light of IUCN accounting rules under which programmes are not to operate projects in a deficit mode, all work under the project was technically required to cease pending receipt of funding. EARO was undertaking its work with IUCN staff members, and had obtained additional assistance from the Lake Naivasha Riparian Association. It was therefore able to complete its work in 2003, despite the lack of ready funds. ROSA, however, which was undertaking the work with the assistance of consultants, was forced to cease operations once the initial funds ran out. When the second tranche of funding was finally received in October 2003, it was necessary to reschedule time with consultants, as well as staff availability, both of which were significantly hampered by a very full schedule of essential conservation activities and processes, both internationally and locally.

Ultimately, the project work of both offices was completed and submitted.

Final Note:

IUCN commends AEWA and the Government of the United Kingdom for their willingness to give attention to this vital issue, and to begin a process by which the work already undertaken in key regions like Eastern and Southern Africa can be shared and provide lessons learned and other value in other regions. IUCN, too, is committed to continuing to address invasive species, which, together with habitat destruction, has been identified as the major cause of extinction of native species throughout the world for over a hundred years.

The IUCN-ELC commends the work of IUCN's Eastern Africa Regional Office, and IUCN's Regional Office for Southern Africa, for their excellent work under this project, in very trying circumstances, and especially notes the important work of Excellent Hatchileka, Geoffrey Howard, Francis Mkanda, Maurice Nyaligu, G. Richardson-Temm, Kelly West, Florence Chege and Francis Karanja.