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**Information Document: Report of the Experts Mission to Djoudj National Bird
Sanctuary, Senegal, 14-21 September 2000**

Mission Report

Djoudj National Bird Sanctuary, Senegal, 14-21 September 2000

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Summary

Salvinia molesta first appeared in the Senegal River delta in September 1999 and has spread since then to many bodies of water and water basins, disturbing the existing biological equilibrium and threatening human health as well as the overall ecological and economic characteristics of the delta. This invasive species directly threatens the Parc National des Oiseaux du Djoudj, included in the Montreux Record in 1993 and formerly placed on the list of endangered UNESCO World Heritage sites in 1984, and the Parc National du Diawling in Mauritania.

After field visits and meetings with the institutions involved, the mission feels that the threat of *Salvinia molesta* to the ecosystem of the Senegal River basin and to the economic, social and ecological functions of the Parc National des Oiseaux du Djoudj and the Parc National du Diawling is very serious and merits the continued and constant attention of local officials, national leaders at all levels and the international community.

Measures should first be aimed at preventing the entry and growth of *Salvinia molesta* in the backwaters of the tributaries to these two national parks. Next, a revised management plan for the Djoudj and Diawling parks should be prepared in order to obtain additional financing for the programmes managed by IUCN.

Listing of the Parc National du Diawling in the Montreux Record is highly recommended in order to bring the threat to the attention of the international community and to begin eradication in partnership at the local, national and international levels. The Parc National des Oiseaux du Djoudj should be added to the list of endangered UNESCO World Heritage sites, and this has the support of the governments of Senegal and Mauritania.

It is also urgent and necessary to recognize the important function played by the buffer areas around Djoudj and Diawling (Trois Marigots and the Dioup-Keur Macène system), by designating them as Ramsar sites in addition to existing designated sites on both sides of the river.

All of the delta is a wintering area (as defined by Wetlands International) that merits recognition by Ramsar.

At the international level, it is also urgent to inform public opinion about the dangers threatening the delta. National and international media should be used, specifically through targeted articles in nature or conservation publications, before this scourge becomes a regional disaster.

The UNESCO World Heritage Centre has been asked to provide support for the consolidation of progress and to prepare an integrated campaign based on the conservation work already

carried out in the two national parks. This support should cover immediate training needs in biological eradication.

1. Introduction

The mission took place following a request by the government of Senegal to the Bureau of the Convention on Wetlands (Ramsar) and to the UNESCO World Heritage Centre, asking them to organize a joint mission to study the situation in the Parc National des Oiseaux du Djoudj and to make recommendations on measures and programmes. In reply to this request, the Bureau of the Convention on Wetlands (Ramsar), the UNESCO World Heritage Centre and IUCN Headquarters organized this joint mission from 14 to 21 September 2000, in cooperation with the governments of Senegal and Mauritania in order to study the situation in the Parc National des Oiseaux du Djoudj (Senegal) and the Parc National du Diawling (Mauritania).

***Salvinia molesta* in the delta of the Senegal River: a major risk for nature conservation.**

Salvinia molesta appeared for the first time in the Senegal River delta in September 1999 and has spread since then to a number of bodies of water and water basins, disturbing existing biological equilibrium and threatening human health as well as the overall ecological and economic characteristics of the delta. *Salvinia molesta* is an aquatic fern considered to be one of the most invasive plants in the world. It is native to southeastern Brazil and easily adapts to any environment, doubling its area every two to four days. Furthermore, it can propagate from simple pieces of the plant and, as a result, quickly completely covers a body of water. It has the following effects:

- almost complete blockage of the exchange of gases between the air and water; during decomposition of leaves there is heavy consumption of dissolved oxygen, which is needed by the aquatic fauna, especially fish;
- blockage of irrigation pumps;
- increase in the habitat for mosquitoes and gasteropods, which are disease vectors;
- impossibility for waterfowl to land on the water;
- risk of spreading to rice fields, which are well-known areas for the development of this species;
- impossibility of river traffic;
- a great risk of a lack of potable water for the cities of Dakar and Saint Louis;
- impossibility of fishing;
- decrease in the access for cattle to the water.

The threat is even greater for the world because the Senegal River delta plays an irreplaceable role for many migratory species. This role was recognized long ago by the governments of Senegal and Mauritania and led to the creation in Senegal of the Parc National des Oiseaux du Djoudj, the Parc National de la Langue de Barbarie, the Gueumbeul wildlife reserve, the Ndiael wildlife reserve and the Parc National du Delta du Saloum; all Ramsar sites except the Parc National de la Langue de Barbarie. The Parc National des Oiseaux du Djoudj is also a UNESCO World Heritage Site. In Mauritania, the Parc National du Diawling and the Parc National du Banc d'Arguin are both Ramsar sites.

2. The importance of this fragile environment and the threat to it

2.1. Parc National des Oiseaux du Djoudj (Senegal)

Approximately 450,000 and up to 550,000 Anatidae, 250,000 Limicolae, 20,000 greater flamingos, 3,000 to 12,000 lesser flamingos and 2500 European spoonbills owe their winter survival to the quality of the environment of the Senegal River delta (Triplet and Yésou, 1997, 1998, 1999; Schricke, Leray and Triplet, unpublished). These species have already been directly affected by the Diama dam, which has prevented salt water from moving up stream. The less brackish water is responsible for the proliferation of many plant species, specifically *Typha australis*, *Pistia stratiotes* and more recently *Salvinia molesta*.

The Parc National des Oiseaux du Djoudj, listed on the Montreux Record since 1993, had earlier been placed on the World Heritage list of endangered sites. It was taken out of this category after sluices were constructed that allowed better regulation of water. However, the spread of invasive plants now fully justifies its reinscription in this category.

Taking this into account, the UNESCO World Heritage Centre and the Bureau of the Convention on Wetlands (Ramsar) decided to organize an evaluation mission to study threats to nature and to propose measures and programmes to counter the threats.

2.2 Parc National du Diawling (Mauritania)

Created in 1991, the Parc National du Diawling is a unique example of the reconstruction of a natural environment of 16,000 hectares in the heart of the estuary of the Senegal River. This park is the habitat of several species of fish and shrimp and is a feeding area for large populations of waterfowl. For example, in 1998 more than 47,000 Garganey teals (*Anas querquedula*) were recorded in southern Mauritania and the lower delta of the Senegal River (Wetlands International, 1998).

Nevertheless, this fragile milieu suffers from multiple constraints: the negative effects of the Diama dam on habitats, leading to the development and expansion of *Typha australis*, considerably reducing fisheries and transportation and increasing health problems.

Thanks to the artificial flooding carried out by the park management project (sponsored by IUCN), local inhabitants returned to their traditional activities (handicrafts, fishing and livestock husbandry). Programmes to prevent the invasion of the habitats of fish and birds by *Typha* have been unsuccessful and another even more invasive species, *Salvinia molesta*, has appeared, the spread of which risks cancelling the success of the programme for rehabilitation of the natural environment.

3. Terms of reference for the mission

Mission objectives:

- Study of the current situation in the Parc National des Oiseaux du Djoudj and the Parc National du Diawling through field visits to both sites;
- Meetings with representatives of these national parks in order to learn which steps have already been taken and to study the nature and extent of their immediate and long-term needs in order to avoid the destructive effects of invasive plants in these environments and, if possible, to eliminate the biological invasion, especially that of *Salvinia molesta*;
- Meetings with government officials from Senegal and Mauritania and representatives of the local communities in order to coordinate eradication methods in the region of the Senegal River;
- Proposal of immediate and long-term measures for the elimination or limitation of the invasion of *Salvinia molesta* in order to maintain the biodiversity of these two national parks intact;
- Evaluation of the cost of the operations to be carried out immediately and later. The mission was to establish a schedule of operations and estimate the cost of emergency operations to be carried out;
- Proposals for monitoring increases in *Salvinia molesta* and eradication programmes.

4. Composition of the mission

The mission was composed of:

- Dr. Patrick Triplet: UNESCO consultant and scientific director of the Syndicat Mixte pour l'Aménagement de la Côte Picarde
- Mr. Anada Tiéga: Regional coordinator for Africa, Bureau of the Convention on Wetlands (Ramsar)
- Dr. David Pritchard: attorney with BirdLife International

In the field, Colonel Sara Diouf, assistant director for national parks, participated and logistic support was provided by IUCN (a vehicle and driver during the mission).

5. Calendar of activities

5.1 In Senegal

- 14 September: departure from Paris; welcome in Dakar by Sara Diouf.
- 15 September: meeting with the Director of national parks in Senegal, followed by a meeting with the national institutions and international organisations working on the problem of *Salvinia molesta*; meeting with the chief of staff of the minister for the environment; meeting with Colonel Mbarek Diop, adviser for the environment to the president of Senegal and head of mechanical eradication;
- 16 September: arrival at the Parc National des Oiseaux du Djoudj; meeting with the director, Issa Sidibé; field visit to the Djoudj backwater;
- 18 September: meeting with Djiby Seye, representative of the villages around Djoudj; return to Dakar;
- 19 September: final meeting with the chief of staff of the minister for the environment; meeting with S.I. Sylla, coordinator for West Africa for Wetlands International; departure of Anada Tiéga and David Pritchard;
- 20 September: meetings at the Direction des Parcs Nationaux;
- 21 September: meeting with Ms. Meriem Bouamrane (UNESCO); final meeting with the Director des Parcs Nationaux; return to Paris of Dr. Patrick Triplet.

5.2 In Mauritania

- 17 September: visit to the Parc National du Diawling and meeting in the field with El Waled Ould Mome, Director of the Parc National du Diawling, Amadou Ba, head of the Parc National du Diawling; visit to Chatt Boul, a coastal wetland proposed as a Ramsar site by Mauritania. This visit and the other meetings with Mauritanian officials were held with the participation of Dr. Jean-Yves Pirot, coordinator of wetland programmes for IUCN, Dr. Pierre Campredon, scientific director of the Fondation du Banc d'Arguin, and Cheikh Hamallah Diagana, coordinator of the Chatt Boul project. The mission met with the head of the military area of Chatt Boul, Capitaine C. Cheikh O. Ahmed, who strongly supported the registration of this area as a Ramsar site.

6. Propagation of *Salvinia molesta* in the Senegal River delta

Salvinia molesta was observed on the Senegal River on 25 September 1999 by an IUCN mission after its accidental introduction following flooding of a centre growing feed for chickens. In October, at the height of flooding, many plants were carried away down river after all the floodgates of the Diama dam were opened, but other plants found propitious conditions in the channels, backwaters and areas of calm water located along the shores of the

river. In January 2000, all of the channels had been covered by this plant, including those that allow the flooding of the Parc National des Oiseaux du Djoudj. In three months, *Salvinia molesta* had colonised several hundred hectares. During the first months of 2000, the situation deteriorated, and all of the areas of water in direct contact with the river have become contaminated (Diop and Triplet, 2000). By the end of September 2000, *Salvinia molesta* was now found in all of the tributaries located between the river and the delta and threatened several agricultural projects linked to the river. The area of the Parc National des Oiseaux du Djoudj is affected in the sector of Tiguet and the Diar backwater, colonized by *Typha* ten years ago.

The backwaters of Djoudj and Khar, as well as the Grand Lac and the Khar and Lamantin lakes have not been affected. Farther north, patches of *Salvinia molesta* have been reported on the Taoué, an affluent of Lake Guier, a source of water for the city of Dakar. The northern part of the backwaters of Gorom and Kassak have become affected, but expansion has been stopped by the construction of barriers. A map prepared by the SAED shows the areas colonised by *Typha* spp., which are potentially subject to colonisation by *Salvinia molesta*.

7. Action taken by the government

7.1. In Senegal - The scientific committee of the Direction des Parcs Nationaux met on 14 February 2000 with Dr. Arnold Pieterse from the Royal Tropical Institute (The Netherlands), an expert on *Salvinia molesta*. Immediately, after taking office following a change of president, a ministerial meeting was organised on 19 April under the aegis of the minister for the environment with the following results.

A joint civilian and military committee was formed to carry out mechanical eradication in cooperation with the local inhabitants. In addition to governmental agencies (sections of the ministries for the environment, tourism, agriculture and water) and the army, other partners (SAED, IUCN, several associations and local officials) have participated. Colonel Mbareck Diop, technical adviser to the president of Senegal, is the head of this committee.

A committee has been formed for biological eradication using the introduction of the weevil *Cyrtobagous salvinae*, completely dependent on *Salvinia molesta* for its survival.

Coordination of the work with Mauritania was agreed upon at meetings held from 26-27 April in Saint Louis and on 20 May at Keur Macène (Mauritania). So far, this declaration of intentions has not been followed up by joint action.

7.1.1. Mechanical eradication - Mechanical eradication was carried out in the delta between 15 May and 30 June 2000 by SAED and the Service des Eaux et Forêts. Military personnel and local inhabitants living around the Parc National des Oiseaux du Djoudj participated; 200 persons and 6,000 hours of work. The eradication consisted in pushing pieces of *Salvinia molesta* into the river and removal of pieces in order to leave it to deteriorate at the site. Barriers of fencing were installed in order to trap the ferns and prevent them from spreading into the backwaters of the delta and especially in the Parc National des Oiseaux du Djoudj. More than 200 persons were involved in the field work, and they removed more than 20,000

cubic metres of *Salvinia molesta* during the 45-day campaign and 5,000 litres of diesel fuel were used during the first phase.

This programme was made possible with the financial support of China, the Netherlands, the Ministry for Tourism, the Compagnie sucrière du Senegal and private parties at a cost of FCFA 25 million. IUCN also provided the means for eradication in the Parc National des Oiseaux du Djoudj (270 litres of fuel and 35 persons during 72 hours at FCFA 3500/day/person). A monitoring committee of 15 persons was created after the first operations. Concern has been expressed in the villages surrounding the Parc National des Oiseaux du Djoudj, whose representative confirmed the commitment of the populations to contribute to the efforts of eradication to save Djoudj. According to their representative, the local communities intend to continue the eradication without outside assistance as long as possible.

7.1.1.1. Advantages of mechanical eradication - Mechanical eradication provides an immediate solution to the problem and clears, in a relatively short time, water works, right where most of the work should take place.

7.1.1.2. Disadvantages of mechanical eradication - Mechanical eradication does not eliminate all of the juvenile plants, whose strong reproductive characteristics cancel out a large part of the effort made. Furthermore, many of the juvenile plants develop among the *Typha* and serve as a basis for re-colonisation of open water. The cost is high, and its effectiveness requires mobilisation of considerable resources constantly over a relatively long period.

7.1.2. Biological eradication - Biological eradication is only in an experimental stage. It has been successful on the water lettuce *Pistia stratiotes* using the weevil *Neohydronomus affinis*. To combat *Salvinia molesta*, 200 specimens of *Cyrtobagous salvinae* were released on 8 June, 50 kilometres up river from the Parc National des Oiseaux du Djoudj. The method of release and monitoring have not been evaluated because of a lack of information provided to the mission. This part of the operation is assigned to the Direction de la Protection des Végétaux, but ISRA has stocked some of the insects in a breeding centre. An order for 2000 insects has reportedly been placed with South Africa.

7.1.2.1. Advantages of biological eradication - Biological eradication specifically destroys *Salvinia molesta*, and once the insects are released, little management is required. All that is needed is to monitor the treated areas and the density of insects. In many cases in Australia, the Fiji Islands, Ghana, Malaysia, Papua New Guinea, South Africa, Zambia, Zimbabwe, India, Botswana, Namibia and Sri Lanka, the population of *Salvinia molesta* has been reduced by 90 per cent in less than one year (Salvinia Task Force, 1999). Many studies have been made of the relationship between *Salvinia molesta* and its predator, which confirm the specificity of the predator. Two hundred insects were released on 8 June 2000 near Khor. The monitoring carried out three weeks later provided no evidence of significant results.

7.1.2.2. Shortcomings of biological eradication - The main shortcoming is the overall length of treatment, extending sometimes over several years. Furthermore, all of the *Salvinia molesta* is not destroyed and other methods must be used in order to counter the invasion. The number of insects must be sufficient to produce a significant effect on *Salvinia molesta*. As a

result, it is necessary either to raise or to import the largest possible number of insects. This type of eradication requires excellent knowledge of the biology of the invasive plant and its predator, which must be specific for the invasive species in order to be effective without secondary effects on the environment.

It should be mentioned that biological eradication cannot be carried out in the same areas as mechanical eradication based on the extraction of plants from the water, which inevitably leads to the death of the insects. These two methods should be used jointly--mechanical eradication along the tributaries and biological eradication in all types of open water and on the areas of *Salvinia molesta* among the *Typhia*.

7.1.3. Chemical eradication - Chemical eradication, excluded at the outset by the national committee, has, nonetheless, been the only effective means in several states in North America. *Salvinia molesta* has proven to be sensitive to common herbicides such as hexazinone, diquat (usually associated with copper, it creates fewer problems than the other chemicals), amétrine and fluridone plus glyphosate. A synthetic pesticide, Reward, and an unconventional herbicide developed in Australia, AF 101, have also been used (Salvinia Task Force, 1999). Trials using the spraying of sea salt have been carried out successfully on small surfaces, but because of the morphological characteristics of *Salvinia molesta*, this method of eradication requires large amounts of salt, which, in turn, makes the water unfit for human, animal and non-marine consumption (USA Salvinia Task Force, 1999). The testing of Roundup Bioforce was authorised on 70 square metres under the supervision of SAED and the DPV.

Use of *Salvinia molesta* - Attempts to find uses for *Salvinia molesta*, advocated by some and studied by others, are to be totally excluded for *Salvinia molesta* because similar approaches led to the current situation and can lead to an invasion even more disastrous on a scale even more difficult to control.

7.2. In Mauritania - The Parc National du Diawling, designated as a Ramsar site in 1994, is composed of three basins, two of which are supplied by an affluent from the river (the works of Lemer and Cheyal). These two bodies of water completely dry up from March to July and remain brackish. Because of this, few *Typha* succeed in developing outside of the Gambar basin, located in the area of flooding of the river upstream from the dam. *Salvinia molesta* was observed for the first time at Lemer in September 1999. This was closed and no fern entered the park at that time. Several plants also entered through Cheyal where the progressive raising of the level of salinity destroyed them. As in Senegal, a ministerial eradication committee was set up. Mechanical eradication had begun but was not completely pursued. In September 2000, the inlets for the dams were filled with *Salvinia molesta*, forcing the park administration to close one of the valves and to open the second valve only slightly. Insects imported from South Africa died in large numbers upon arrival. Two attempts to raise them brought to light the predatory nature of a spider on *Cyrtobagous salvinae*. It has not yet been confirmed that this spider acts as a predator in the natural environment. A detailed study of the biology of this spider and especially of its direct effect on *Cyrtobagous salvinae* should be included in the programme of biological eradication in order to ensure that this aspect does not hinder eradication. The inlets, a total length of 800 metres each, should be cleaned by personnel recruited on the basis of UM 600 per person per day (the equivalent of

approximately 25 French francs). One month of work by 30 persons is expected to be necessary.

8. Conclusions

After meetings with participating institutions and field observations, the mission feels that the threat of *Salvinia molesta* to the ecosystems of the Senegal River basin and especially on the economy, human population and ecology of the Parc National des Oiseaux du Djoudj and the Parc National du Diawling is very serious and merits the continuous attention of all persons involved at the local and national levels and the international community.

The mission praises the efforts made by Senegal and Mauritania and encourages continuation of discussions between the two countries for the creation of a joint strategy as part of the integrated management plans for the two national parks.

The mission stresses the difficulty of establishing effective biological eradication because of insufficient populations of the predator *Cyrtobagous salvinae*, insufficient monitoring of the operation and the need to have experts available in this field.

It is also important to point out that despite the efforts of Senegal and Mauritania, the problem remains, and it is urgent to create a strategy for large-scale eradication with adequate means to prevent a major ecological disaster from an invasion of *Salvinia molesta*.

The mission notes that the management plans being carried out in Djoudj and Diawling do not sufficiently include eradication of the invasive species although this problem has been a concern for users of the ecosystems in the delta since construction of the Diama dam, which favours development of invasive species such as *Thypha australis* and more recently *Salvinia molesta*.

The mission is pleased that the problem of *Salvinia molesta* is taken seriously by all of the partner organisations of the Ramsar Convention and that a partnership is being formed between BirdLife International, IUCN, Wetland International and WWF International to support the efforts of the countries concerned. Recent contacts of the Ramsar Bureau indicate that the Bonn Convention would be interested in supporting eradication through the African-Eurasian Waterbird Agreement (AEWA).

Nonetheless, the mission deplores that the visit to Djoudj could not take place with the participation of the technical representatives of IUCN working in this subregion and hopes that the following recommendations will be taken into account for integration into IUCN's management plans for Djoudj and Diawling.

9. Recommendations

Taking into account the conclusions given above and the risk of countless loss that would be produced by the invasive species on the valley of the Senegal River and other bodies of water, the mission recommends that the following programme of measures be implemented:

9.1. Action programme

Several approaches to eradication can be adopted in order to avoid a catastrophe. These actions are on three levels and involve all of the institutions that have participated in the past several months.

9.1.1. Local level

9.1.1.1. Immediate and short-term proposals

It is urgent to save the Parc National des Oiseaux du Djoudj. At the policy level, it is important to act simultaneously in the Parc National des Oiseaux du Djoudj and the rest of the delta in order to avoid that the park becomes the only unaffected area and because of that the object of economic interest.

The director of the Parc National des Oiseaux du Djoudj must play a key role. He must be responsible for the organisation of eradication of the invasive plants. He also must involve the local communities, tour operators and visitors, who should all be involved in the eradication effort. Priority must be given to prevent all entry and any development of *Salvinia molesta* in the backwaters of the tributaries. There must be cleaning as complete as possible of the parts of the backwaters located between the river and the inlets, followed by regular cleaning aimed at eliminating all of the remaining plants. Eradication around the backwaters should be backed up by the cutting of *Typha* to prevent the spread of those plants. This measure requires reinforcement and expansion of fencing. A new barrier should be constructed on the Gorom, at Flamant, where daily inspection can take place like at other sites. There are plans to create a surveillance team, formed among the park guards. The whole team will be mobilised when large quantities are found. If that is impossible, a team of four to ten persons will remove the plants found and clear areas colonised by *Typha* daily.

Eradication could be financed by the creation of a fee of about FCFA 500 added to the entrance fee for the park. This contribution should be paid against a special numbered ticket from a packet of tickets in order to avoid any possibility of fraud. The money collected in this way should be invested locally in several approaches to mechanical eradication of *Salvinia molesta* and *Typha*. These funds could be administrated by the Station Biologique, authorised to collect the fees.

An objective must be added to the three-year integrated management plan, aimed at protecting the national park from any harmful effects to the reasons for its creation: preservation of unique delta environments and populations of waterfowl. This new objective would include the following operations:

- a) mechanical eradication of invasive plant species, especially *Typha* and *Salvinia molesta*: continuation of the intervention already described, financed by a special fee.
- b) development and application of all stages of biological eradication in order to follow up on mechanical eradication and ensure control of the effects of the

invasion. This should include a system for reproducing *Cyrtobagous salvinae* in order to have a sufficient population and to obtain the results expected on *Salvinia molesta*. Regular monitoring of progress in biological eradication should be set up.

- c) reinforcement of the exchange of information and cooperation between the park managements (especially the park director and IUCN) on the one hand and the local inhabitants around the national park in order that the eradication of *Salvinia molesta* becomes a constant concern for everyone. The work being carried out by the park wardens in cooperation with the GTZ should be part of this approach.
- d) information and promotion of awareness of the captains of the boats taking tourists to pelican nesting sites in order that the boats do not act as vectors for the spread of *Salvinia molesta*. If *Salvinia molesta* spreads to the national park, the boats should be cleaned systematically after excursions, including the propeller and removal from the water of plants found during the visit. The plants should be removed from the water for destruction by drying.
- e) Review of the role of water in the park
 - drying of the largest possible area in the lakes and backwaters, which will require the complete closing of the backwaters until the flooding season, without any possibility of reopening;
 - use of the results of the topographic study provided for in the three-year integrated management plan for creation of a system of drainage of saline soils towards the backwaters and bodies of water;
 - identification of the problems of water flow (backwaters blocked by live or dead vegetation or by sedimentation);
 - clearing of all the backwaters and canals making it possible to allow circulation of the water in all of the lower parts of the park.
- f) restoration of the lakes
 - elimination of the vegetation that has developed in Lake Lamantin and study of the possibility of filling it better including suppression of any barriers in the inlet canals or, if necessary, after studies during the dry season, partial clearing of specific areas;
 - elimination of vegetation from the eastern shore of Grand Lac, opposite the Président observation point. If necessary and after a detailed study during the dry season, restoration of areas subject to flooding.

9.1.2. National level

9.1.2.1. Immediate and short-term measures

Important efforts have already been made by the government of Senegal, the army and the public. The response of the Senegalese government has been insufficient given the extent of the risk of ecological catastrophe facing the delta. This has been acknowledged by the Senegalese government. The assistance is, however, real, of considerable importance and can be expanded.

Reinforcement of the two eradication committees and placing them under the sole authority of the minister for the environment is urgent. Broad discussion of the possible use of chemicals should take place at several levels of the administrations and then involve NGOs and all local participants. The projects and interventions should be in harmony with the overall strategy decided upon by the two eradication committees and coordinated by the Ministry for the Environment. All decisions and measures should be announced through the press to all of Senegal. In Senegal, a detail eradication project has been prepared for all of the delta by SAED.

The creation of a national committee for wetlands, under the aegis of the Ministry for the Environment is absolutely necessary in order to gather quickly detailed information on the response needed to counter any threat to the wetland.

9.1.2.2. Strategic measures

Eradication should be continuous and reinforced and should be the object of national concern. The starting point for general mobilisation could be a message by the president of Senegal requesting vigilance by everyone and a reasonable attitude to the catastrophe and towards all invasive species threatening the ecosystem.

Legislation has been proposed, and regulations for its application will be adopted with the following provisions:

- Preventive measures (procedures concerning intentional introduction, reduction of risks of unintentional introduction, early warning);
- Quick-response measures to the invasions (containment of the invasion, management of the effects of the invasion);
- penal provisions.

A review of strategies and action plans concerning the environment is planned in order to integrate preventive measures and eradication of invasive species (Strategies and action plan for the conservation of biodiversity, action plan for combatting desertification...)

9.1.2.3 Training, information and reinforcement of public awareness

It is important to recall that, even with full political support for implementation of strategies and the good will of participants, the problem of invasive species cannot be solved unless human resources are trained in this field.

It is also recommended that several agents be quickly trained specifically for implementation and monitoring of biological eradication. This training could be in South Africa for practical experience in the field where there has been positive results using this type of eradication.

9.1.3. On the international level

9.1.3.1. Action concerning the conservation status of sites

The first measure to take is to follow up on the request of the Director of national parks in Senegal to place the Parc National des Oiseaux du Djoudj on the list of endangered World Heritage Sites. The Parc National des Oiseaux du Djoudj should also be maintained on the Montreux Record until the eradication efforts against invasive species are successful. The procedure for designating the parks of Djoudj and Diawling as cross-border biosphere reserves should also be supported and take place as soon as possible.

Inclusion of the Parc National du Diawling in the Montreux Record is strongly recommended in order to attract the attention of the international community to the risks and begin eradication in a partnership at the local, national and international levels.

Ties are being expanded between the Parc National des Oiseaux du Djoudj and the Parc National du Diawling that should facilitate communication across the two shores of the river and make it possible to carry out joint projects in order that the work of one party is not made useless by the non-intervention of the other. This is even more important because clusters of *Salvinia molesta* float from one shore to the other pushed by the orientation and strength of the wind.

At the local and subregional levels, the two national parks alone are insufficient to serve as the habitat for the populations of migratory birds. Several sites, even without protection status, are, nonetheless, used by the birds, especially the Anatidae, as feeding areas. This is the case of the Trois-Marigots in Senegal and the Dioup-Keur Macène complex on the Mauritanian side. It is urgent and necessary to recognize the important role played by these two sites by designating them as Ramsar sites complementary to those already existing on each side of the river.

All of the delta is in fact a wintering area (as defined by Wetlands International) that justifies designation as a Ramsar site. It is, therefore, important to make a contribution to solving many of the questions raised by the development possibilities of the activities in the delta. The eradication of *Salvinia molesta* should be the basis for strategic thinking that can mobilise efforts once the adjacent sites are affected.

Reinforcement of transborder cooperation should be encouraged and be supported by the World Heritage Centre, the Convention on Wetlands (Ramsar), the Bern Convention, the Convention to combat Desertification, the Bonn Convention, IUCN, BirdLife International, Wetlands International, WWF and OMPO.

Wetlands International could be approached to include eradication techniques against invasive species in its training programme for wetland managers.

BirdLife International could promote awareness of the problem of invasive species at the sites managed by the organisations who are official partners and at a broader level. BirdLife International could also provide advice on policies (strategic orientations). This advice could cover evaluation of the impact of invasive species on the network of important bird conservation areas and on populations of endangered bird species.

IUCN could help to understand better the use of technical information available at the international level through the Specialist Group for Invasive Species.

WWF International could use its communication programme to reinforce awareness about invasive species.

The Bureau of the Ramsar Convention should continue to provide its support of the Contracting Parties in their efforts to implement Resolution VII.14 on invasive species in wetlands, adopted at the 7th Conference of the Contracting Parties in San Jose, Costa Rica in 1999. The Scientific and Technical Review Panel of the Convention should be requested to provide additional tools taking advantage of the range of knowledge available in this field.

The OMVS should be involved on the national and international levels. Current use of the dam, with considerable elimination of salt water and the opposite effect of salinization of soils by hydrostatic pressure, is tied to the management option for water dictated by the dam. Two approaches should be pursued. The first is technical, the second is political and requires a decision based on technical data by the representatives of the governments of Senegal, Mauritania and Mali. There should be a review of the effects and contributions of the dam in order to make proposals for better use. This review should cover out-of-season agriculture, especially river fisheries, human health, water available to livestock and settlements, changes in the quality of the water and soil, the problem of invasive plants and evaluation of the international importance of the delta for the conservation of biological diversity especially its importance for waterfowl.

These questions could be discussed at a conference to be held in 2001, in Saint Louis (Senegal) where there are facilities for this type of meeting.

It is also urgent to inform public opinion about the danger facing the delta. National and international media should be used, especially articles targeted in the nature or conservation publications before this scourge becomes a regional disaster.

Cooperation between the IUCN working group in the field and the Specialist Group on Invasive Species of the Species Survival Commission should be reinforced for a better use of the worldwide experience of IUCN.

The workshop on invasive species jointly organised by IUCN, the Ramsar Bureau, the MacArthur Foundation (USA) and the Commonwealth Secretariat is an additional opportunity to attract the interest of the international community to Djoudj and Diawling. This workshop could be held in Djoudj with a visit to Diawling with the agreement of the Senegalese and Mauritanian governments.

9.1.3.2. Financial and technical support

The urgent action taken by the Bureau of the Convention on Wetlands (Ramsar) supports local efforts. The contribution of CHF 12,500 will make it possible to consolidate progress in mechanical eradication and the preparation of a strategy for periodic monitoring by local communities under the responsibility of the director of the Parc National des Oiseaux du Djoudj.

Further short-term help is urgently requested to help Senegal and Mauritania to undertake action aimed at consolidating advances and to prepare implementation of integrated eradication based on biological eradication on a more solid basis. The UNESCO World Heritage Centre has been requested to provide this support and a request by Senegal should be submitted as soon as possible. This assistance should cover immediate needs for practical training in biological eradication.

It is intended to prepare and submit a revised management plan for Djoudj and Diawling in order to obtain additional financial support for the programmes managed by IUCN. Contact with officials of the Global Environment Fund have identified an interest to support cross-border actions for the eradication of invasive species.

9.2 Implementation

9.2.1. Short-term action

Cleaning of protective barriers, maintenance and installation of new barriers

Period: October 2000
Cost: FF 35,000
Financing: Ramsar Bureau

Monitoring of the barriers, organisation of eradication of *Typha*

Period: November 2000
Cost: FF 15,000
Financing: Ramsar Bureau

Creation of an intervention and monitoring unit

Period: December 2000 and continuing indefinitely

Cost: Six persons at FF 500/month (FF 36,000/year); fuel costs of FF 5000/year; supplies FF 10,000/year; contingency funds FF 9000/year for a total of FF 60,000/year

Training of guards and park wardens for field work in order to have staff trained in established field management operations and provide them with a minimum of knowledge about the functioning of aquatic ecosystems. This type of training should be primarily practical and should cover techniques and the use of tools.

Period: Ten days in April 2001 (first phase)

Cost: travel and per diem expenses of the trainer; lunch for the trainees

Clearance of the entrances of the canals and backwaters by manual and mechanical means

Period: as soon as the park is dry (April to July 2001) then annual maintenance by cutting the vegetation and removal of waste from the entrances (by burning if necessary)

Cost: Intervention and monitoring unit; FF 50,000 for the work of a mechanical digger

Cleaning of Lake Lamentin (first phase) topographical survey, followed by the cutting and burning of vegetation, clearing of tributaries and removal of roots in order to lower the ground level

Period: 2001 (May and June)

Cost: Intervention and monitoring unit; FF 600,000 for the topographical survey and work with the machines

Clearing of Lake Lamantin (second phase) Based on observations of flooding during the previous winter, additional clearing

Period: 2002 (May and June)

Cost: FF 200,000

Creation of a drainage system in the saltwater areas around the dike; topographical survey; creation of a system of interconnected canals leading to the nearest backwaters (Khar and Djoudj)

Period: 2002 (May and June)

Cost: FF 150,000

Restoration of the eastern shore of Grand Lac through elimination of vegetation between the current water level and the base of the President observation point; completion of a topographical survey; clearing to a depth of 3 to 10 cm as dictated by the topographical survey; accumulation of material on the eastern side up to 1.5 metres high

Period: 2003 (April to July)

Cost: FF 500,000

Workshop on water management in the delta; creation of an organizational structure; survey of potential sources of support and preparation of a draft network of communications; organisation of logistics on the spot

Period: November 2001

Cost: FF 200,000

Persons contacted

- Babacar Ndao: Chief of Staff of the Minister for the Environment
- Mbareck Diop: Technical adviser to the president of Senegal
- Djiby Seye: Representative of the villages on the management team for the Parc National des Oiseaux du Djoudj
- Boucary Bodian: Commissariat Après-Barrage
- Dr. Awaïss Aboubacar: Wetlands International, Dakar, Senegal
- Demba Mamadou Ba: Director of National Parks, Senegal
- Abdoulaye Kane: Head of the IUCN mission, Dakar
- Merien Bouamrane: UNESCO Regional Office, Dakar
- Sara Diouf: Deputy director for National Parks in Senegal
- Amadou Matar Diouf: IUCN, Dakar
- Cheikh Awa Balla Fall: Principal technical adviser, Ministry for the Environment
- Ndiawar Dieng: Directeur des Eaux et Forêts
- Amadou Lamine Ndiaye: Technical adviser, Ministry for the Environment
- Issa Sidibé: Director of the Parc National des Oiseaux du Djoudj
- El Waled Ould Mome: Director of the Parc National du Diawling
- Amadou Ba: Head of the Parc National du Diawling
- C.C. Cheikh O. Ahmed: Marine Nationale, Responsible for the area of Chott Boul, Mauritania
- Dr. Papa Samba Diouf: WWF Regional Office for West Africa
- Dr. Jean-Yves Pirot: Coordinator for wetland programmes for IUCN
- Dr. Pierre Campredon: Scientific coordinator for the Fondation du Banc d'Arguin, Mauritania
- Cheikh Hamallah Diagana: Coordinator, Projet Chatt Boul, IUCN, Mauritania
- Dr. Mike Smart: Independent consultant
- Yves Capitaine: Businessman in the fisheries sector, Saint Louis, Senegal
- Seydina Issa Sylla: Representative for Wetlands International for West Africa, Dakar

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Annex 1: Decisions and resolutions adopted by the conventions and international treaties concerning the environment

1. The Conference of Parties (COP) of the Convention on Wetlands (Ramsar) adopted Resolution VII.14 in May 1999 on invasive species and wetlands, referring to previous decisions on wise use and management planning, which include references to avoidance of introductions, damages from unlawful introductions, and eradication of introduced species. A background document for that conference gave definitions and examples. Global coordination

measures are referred to, and the Bureau of the Convention is directed to prepare case studies. Parties are asked to review legal and institutional measures and adopt new ones where necessary, to prevent the introduction and movement of alien invasives.

2. The same resolution directed the Convention's Scientific and Technical Review Panel (STRP) to prepare wetland-specific guidelines on alien invasives and to prepare guidelines on legislation and other best practice management approaches incorporating relevant risk assessment techniques. The STRP set up a working group that considered in June 2000 whether existing guidelines developed by the Convention on Biological Diversity (CBD) and IUCN might fulfil this need. The working group decided that new Ramsar wetland-specific guidelines were not needed. The STRP itself and the Standing Committee are still considering this question.

3. Ramsar and CBD have a joint work programme, which was renewed in May 2000. Section 4 of this programme covers alien species and refers to the communication and awareness-raising project on invasives in Africa being developed by the Ramsar Bureau in partnership with IUCN, the Commonwealth Secretariat and the MacArthur Foundation. The CBD's 5th COP adopted Decision V/8 on "alien species that threaten ecosystems, habitats or species" in May 2000. Article 8(h) of the CBD itself obliges its Parties to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or indigenous species".

4. Decision V/8 urges the development and implementation of invasive species strategies and action plans, mechanisms for transboundary cooperation, enhancement of the capacity of ecosystems to recover from invasions and further development of guiding principles.

5. In the meantime, an interim set of 15 guiding principles, including definitions, is appended to the decision. The first of these principles cautions that "lack of certainty about the long-term implications of an invasion should not be used as a reason for postponing eradication, containment or control measures". Principle 4 includes a transboundary element, "States should recognise the risk that they may pose to other States as a potential source of alien invasive species and should take appropriate actions to minimise the risk". Principle 12 emphasises that "mitigation measures should take place in the earliest possible stage of invasion, on the basis of the precautionary approach", and Principle 14 emphasises that "regular monitoring outside the control boundaries is essential".

6. In addition, to the principles, the decision calls for submission of case studies and provides, in an annex, an outline format for these. One important element of this is the explicit statement of the reasons why a particular response action was selected.

7. Senegal is one of three African countries that has acceded to the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). The Convention's Standing Committee adopted Recommendation 57 in 1977 on the "introduction of organisms belonging to non-native species into the environment", which among other things calls for case studies. Appended to that recommendation is a set of guidelines. These include reference to the principle of precaution (1(a)), and not only a comprehensive and carefully planned impact study (of introductions, which would include introducing biological

control agents for alien invasive species) but also favourable conclusions to such studies before such introductions go ahead and an appropriate assessment of any other control or mitigation measures. The drawing up of special rules for certain sensitive areas is also suggested.

8. A number of aspects of these guidelines are not picked up in those produced under other Conventions; for example, “steps should be taken to ensure that introduced species are not automatically protected by law when the latter applies to all the species belonging to a particular taxonomic group, in order to make it legally possible to control them (express reference should be made to indigenous species in lists of protected species)”; and coverage of liability and compensation. There is also reference to cooperation with neighbouring countries, whether or not they are parties to the Bern Convention.

9. In 1992, the Standing Committee of the Bern Convention set up a working group of experts on introductions of non-native species, and it has been suggested (at a workshop in 1999 on non-native terrestrial vertebrates) that this be reconvened. The Standing Committee adopted a further Recommendation (77) in 1999, which included definitions and reference to impact assessment, to the fact that eradication methods should be “as selective as possible”, to inter-State liability and cooperation, to the uncertainty of the impact of eradication, and to the monitoring responsibilities of States regarding the potential threats from non-native species to biological diversity “both within their territory and elsewhere”. Finally, there is a further call for case studies.

10. The Convention on Migratory Species (Bonn Convention or CMS) provides in Article 4(c) that Parties that are range States of migratory species listed in Appendix I shall to the extent feasible and appropriate, “prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species”. The same formula is applied to Appendix II-listed species by virtue of Article V (5)(e).

11. Senegal is a party to the CMS and to the African-Eurasian Waterbird Agreement (AEWA). The current AEWA schedule of implementation priorities for 2000-2004 includes, as No. 25, “rehabilitation of important sites for migratory waterbirds which have been degraded by invasive aquatic weeds”.