



**Managing weeds in  
tropical wetlands:  
Wetland risk  
assessment and  
*Mimosa pigra***

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## **Managing weeds in tropical wetlands: wetland risk assessment and *Mimosa pigra***

**D Walden, M Finlayson, R van Dam & M Storrs**

Overhead sheets from talk presented during Technical Workshop on the Management of Biological Resources of Tram Chim National Park – Cao lanh, Dong Thap, Viet Nam; 22-27 June 1999.

### **Sponsoring organisations**

- Tram Chim National Park, Dong Thap Province, Viet Nam
- Department of Science, Technology and Environment, Dong Thap Province, Viet Nam
- International Crane Foundation, Baraboo, Wisconsin, USA

### **Themes**

- Growth characteristics of four grassland communities under two different water management regimes.
- Review of current knowledge about the relationship between soil, water conditions and *Melaleuca* growth.
- Prescribed burning as a means to prevent *Melaleuca* forest fire and management of plant communities adapted to frequently-burnt conditions.
- Population dynamics of waterbirds in Tram Chim, with special emphasis on the Sarus crane population.
- Managing weeds in tropical wetlands: the example of *Mimosa pigra*.
- Solutions for reducing the pressure from the local community on Tram Chim Reserve for the period 2000-2005.

## Content -- Overhead Sheets

1	Title page	(1)*
2	Contents	(2)
3	Wetland risk and assessment – text	(7)
4	Steps in WRA – list	(8)
5	Steps in WRA – diagram	(9)
6	Early warning systems – text	(16)
7	EWS and management	(17)
8	<i>Mimosa pigra</i> – distribution	(19)
9	<i>Mimosa pigra</i> – description	(20)
	Insert 4 slides -	
	large stand	
	ditto	
	aerial extent	
	seedling	
10	<i>Mimosa pigra</i> -- weedy features	(22)
	Insert 6 slides –	
	adventitious roots	
	ditto	
	leaf spines	
	flower	
	seed pod	
	dehiscent seed pod	
11	<i>Mimosa pigra</i> – spread in Australia	(23)
12	<i>Mimosa pigra</i> – ecological and economic effects	(24)
13	<i>Mimosa pigra</i> – control measures	(25)
14	Control measures – prevention	(26)
15	Control measures – physical	(27)
16	Control measures – ecology	(28)
17	Control measures – chemicals	(29)
18	Control measures – chemical application	(30)
19	Control measures – biological	(31)
20	Integrated control	(32)
	Insert slides	
	seedling	
	Spraying	
	Stem injection	
	Aerial effects	

Burning  
Chaining  
Biological

Overhead sheets prepared but not used in presentation

1	Tropical wetlands – values and benefits	(3)*
2	Wetland functions – examples	(4)
3	Wetland products – examples	(5)
4	Wetland attributes – examples	(6)
5	WRA – identification of the problem	(10)
6	WRA – identification of the effects	(11)
7	WRA – identification of the extent	(12)
8	WRA – identification of the risk	(13)
9	WRA – risk management and reduction	(14)
10	WRA – monitoring	(15)
11	Attributes of early warning indicators	(18)
12	<i>Mimosa pigra</i> – habitat range and distribution	(21)

\* Numbers in parentheses refer to order in the original set of powerpoint slides  
(R:\wetland\ecology\mimosa esa\.....ppt.

## Talk Outline

- 1 Introduction
- 2 Contents page
  - i The weed – *Mimosa pigra*
    - habitat and distribution
    - biology
  - ii Assessing weed problems
    - wetland risk assessment
    - early warning indicators
- 3 Distribution
- 4 Biology

### Slides

- 5 Wetland risk assessment
- 6
- 7 Early warning system
- 8 Control measures
- 9 Example of early warning and prevention
  - Kakadu NP – survey & control before major problem
    - \$2/ha/yr (200 000 ha)
    - \$400 000/yr
  - Outside park- 80 000 ha total
    - 6000 ha treated \$200/ha/yr
    - still requires survey and prevention
- 10 Prevention
- 11 Physical
- 12 Chemical - Herbicides
- 13 - Application'
- 14 Biological
- 15 Integrated
- 16 Rate of spread – NT

# **Managing weeds in tropical wetlands: wetland risk assessment and *Mimosa pigra***

**D Walden, M Finlayson, R van Dam & M Storrs**

**22-27 June 99 Cao Lanh, Dang Thap, Viet Nam**

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## Introduction 2

Tropical wetlands – values and benefits – 4 (1)

Wetland risk assessment – framework – 8 (3)

Early warning indicators – 3 (2)

*Mimosa pigra* – distribution and description – 3 (2)

- weed features – 2 (2)
- ecological and economic effects – 1 (1)
- control measures – 8 (8)

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Add colour slides

# **Appendix 1**

## **Overheads**





# **Managing weeds in tropical wetlands**

## **Wetland Risk Assessment and *Mimosa pigra***

**Dave Walden, Max Finlayson**

**Rick van Dam**

**Environmental Research Institute of the  
Supervising Scientist, Australia**

**&**

**Michael Storrs**

**Northern Land Council, Australia**



# **Managing weeds in tropical wetlands**

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- **☼ Tropical wetlands**

- values and benefits**

- **☼ Assessing weed problems**

- formal assessment**

- early warning monitoring**

- **☼ Mimosa pigra**

- life cycle**

- habitat range**

- ecological/economic effects**

- control measures**



# **Tropical wetlands**

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## **Values and benefits**

- **include many functions, products and attributes**
- **provide the reason (goal) for managing a wetland**
- **require surveillance or monitoring**
- **can easily be lost**
- **can not easily be replaced**



# **Wetland functions**

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**Include:**

**water storage**

**flood mitigation**

**erosion control**

**groundwater recharge**

**groundwater discharge**

**retention of nutrients**

**sediments and pollutants**



# **Wetland products**

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**Include:**

**wildlife resources**

**fisheries**

**forest resources**

**forage resources**

**agricultural resources**

**water supply**



# **Wetland attributes**

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**Include:**

**biological diversity**

**geomorphic features**

**unique cultural features**

**unique heritage features.**



# **Assessing weed problems**

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**Wetland risk assessment -**

**formalised procedure to  
assess the nature of the  
problem and management  
options**



# **Wetland risk assessment**

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**1. Identification of the problem**

**2. Identification of the effects**

**3. Identification of the exposure**

**4. Identification of the risk**

**#####**

**5. Risk management/reduction**

**6. Monitoring & surveillance**

**#####**



# **Wetland risk assessment**

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Identification of the problem

Identification of the effects

Identification of the extent  
of exposure

Identification of the risk

Risk management/  
Risk reduction

Monitoring



# **Wetland risk assessment**

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## **1. Identification of the problem**

- **Chemical - describe the  
chemical and its effect**
- **Invasive species - describe  
the species and its effect**
- **Identify what should be  
protected**



# **Wetland risk assessment**

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## **2. Identification of the effects - determine the seriousness of the problem**

- **Chemical - on-site  
ecotoxicological tests**
- **Invasive species - on-site  
mapping and observations**



# **Wetland risk assessment**

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## **3. Identification of the extent - determine how far the problem could spread**

- **Chemical - rate of input and  
dispersion**
- **Invasive species - rate of  
spread and habitat  
preference**



# **Wetland risk assessment**

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## **4. Identification of the risk - integrate the previous information**

- **GIS and/or relational  
databases show spatial  
aspects and linkages**



# **Wetland risk assessment**

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## **5. Risk management and reduction - decisions to manage the problem**

- **☉ Takes account of socio-economic, political and technological factors**



# **Wetland risk assessment**

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## **6. Monitoring - verify the effectiveness of the management steps**

- ⦿ Hypothesis based**
- ⦿ Provides early warning**
- ⦿ Assumes that harm has  
been defined**



# **Early warning indicators**

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- **Provide a measurable biological, physical or chemical response to a particular problem**
- **Precedes the occurrence of potential significant adverse change**





# **Early warning indicators**

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## **An early warning indicator**

- **is only useful if the information is used within a management process**
- **implies a precautionary approach and intervention before harm occurs**



# **Attributes of early warning indicators**

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- **Anticipatory/predictive**
- **Sensitive**
- **Timely and cost-effective**
- **Diagnostic**
- **Socially relevant**
- **Non-destructive**



# **Mimosa pigra**

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## **Distribution**

- **Native to tropical America**
- **Now widespread across tropics - Australia, Asia & Africa**



# **Mimosa pigra**

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**Description - tall, prickly shrub**

- **Stem - erect, branched, prickly, 3-6 m high**
- **Flower - pink/mauve globular**
- **Leaf - touch sensitive, bipinnate**
- **Fruit - hairy, flat, segmented pod**
- **Seed - oblong, 5-6 mm long, 2 mm wide**



# **Mimosa pigra**

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## **Weedy features**

- **Adventitious roots - survive in anaerobic water**
- **Resprouts from stem**
- **Sets seed in first year**
- **Seeds easily spread by water and animals**
- **Seed viability high**
- **Seed production high**
- **Withstands seasonal drought**



# **Mimosa pigra**

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## **Spread in Australia**

- **1890 - Darwin botanical gardens**
- **1952 - first seen on floodplains**
- **1970s - seed spread by floods**
- **1978 - 200 ha**
- **1980 - 4000 ha**
- **1984 - 30000 ha**
- **1989 - 80000 ha (unverified)**



# **Mimosa pigra**

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## **Habitat range and distribution**

- **Wet-dry tropics**
- **Floodplains, coastal plains, river banks**
- **Rapidly invades disturbed areas**
- **Unlikely to be in <750 mm or >2250 mm rainfall**
- **Tolerant of brackish water**



# **Mimosa pigra**

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## **Ecological effects**

- invades and alters habitats**
- loss of breeding and refuge areas**

## **Economic effects**

- invades productive areas**
- replaces cultivated species**
- reduces access**





# **Mimosa pigra**

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## **Control measures**

- **Prevention and quarantine**
- **Surveillance**
- **Physical and mechanical**
- **Ecological**
- **Chemical**
- **Biological**
- **Integrated**



# **Control measures**

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## **Prevention**

- **Education**
- **Legislation**
- **Permits**
- **Quarantine**
- **Inspections**



# Control measures

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## Physical

☉ **Hand weeding**

☉ **Slashing**

☉ **Mowing**

☉ **Chaining**



# Control measures

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## Ecology

☉ **Fire**

☉ **Competative species**



# **Control measures**

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## **Chemical**

☉ **Tebuthiuron**

☉ **Fluroxypyr**

☉ **Dicamba**

☉ **Metasulfon methyl**

☉ **Hexazione**



# **Control measures**

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## **Chemical**

- ☉ **Foliar - air or ground**
- ☉ **Soil - air or ground**
- ☉ **Cut-stump**
- ☉ **Stem injection**
- ☉ **Basal bark application**



# **Control measures**

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**Biological**

**11 species released**

**15 years of effort**

**not yet effective**



# Control measures

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**Integrated**

☉ **Multiple efforts**

☉ **Coordinated**

☉ **Continual**



# **Appendix 2**

## **Trip Report**

**Cao Lanh, Viet Nam**

**18 June - 1 July 1999**

**Trip Report**  
**Cao Lanh, Viet Nam**  
**18 June – 1 July**

**CM Finlayson**

**Purpose**

Participate in Consultative meeting on Management Measures for Tram Chim National Park 22–25 June 1999, Cao Lanh, Dong Thap.

**1 Background**

- 1.1 The International Crane Foundation (ICF) has supported conservation efforts at Tram Chim National park (formerly a Nature Reserve) since 1989. In 1994 ICF arranged for four Vietnamese associated with Tram Chim to visit Kakadu for an informal training program. The program was well received.
- 1.2 In 1998 ICF requested input to a consultative meeting on management planning for Tram Chim. They specifically requested advice and information on managing *Mimosa pigra*. Travel and living expenses were covered by ICF with support from the Dong Thap provincial authority.
- 1.3 A draft paper entitled 'Managing weeds in tropical wetlands: Wetland risk assessment and *Mimosa pigra*' was prepared by Dave Walden, Max Finlayson, Rick van Dam and Michael Storrs. A shortened version of the text was presented during the workshop (consultative meeting). A copy of the overheads prepared for the talk are shown in IR 321. A sub-set of the overheads were used in the presentation along with slides (see R:\risk\mimosa\_wra\overheads.ppt).

**2 Workshop (22-23 June 1999)**

- 2.1 The workshop covered 2 days and included welcome and opening speeches followed by presentations on biophysical characteristics of the National Park (soils, water, aquatic biota (Melaleuca forest, herbaceous plants, waterbirds, fish)), socio-economic factors, and management procedures (water depth and flooding, fire and invasive species). The talks were presented in either Vietnamese or English with either individual or group translation arrangements. Written papers were also distributed, in either language.
- 2.2 Presentations were also requested from various Vietnamese agencies, the Mekong River Commission, and myself describing management issues in Kakadu. As previously indicated, Kakadu was being used as a source of information and guidance on some of the management issues faced at Tram Chim given the similarity in species and climate.
- 2.3 Workshop discussions addressed biophysical and socio-economic conditions at the park. The former included developing a balance between fire, water and weed management with a major consideration being the imposition of a draw-down of water to encourage the expansion of wild rice, as had previously existed under more natural conditions. The rice had largely been replaced by eleocharis-sedge as the water level in a major component of the park had been kept high to prevent wild fire in the Melaleuca forests. Such fires had previously devastated the forests that accumulated a large amount of litter that was no longer flushed through.
- 2.4 A management plan that addressed many of the issues being discussed was somewhat unexpectedly thrust upon the workshop. This was supported by the scientific advisors,

but only reluctantly accepted by administrative staff concerned about the danger of fire under a proposal to lower the water level during the dry season. The discussion was animated and very much represented the fire management arguments that have resounded in forest and parks elsewhere in the world.

- 2.5 The discussion also high-lighted a need to accept a realistic goal that focussed on the features of the park area (6700 ha) and did not try to replicate the former Plain of Reeds per se. The reserve is in effect an 'island' within a greatly altered landscape. Further, the reserve is surrounded by heavily populated villages and rice paddy, much of it of recent origin and not necessarily sustainable without the addition of chemical fertilizers. Socio-economic surveys did not show a great deal of public knowledge of or support for the park.
- 2.6 The presence of the Cambodian wetland program team was welcomed and could have some immediate benefits as ICF staff plan to visit Cambodia very soon. Some of the birds that now visit Tram Chim may also use wetlands in Cambodia.
- 2.7 Amongst the Vietnamese participating in the workshop was Pham Trong Thinh who visited *eriss* in 1994. On several occasions during the workshop he espoused the benefits gained from that visit. The workshop organiser, Tran Triet, was also very mindful of the information source that *eriss* presented. In this respect the reference material on Mimosa compiled by Dave Walden was well received.

### **3 Tram Chim National Park**

- 3.1 An initial one day visit to the park was made with most workshop participants. This was a general introduction and covered the issues of water management (particularly inundation period), fire and weed invasion. The balance between water/fire/weeds is a critical aspect of management controversy. Associated, in fact, inseparable is the local communities who ring the park. A very hot field trip by boat was conducted, punctuated by the now 'expected' wonderful food.
- 3.2 Immediately following the field trip a discussion on management issues was held, after a 'formal' and scrumptious dinner. It was identified that Kathy Ewe and myself would seek support from the journal Wetland Ecology & Management to publish the workshop proceedings as a special issue.
- 3.3 Further immediate ideas focussed on seeking support for a weed (Mimosa) and fire management practitioners to visit and provide advice and training. It seems that northern Australia has the necessary expertise, but from whence does the money cometh? And the expertise does not reside within *eriss*. But could be potentially developed through the NCTWR. The USDA may have better (by far) access to finding support. A tripartite arrangement was anticipated.
- 3.4 A further more detailed site inspection of the park was cut short after three people were badly stung by very aggressive paper wasps (25-50 bites each). The three people were in great pain and evacuation procedures were pain-stakingly slow, by necessity – walking, swimming and paddling from the wetland to the local clinic and eventually by bus to the regional hospital. The care and hospital treatment was excellent, but the terrain made things difficult. The provincial authorities responded marvelously and provided practical and sentimental care to a high level.
- 3.5 Further visits, with increasingly smaller parties as people departed, focussed on Mimosa invasion and possible control, fire control, water regulation, and biological surveys and

- monitoring. All issues were developed further in discussions with park staff and provincial officials. These specifically addressed – water, vegetation and bird surveys; Mimosa and fire control and management; and socio-economic features, including appropriate development in the buffer zone and involvement of local people in park activities.
- 3.6 Two further days were spent conducting bird surveys (low season for species and numbers) and taking GPS readings at key boundary points. This was done by boat. Copies of data were left at the park.
  - 3.7 The staff of the park were very competent and personable. They have an enormous task and are aware that they are not inseparable from the society around them. The handling of poachers was done firmly, but not by an arrogant demonstration of power. Socio-economic programs were integral to the park's survival and a 'park-boundary' mentality did not exist. They were under-resourced to hell. They were erudite and far-thinking, and perfect hosts. And they were prepared to accept advice from scientists.
  - 3.8 An inventory of fire-fighting equipment was made (see attached) and copies left with park staff and ICF.

#### **4 Further actions**

- 4.1 With relevant agencies develop a proposal to send a Mimosa control practitioner to Tram Chim, under auspices of NCTWR.
- 4.2 Ditto for fire management in Melaleuca, and combined with USDA initiatives.
- 4.3 Seek support for student research projects at Tram Chim on fire and weed management, also under possible NCTWR links.
- 4.4 Provide costings for possible visit to *eriss*/Kakadu by staff from Tram Chim and Dong Thap. Model as per that developed for Malaysian visitors in 1998. And seek possible funding support.
- 4.5 Collate and send further literature on tropical wetland ecology.
- 4.6 Assist with workshop proceedings, via contact with Kathy Ewell and Wetland Ecology and Management journal.
- 4.7 Specifically collate information on Melaleuca ecology and send to Tram Chim.
- 4.8 Provide incentive for more *eriss* staff to get off their butts and become involved in the world. They have not developed sufficient capacity to do so.
- 4.9 Investigate acquisition of remotely sensed data from CEISIN (see Ramsar COP7 trip report).
- 4.9.1 Send bird data and GPS readings to ICF.

#### **5 Recommendations**

- 5.1 See attached sheets for draft recommendations for Mimosa control. These require further discussion.
- 5.2 A critical factor to consider in all further management actions was the need to involve the local people. Mimosa currently provides a supply of wood for fuel. Bird and fish/snail poachers were evicted and their catches released, even dead fish being dumped.

**Tram Chim National Park  
Management of *Mimosa pigra*  
Ideas and Concepts for discussion**

Procedures drafted after field visit and discussion with Tram Chim personnel

Key steps identified as a basis for decisions by Tram Chim management

Further steps and potential for assistance and advice identified

Max Finlayson

27/06/99

## **Procedures for managing *Mimosa pigra* in Tram Chim National Park, Dang Thap (draft 1)**

### **1 Prelude**

- 1.1 These procedures are produced as guidelines for the staff from Tram Chim National Park and others, as appropriate, to develop and implement a management program for *Mimosa*. The program needs to be developed with full consideration of local circumstances and to be responsive to changing circumstances (ie an 'adaptive management' approach).
- 1.2 The procedures as outlined below were developed based on information obtained from northern Australia and after discussion with staff from Tram Chim and other organisations. Discussions were undertaken in formal and informal settings, including visits to the park.
- 1.3 Further information can be obtained from the report 'A guide to the management of *Mimosa pigra*', KLS Harley (editor), CSIRO Canberra 1992, 121 pages. This report was prepared for an international workshop held in Darwin, Australia, 11-15 May 1992. Further information has become available since 1992 and should be considered. Much of this information will be summarised in the paper 'Managing weeds in tropical wetlands: Wetland risk assessment and *Mimosa pigra*' prepared by Walden D, Finlayson M, van Dam R and Storrs M for the Consultative meeting of Management Measures for Tram Chim National Park, 22-25 June 1999, Cao Lanh, Dang Thap, Viet Nam. This work will be further extended through a collaborative program being developed under the auspices of the newly established National Centre for Tropical Wetland Research in Darwin, Australia.

### **2 Procedures – strategic control of *Mimosa***

- 2.1 Survey to establish or confirm the extent of *Mimosa* infestation in each sector of the National Park. The larger sectors could be sub-divided for ease of management planning.

The survey information could include:

- Number/density estimate of plants (eg number of plants per area, or subjective broad analysis – none, low, medium, high density)
- Height of plants (eg subjective analysis – seedlings, 10-50 cm, 50-100 cm, 100-200 cm, >2 m)
- Phenology of plants (eg seedling, flowering, fruiting, seeding)
- Distance from the park boundary or water gates
- Distance from other infestations
- Water depth and fluctuations

The survey information should be stored in a formal record system, database and/or presented on a map. The survey methods, dates and names of staff should also be recorded.

- 2.2 Assessment to identify priority areas for control activities. Prioritisation could be based on a number of factors, including:
  - Low level of current infestation
  - Potential to become (further) infested (eg following draw-down or reduced competition following fire)

- Particular conservation value or use of the area
- Potential to spread to other sites
- Usefulness as a demonstration site for training and public education

The assessment will reflect the objectives and management priorities outlined in the management plan for the park, and should be regularly reviewed. Areas of current low infestation or those exposed after draw-down could be initial priorities.

2.3 Choice of control methods will be related to the assessment and prioritisation process, and be influenced by practical considerations (eg access, equipment and personnel). Control methods (in brief) include:

- Cutting and removal of flowers/seed pods
- Cutting and removal of stem material before flooding
- Hand-removal of seedlings (eg after draw-down or low level flooding)
- Chemical applications (eg foliar application or slow-release pellets in association with above methods)
- Establishing competitive plant species after physical removal, in shallow water, or on areas exposed after draw-down.
- A combination of control measures may be needed. Further assessment of the usefulness and costs of chemical applications could be worthwhile. Biological control may be useful in the future.

2.4 Education and training of staff involved in the survey and control is required. This could cover the necessity to control Mimosa as well as the methods that could be used to control or, at least restrict the spread of Mimosa.

2.5 Implementation of active control measures should be based on the above strategic considerations, and be ongoing. Where necessary the program should be adopted on the basis of local experience and further information, with regular review and reassessment.

2.6 Research into specific aspects of the biology of the weed (eg seed viability and longevity) or specific control methods (eg extent of flooding, or effectiveness of slow-release chemicals) may assist the development of the control program. This could be done in conjunction with an active control program, and should be coordinated to avoid confounding the results.

2.7 Survey and reassessment of the program should be done on a regular basis. The reassessment will draw heavily on the records kept during the above described procedures. Where necessary the program should be adjusted, based on practical experience and scientific evidence, and even stopped if proving ineffective (in terms of costs and results).

### **3 Public awareness and participation**

3.1 Management of Mimosa inside the park can not be done effectively if it is done in isolation of the surrounding land and local communities. Mimosa does not 'respect' lines drawn on a map. The park is both a (potential) recipient and a source of propagules (eg seeds) for further infestation. The latter could be seen as a negative aspect of the park and result in (further) antagonism towards achieving the values and goals espoused through the management plan.

- 3.2 Mimosa is also a direct threat to the livelihood of the local people who ring the park boundary. It can quickly expand along the banks of canals, streams and even paddies and prevent access by people. It can also invade the rice paddy and other cultivated areas.
- 3.3 Mimosa is seen as a source of fuel-wood by local people. This can be used, given appropriate measures to ensure that it does not lead to further spread of infestations (eg by removing and burning the seed pods), to encourage local people to control Mimosa near their houses etc and, under contract and supervision, in the park. This would be most effective if done in conjunction with a scheme to propagate an alternative source of fuel-wood.
- 3.4 The local communities that surround the park should be made aware of the disadvantages of the further spread of Mimosa and of the benefits of controlling it.

#### **4 Further assistance/advice**

- 4.1 In collaboration with relevant agencies and individuals in northern Australia it may be possible to arrange for a practical Mimosa control practitioner to visit Tram Chim. This person(s) could provide practical advice and on-site training for local personnel.
- 4.2 In collaboration with appropriate Vietnamese agencies and the USDA-Forest Service (Dr Kathy Ewell) it may be possible to engage a student to undertake specified autocological studies on Mimosa at Tram Chim. This could be used to corroborate or affirm ecological aspects of the potential of Mimosa to spread further at Tram Chim. Current expectations are primarily based on knowledge from northern Australia and initial experience only of the site conditions.
- 4.3 The above 'programs' could be coordinated through the National Centre for Tropical Wetland Research in Darwin with Dang Thap Province and ICF.

Max Finlayson



## Tram Chim National Park

### Fire equipment – Inventory 26/6/99

6	Stainless steel tanks (14-17 L) back-pack with hand operated spray pump (Yama Kutoba brand)
2	Bladder packs (not seen)
16	30 L plastic water drums
12	4 inch hoses, assumed 50 ft lengths
2	Drip torches
7	Hand rakes (hoes)
2	High pressure pumps 5/6 HP (Vanguard brand, B & S motors)
1	High volume pump (Rabbit portable fire pump)
3	4 inch hose nozzles
1	Double-nozzle, assumedly for high volume pump

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Issues	<ul style="list-style-type: none"><li>- maintenance of equipment eg hose integrity, and motors</li><li>- equipment required to readily access fire location, noting wet-dry conditions and potential to 'stake' tyres</li></ul>
Storage	<ul style="list-style-type: none"><li>- equipment stored in room at 'guest house', locked, but key not readily available</li></ul>
Procedures	<ul style="list-style-type: none"><li>- not discussed, but apparently theses have previously been determined.</li></ul>

Max Finlayson

John Phipp

26/6/99