

LEGISLATIVE ASSEMBLY OF THE NORTHERN TERRITORY

SESSIONAL COMMITTEE ON THE ENVIRONMENT

REPORT INTO MATTERS RELATING TO ENVIRONMENTAL PROTECTION AND MULTIPLE USE OF WETLANDS ASSOCIATED WITH THE MARY RIVER SYSTEM

APRIL 1995



FOREWORD

The successful achievement of multiple land use in the Mary River will not be easy. It will depend largely on the ability of all stakeholders concerned with the use and management of this area to find compromise on many of the problems and issues affecting the Mary River and its wetlands.

This inquiry was most interesting and challenging and generated a wealth of information from a wide cross section of the community with an interest in this area. This knowledge collated in this report and that provided by participants to the inquiry will be of immense value to the management of wetlands and in particular those associated with the Mary River.

On behalf of the Committee comprising Mr Peter Adamson MLA (Member for Casuarina), Mr John Bailey MLA (Member for Wanguri), Mr Wes Lanhupuy MLA (Member for Arnhem) and Mr Phil Mitchell MLA (Member for Millner), I would like to formally express my thanks and appreciation to all those people who assisted the Committee in preparing this report.

I am particularly grateful for the efforts provided by Mr Rodney Applegate, specialist wetlands consultant to the Committee. He worked extremely hard in analysing the information, providing professional advice and guidance and in ensuring that the report was completed on schedule.

Also special thanks to Mr Graham Gadd, secretary to the Committee and Ms Liz McFarlane for the administrative and coordination assistance provided.

The Committee would like to express its appreciation to the Parliament for the opportunity to contribute to the resolution of problems and issues affecting the sustainable management of the Mary River wetlands for multiple use.

Dr Richard Lim, MLA Chairman

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1. INTRODUCTION

1.1 Terms of Reference

The Sessional Committee on the Environment has been charged to -

"inquire into and from time to time report upon and make recommendations on:

(a) all matters relating to uranium mining and processing activities and their effects on the environment within the Alligator Rivers region; and

(b) any matter relating to mining and/or the environment within the Northern Territory which is referred to it by -

(i) the relevant Minister; or

(ii) resolution of the Legislative Assembly.

On Thursday 24 November 1994 the Legislative Assembly passed a resolution in accordance with paragraph (b) (ii) above, for the Committee to investigate:

matters relating to environmental protection and multiple use of wetlands associated with the Mary River system, including measures to rehabilitate and restore wetlands degraded by usage and natural occurrence; Committee to report not later than 30 April 1995.

The Committee has also been authorised during the course of its investigations -

"(a) to send for persons, papers and records, to sit in public or in private session notwithstanding any adjournment of the Assembly, to adjourn from place to place and have leave to report from time to time its proceedings and the evidence taken and make such interim recommendations as it may deem fit, and to publish information pertaining to its activities from time to time;

(b) to publish from day to day such papers and evidence as may be ordered by it, and, unless otherwise ordered by the Committee, a daily Hansard to be published of such proceedings as take place in public; and

(c) to consider the Minutes of Proceedings, evidence taken and records of similar Committees appointed in previous Assemblies.".

1.2 Procedure adopted by the Committee

This is the first reference on environmental matters received by the Committee in pursuance of part (b) of its terms of reference. It was a challenge readily accepted by all members of the Committee.

The Sessional Committee comprising Dr Richard Lim (Chairman), Peter Adamson, John Bailey, Wes Lanhupuy and Phil Mitchell carried out inspections of the Mary River wetlands both before and during the wet season. These visits gave members first hand exposure to the most serious problems of both saltwater intrusion and Mimosa infestation. The Committee was able to appreciate the magnitude of the areas affected or likely to be damaged if these problems are not dealt with successfully.

Members of the Sessional Committee attended the Wetland Workshop hosted by the Conservation Commission of the Northern Territory in December 1994 and heard first hand from the key stakeholders regarding their concerns and listened to detailed discussion of a range of possible solutions and their implications.

The Sessional Committee called by advertisement in local and interstate newspapers for public submissions regarding multiple use of wetlands associated with the Mary River system in December 1994. The Committee also wrote to over 60 organisations and interest groups seeking their input to the inquiry. By the closing date of submissions on the 14 February 1995, eighteen submissions had been received.

Public hearings were held on 14-15 February 1995 and eleven organisations or individuals made oral presentations to the Committee and answered questions from the Committee.

All submissions both oral and written were carefully considered in the Committee's deliberations and the conclusions and recommendations presented in this report.

1.2.1 Multiple Use

The Committee is charged with the responsibility of advising on strategies for multiple use of the Mary River wetlands. In order to discharge this responsibility effectively, it is necessary for the Committee to adopt a working definition of the term "multiple use". A literal interpretation might suggest that it relates to the achievement of more than one land use on a given parcel of land.

However, to adopt such a view would trivialise the issues referred to this Committee, because all Territory lands are then by definition multiple use. Parks and Reserves meet conservation goals while also supporting a thriving tourism industry. Land managed for other forms of production, like pastoralism, are subject to regulatory instruments designed to promote conservation of wildlife.

Rather, the Committee view the achievement of multiple use as a regional land-use goal. To adopt a multiple use strategy for a region is to accept the responsibility to:

- ensure the long term economic and social sustainability of individual enterprises in that region;
- maintain the resource base on which those enterprises depend;
- promote opportunities for new enterprise based on as yet unutilised resources;
- protect the region's biological diversity; and
- maintain essential ecological processes.

Combining two or more sustainably managed enterprises in one region does not in itself constitute effective multiple use, because their combined sustainability does not necessarily maintain biological diversity nor ecological function.

It may be necessary to limit development before maximum economic productivity is achieved, if ecological sustainability is to be ensured.

The Committee consider that the responsibilities it has outlined can only be satisfied if it is accepted from the outset that landholders, representatives of other sectoral interests, and community groups may be required to accept some constraints on the achievement of their narrower goals. There can be no simple formulae for arriving at effective multiple-use regimes because issues will vary from region to region. The only constants will be the need for careful analysis, and a willingness to compromise to achieve a balanced outcome.

The recommendations made by the Committee constitute an attempt to achieve that balance, and so optimise the net benefit to the community from the management of the Mary River wetlands.

1.3 The Wetland Workshop

In order to promote discussion of the issues affecting the Mary River wetlands among various interest groups and stakeholders involved in their management and use, the Conservation Commission of the Northern Territory convened a workshop on the 6-7 December 1994 at the Beaufort Hotel in Darwin. This workshop aimed to broaden the understanding of wetlands and their problems and to obtain acceptance and consensus among stakeholders and interest groups that action needs to be taken to ensure the survival of the Mary River wetlands for multiple use purposes.

The workshop attracted a wide range of representation from all stakeholders with an interest in the wetlands and their future management. Expert speakers from the USA and Australia provided background on how conflicts in wetland land use have been addressed in other parts of the world and other information specifically related to the Mary River wetlands. The history of land management in the region was summarised, with emphasis being given to the major issue of saltwater intrusion.

It was apparent to the Committee as a result of their attendance at the Wetland Workshop and from subsequent evidence presented during public hearings that the Northern Territory Government, in conjunction with local landholders, has actively addressed problems of saltwater intrusion in the Mary River wetlands since 1988. Over this period, a number of critical investigations have added to the understanding of the problem and the processes driving the saltwater intrusion. The region is also suffering from other problems and because of competing land uses there are new conflicts emerging.

The workshop concluded with a resolution which recognised that all stakeholders in the wetlands were united in their support of actions to improve conservation, management and sustainable use of the resources and biological diversity of the Mary River wetlands. There was also recognition that coordination of action by the large range of stakeholders involved in the wetlands was poor and needed improvement.

The workshop participants agreed unanimously that:

- government be informed of the need for a task force to address the problems identified by the workshop participants.
- government appoint a lead agency to coordinate the task force.
- government makes resources available to:
 - 1. Establish a monitoring program to collate baseline information.
 - 2. Design and construct effective barrages in 1995 to arrest saltwater intrusion.
 - 3. Prepare a catchment management plan.
- the problems identified in the workshop be compiled into a reference document of the stakeholder views.

The outcomes of the workshop were referred to the Sessional Committee on the Environment for consideration in conjunction with its reference on the Mary River wetlands.

2. RECOMMENDATIONS

2.1 Integrated Catchment Management

The Committee recognises the urgency of undertaking remedial action to address a number of key problems affecting the catchment of the Mary River. In the short term these urgent issues must be addressed by appropriate and relevant departments. However, in the long term many of the problem issues requires a coordinated approach to their successful resolution and one which ensures all stakeholders are consulted and involved in any decision. As such the Committee recommends:

- 1. That Government establishes a Task Force to coordinate, plan and implement the range of works and strategies recommended in this report. The Task Force should be Chaired independently and have a majority of non government members. The Task Force should have only one representative from the key industry groups and Government departments.
- 2. That the Task Force examines the option of developing the Mary River Integrated Catchment Management Plan under specific legislation which will bind all stakeholders to the plan and its implementation. The development of the plan and its coordination should be administered by the relevant government department with the most appropriate legislation.

2.2 Saltwater Intrusion

The Committee considers that the Northern Territory Government must treat the problem of saltwater intrusion most seriously and take urgent and immediate action in order to safeguard and protect the future landuse in the Mary River system. In particular the Committee recommends:

- 3. That pilot works trials be completed into tidal choking in estuarine creeks.
- 4. That engineering investigations, environmental assessment and budgetary planning be completed, in conjunction with the pilot works trials, to establish the feasibility of constructing works within the next 2-3 years which will permanently dampen tidal flows through the mouths of Tommycut and Sampan Creeks.

- 5. That detailed survey and assessment be undertaken to determine the location of key barramundi nursery swamps along the coast between Adelaide River and Wildman River including the determination of key vegetation and hydrological characteristics.
- 6. That no new barrages or blocks be constructed across water channels without consultation with the Fisheries Division of DPI&F and consent from the Controller of Water Resources under the *Water Act (1992)*.
- 7. That the difference between works to block saltwater intrusion and works to pond water for pastures be clearly defined and agreed by all stakeholders.
- 8. That remedial works be constructed urgently and prior to the 1995/96 wet season in the Shady Camp floodplain area as an interim measure to prevent saltwater intrusion advancing further south than its current limits.
- 9. That monitoring of fish stocks and migration patterns continue in the Mary River in order to assess the impact of current and future saltwater intrusion remedial works.
- 10. That research is conducted into fish stock numbers in Chambers Bay to determine why catch numbers have decreased over the past 5 years.

2.3 Weeds

The Committee recognises that *Mimosa pigra* infestation is a most serious problem with the capacity to alter the productivity and biodiversity of large tracts of land and in particular wetlands. The Committee considers the weed as one of national importance and should be treated as such by both the Commonwealth and Territory Governments. The Committee recommends:

- 11. That additional resources are provided by Government for the biological, chemical and mechanical control and containment of *Mimosa pigra* in the Mary River catchment and such control programs be enhanced as a priority.
- 12. That subsidy arrangements for landholders conducting Mimosa control programs be structured to encourage greater commitment, action and successful outcomes by landholders.

- 13. That DPI&F devote greater research and extension effort into the use of native floodplain grasses for the purposes of revegetating and restoring areas of floodplain where Mimosa has been removed.
- 14. That these issues be incorporated into a weed management strategy for the Mary River catchment and that it be implemented urgently.

2.4 Improved Pastures

- 15. That no exotic pasture species be planted on the floodplain except as part of an integrated Mimosa control program and that the spread of existing exotic pasture on the floodplains is not actively encouraged.
- 16. That landholders use native pasture species to rehabilitate areas of floodplain degraded by saltwater intrusion or Mimosa.
- 17. That guidelines be developed in conjunction with all landholders in the catchment on the choice of pasture species, the most appropriate sites, method of establishing, and proper management of improved pasture on upland country.
- 18. That alternative pasture species to Gamba grass be identified and that these species be actively promoted as suitable alternatives.
- 19. That the cost of improving the upland country with improved pasture and the associated ongoing management costs be determined so that the full marginal returns on investment are clear, together with the time frame involved.
- 20. That all proposals by landholders to develop areas of ponded pastures on the floodplains be assessed for environmental impacts.

2.5 Land Competition

The Committee recognise that there is limited upland country within the lease boundaries of some of the properties to fully utilise the productive potential of the floodplains. Given this restraining parameter, the Committee recommends:

- 21. That such properties only carry breeding herds at levels that the upland country can sustainably support in the wet season. Appropriate authorities should examine economically realistic measures to improve this upland country and provide advice to landholders on ways to diversify their income so that these properties are sustainable in the long term.
- 22. That the primary purpose for Reserve and Park estate in the catchment be for conservation, recreation and tourism. The value of such land should not be compromised by pressures to use this land for other purposes unless there is a express conservation management requirement to do so.
- 23. That coastal cheniers and mangrove communities along the shore line be fenced from the rest of the property to exclude stock from these areas.

2.6 Visitor Impact

- 24. That any plans to develop the Mary region for increased tourism and recreation activities be done under a broader integrated catchment management plan and in close cooperation with landholders in the Mary River catchment.
- 25. That the legalities regarding trespass, waterways and flood conditions be clarified and disseminated widely to all stakeholders.
- 26. That a crocodile management program be implemented to deal with problem crocodiles in waterways on or adjacent to pastoral properties. Such a program should provide for the exclusion of stock from waterways and alternative watering points by landholders affected.
- 27. That controls be placed on marine/aquatic operations and recreational boating activity on Mary River waterways to minimise environmental impacts including further erosion damage to river banks.

2.7 Feral Animals

The Committee recommends:

- 28. That all landholders treat feral pigs as a serious pest animal and work within their means to eradicate them rather than treat them as a harvestable resource for short term financial gain.
- 29. That an integrated feral pig eradication strategy be formulated by landholders for the catchment.
- 30. That landholders and in particular managers of government estate, are encouraged to consider using qualified and appropriately organised sporting shooters from approved organisations, to conduct feral pig control shoots on land under their control.
- 31. That any shooter licensed to conduct feral animal control operations in the catchment has appropriate certificates in hunting and these operations be carried out in accordance with those certificates developed and issued by recognised and registered Shooting Associations of Australia.

2.8 Bushfires

- 32. That a fire management strategy for the region be developed and integrated with the other land management strategies which have been recommended.
- 33. That landholders work with government and landholders from adjacent catchments to develop a fire management plan and that its resourcing and implementation be closely monitored.

2.9 Wildlife Habitat Protection

The Committee recommends:

- 34. That the relevant authorities, in conjunction with landholders, identify sites important to wildlife including fish and other aquatic biota and assess the potential impacts of changed land use practice on those sites.
- 35. That a wildlife conservation strategy for the catchment be developed, that recognises the linkages between different elements of the wetland system and the need for complementary actions on the public estate and privately managed land, and incorporates agreed responses to adverse change.
- 36. That wildlife values and their contribution to commercial activity (eg. Tourism) be explicitly incorporated in any cost benefit analysis undertaken when developing regional land use plans and property management plans.

2.10 Water Quality

- 37. That investigation of the interrelationships between natural catchment processes, land use and management practices and water quality in key sections of the Mary River system continues and that results are disseminated widely to all stakeholders.
- 38. That water quality management plans be developed and implemented for the full Mary River Catchment in accordance with the Water Act, with full consultation and participation by stakeholders, so that land use, management practices and any new development in the catchment contribute to the maintenance of beneficial uses of the wetlands appropriate to environmental and production needs.
- 39. That the impacts of sand mining on flow dynamics and the movement of sediment in the Mary River system be carefully assessed and these findings be taken into account prior to any further sand mining leases or licences being issued in the Mary River.

3. BACKGROUND

3.1 Geomorphology

The lower Mary River is unusual among river systems in the Top End as until recently it existed as a series of unconnected billabongs rather than a continuous channel to the sea. The only comparable morphology occurs in the Finniss/Reynolds River system to the south of Darwin. About 50 years ago the morphology of the Mary River began to change and today the major outlet of the river system is a 35 kilometre channel from Shady Camp billabong to Chambers Bay.

A three year detailed study was undertaken by the University of Wollongong (Woodroffe and Mulrennan, 1993) to describe the geomorphology of the Mary River and determine the chronology of change and the reasons for such change.

3.1.1 Holocene Development of the Lower Mary River Plains

The plains are Holocene in age having been deposited in the last 10,000 years. The main impact in this period has been fluctuating sea levels. After the last ice age there was a period of rapid sea level rise until about 6,000 years ago when sea levels stabilised to around present levels. During this period of sea level rise a large embayment of the Mary River was inundated and filled with marine muds carried to the embayment by the sea. When the sea level stabilised, there was further vertical accretion of muds stabilised with mangroves.

The coastline continued to build out or prograde as sediment was deposited. Approximately 4000 years ago, freshwater wetlands gradually replaced the mangroves as freshwater muds, eroded from the catchment, were deposited over the marine muds. As the coastline built out , a series of cheniers were also built coinciding with changes in sediment properties. The present shoreline was reached around 2,000 years ago and has changed very little since then.

The path taken to the sea by freshwater flows has varied during this period as evidenced by the remains of old river channels or paleochannels. The paleochannels on the coastal plain are no older than 5,000 years and those which extend seaward of the inland chenier are younger than 3,500 years.

These paleochannels represent both tapering estuarine channels and more fluvial dominated channels exiting to the sea. These paleochannels were abandoned between 2,000 and 3,000 years ago, and the freshwater wetlands were established on the paleoestuarine plains and over much of the coastal plain. There was no major outlet of the Mary River and certainly no major tidal outlet in the past 2,000 years.

3.1.2 Morphology

There are 3 broad morphological provinces recognised on the Lower Mary River floodplains.

- · a Coastal Plain
- a Paleoestuarine Plain
- an Alluvial Plain

3.1.2.1 Coastal Plain

This is a near horizontal progradational plain built up as a result of deposition of sand and mud in Chambers Bay. The average elevation of this plain is 2.0 -2.5 m AHD. The zone closest to the sea is dominated by mangroves up to 200 m wide. An open saline mudflat lies behind this zone before the coastal plain proper is reached. It was once dominated by grasses, sedges and *Melaleuca* forest and woodlands but much of this zone has been inundated by saltwater with associated death of freshwater vegetation.

Paleochannels and associated levees are features of the plain with the paleochannels being former tidal channels. The levees of the paleochannels are often only 50-60 cm higher than surrounding plains. One important feature of the coastal plains is the series of chenier/beach ridges that mark the position of former shorelines as the coastal plain gradually built out. These chenier ridges are made up of sand and shell fragments overlying muds and mark a period of interruption of the normal muddy build-out of the delta shore. They have very little relief, often less than 300 mm above the rest of the plain, but this height difference relative to the rest of the coastal plain gives them a very significant influence over salt and freshwater movement.

3.1.2.2 Paleoestuarine Plain

The paleoestuarine plain formed as a tidal floodplain flanking an estuarine channel. The zones or units within this province are classed as floodplains and swamps and are distinguishable by their elevation and frequency of inundation. Paleochannels and flanking levees are again clearly visible. The elevation ranges from 2.5-2.6 m AHD near Shady Camp steadily increasing to 3.0-3.2 m AHD near Corroboree Billabong. These floodplains are made up of a thin veneer of freshwater sediments overlying deep saline muds.

3.1.2.3 Alluvial Plain

This plain occurs to the south of the paleoestuarine plains and is mainly alluvial deposits traversed by a series of creeks and has a much greater elevation in excess of 4.5 m AHD.

3.2 Significance Of The Mary River Wetlands

The Mary River Wetlands cover an area of 127,600 hectares and is listed in the Directory of Important Wetlands in Australia. In Australia, the driest inhabited continent, all wetlands are of high conservation significance. This is no less true of wetlands in the seasonal tropics of the Northern Territory, where they buffer whole regional faunas against the effects of the annual drought in the dry season.

In particular they provide a breeding area, habitat and refuge for wildlife populations, most conspicuously waterbirds, barramundi and estuarine crocodiles. They assume even greater significance in the face of rapidly shrinking wetland habitats throughout Australia and the rest of the world. Their effective conservation management can make an important contribution to the maintenance of biodiversity in the Northern Territory and Australia.

3.2.1 Flora Values

The components of the flora of the Mary River catchment do not differ in any remarkable way from adjoining areas of the Top End coastal and subcoastal zone. The region supports a mix of savanna woodlands, tall *Eucalyptus* and *Melaleuca* forests, monsoon rainforests and vine thickets, and a range of grassland and sedgeland communities occupying low-lying plains that are inundated for periods ranging from a few weeks to several months. It is the extent of these productive wetland sites that give the Mary River its special character and, as a result, they have been the focus of human activity since they emerged from the sea several thousands of years ago.

In common with other floodplains of the Top End of the Northern Territory, the Mary River wetlands support a number of species of plants and unusual vegetation types that are rare at the national level. Perhaps the most notable of these are the floating mats of vegetation which develop on the margin of permanent waterbodies, such as the larger river billabongs of the Mary River. If undisturbed, these mats may ultimately build, through the accumulation of remains of dead plants and trapped sediment, until they are capable of supporting small trees.

These mats provide important nesting sites for Saltwater Crocodiles, *Crocodylus porosus*, and habitat for a range of other fauna. During the dry season large numbers of Northern Long-necked Turtles aestivate in the shelter they provide. The Mary River is the only site at which floating mats comprised predominantly of the rare plant *Monochoria hastata* have been recorded.

Whilst the protection of these features of the floodplain is important, the significance of the Mary River system is founded neither in the presence of rare plant species, nor unique aggregations of unusual vegetation types. Rather, the collective conservation value of the wetlands and their surrounds derives from a diverse range of interactions between water and vegetation, to provide an equivalently diverse mix of wildlife habitats.

3.2.2 Fauna Values

The Mary River wetlands provide habitat for an unusually rich and abundant fauna, including spectacular aggregations of many hundreds of thousands of birds. Some of the most notable features of the fauna include:

- unusually dense aggregations of nesting White-Bellied Sea-Eagles Haliaeetus leucogaster along the midstream segments of the river channel;
- the world's densest populations of large Saltwater Crocodiles at Shady Camp;
- huge nesting colonies of the Magpie Goose Anseranas semipalmata;
- a number of important breeding rookeries for egrets, herons and cormorants;
- extraordinary dry-season breeding aggregations of the Arafura file snake at Alligator Head;
- a "scientific reference" population of the Australian Freshwater Crocodylus johnstoni in which many individuals have been tagged and studied for more than 15 years;
- large populations of more secretive wetland birds like the White-Browed Crake; and
- roost sites for migratory shorebirds that are protected by international treaty.

Moreover, large numbers of animals which are not usually associated with wetlands may depend on the resources these sites provide during the dry season.

The Mary River is also one of the most productive barramundi fisheries in the Northern Territory. Today it is the most important area for recreational fishing with more than half the barramundi fishing taking place on the Mary River. This abundant supply of barramundi, *Lates calcarifer*, helps to attract large numbers of tourists and recreational fishermen to the river. The coastal waters of Chambers Bay are also important for commercial fishing of barramundi as well as other fish, prawns and crabs.

But perhaps the most important feature of the Mary River system is that it has been described as a "core" or source habitat for some elements of the fauna. For example, Magpie Geese continue to breed on the Mary River in years when breeding fails on other systems. The large number and great expanse of deep, poorly-drained backswamps means that they can also breed safely later in the year than on many other systems. Just as with the barramundi, the Mary River provides a productive nursery, as well as the conditions needed for subsequent rapid growth. This productivity in the face of erratic variation in rainfall is a function of the great diversity of habitats available on the Mary River. Its discontinuous main channel results in rapid rises in water levels and over-topping of banks and levees even in relatively drier years. The complex patterns of drainage lines, freshwater basins and tidal channels provides, in a relatively small area, a most favourable mix of ephemeral, seasonal and permanent wetlands of varying salinity.

For example, in years when water levels are too low to provide a particular habitat type at one location, then a site of different morphology is likely to compensate. The complex template provided by systems like the Mary River is able to reliably satisfy the diverse needs of the fauna even when climatic conditions are adverse.

The Committee accepts the argument that maintaining this spectacular wildlife, which underpins the tourism industry, will be fundamentally dependent on retention of habitat diversity. Government and the broader community must ensure that no important elements of the landscape mosaic are lost in pursuit of development opportunities and increased commercial production.

3.2.3 Cultural Values

Aboriginal cultural sites are abundant throughout the wetlands of the Mary River. The wetlands area featured strongly in the early European exploration and settlement of Northern Australia. Point Stuart was named by John McDouall Stuart in 1862, after his epic crossing of the continent from south to north. Significant non-Aboriginal cultural sites include Stuart's Tree Historical Reserve. The site and monument have national significance having been listed on the Register of the National Estate and recorded by the National Trust.

3.3 Developments

The area once supported a flourishing wild buffalo population which provided hides for industry from the early 1900's through to 1940. Following the 1940's the feral buffalo population increased considerably and the numbers were so great that they supported two abattoirs in the 1960's and '70's. Following the Brucellosis and Tuberculosis Eradication Campaign (BTEC) feral buffalo were removed and the area now supports a thriving pastoral industry based on cattle for the local and live export markets and domesticated buffalo.

There has been an expansion in the number of fishing tour operators and other tourism ventures in the Northern Territory over the past 10 years and much of their business revolves around the waterways and their fish and wildlife of the Mary River system.

4. CURRENT SITUATION

4.1 Geomorphological Changes

4.1.1 Recent Changes To The Lower Mary River Plains

Aerial photographs have enabled a reconstruction of these changes which have occurred over the last 50 years. The extent of saltwater intrusion in the lower Mary River catchment is shown in Figure 1.

4.1.1.1 Coastal Change

There has been considerable erosion of the shoreline west of Tommycut Creek while there is evidence of some accretion east of Tommycut creek. Some erosion of the coast is evident immediate to the west of Sampan Creek.

4.1.1.2 Tidal Creek Expansion

There has been a dramatic expansion of both Tommycut and Sampan tidal creek systems since the 1940's. These creeks have formed an extending dendritic network, invading freshwater wetlands and causing dieback of large areas of Melaleuca forests and freshwater grasslands. The expansion has been in a regular manner with elongation and elaboration of the network and increases in creek cross-sectional areas occurring as the tidal prism increased. The large tidal range and the extensive areas of low elevation coastal plains, provides an ideal environment for extensive inundation of the floodplain by saltwater.

The increase in saltwater intrusion in the Lower Mary River wetlands is evident from the water level recording station that existed at Roonees Lagoon and an examination of aerial photographs. In 1950, the main channel of Sampan Creek was narrow and discontinuous. The tidal range inland from the coast was small (a maximum of 0.3 metres) and the channel networks were only beginning to branch out onto the floodplains. Tidal energy is persistent and the existing barriers that were at the coastline have deteriorated with time, often assisted by anthropogenic influences. The nature of these natural barriers which often were the chenier ridges, is such that once even a minor breach is made, they and the plains behind them become very vulnerable to erosional forces.

As a result of this erosion more tidal energy is allowed to enter the creek and billabong systems. This results in an increase in the volume of saltwater that can move into the channel networks. The channels respond by widening and deepening to accommodate the increased volume and this in turn applies more erosional stress on the system. Coupled with the increase in tidal volumes is the downstream flow of huge volumes of freshwater from the annual wet season flooding, the majority of which is borne by Sampan Creek. The additional energy exacerbates the rapid erosion of the channel networks.

At present the mouth of Sampan and Tommycut Creeks experience the same tidal range as the offshore ocean tides. This is only marginally dampened on Sampan Creek some 23 kms inland at the S-Bends. The tidal range at Shady Camp has been steadily increasing and is at present approximately half of the ocean tidal range. This has increased from a zero tidal range in 1980.

4.1.2 Future Expansion Of Tidal Creek Network

The magnitude of the tidal creek system has increased exponentially over the last 50 years and it is likely to continue to increase for future decades. The process is now internally driven and expansion will follow two basic patterns.

The tidal creeks will continue to invade the middle reaches of Tommycut and Sampan creeks, spreading out in the dendritic pattern of channels until an equilibrium is reached of a drainage density of about 10 km/km^2 on the coastal plain. The main creeks will continue to widen until they comfortably accommodate the wet season fluvial flow as well as the tidal flows that are required to fill the enlarged tidal prism.

The tidal channels will continue to extend south of Shady Camp billabong and into the Paleoestuarine plains. Many of these floodplains and backwater swamps are below 2.5 m AHD and thus are very vulnerable to tidal inundation. If the tides reaching Shady Camp are undampened, then large areas of the paleoestuarine plain are at risk. Woodroffe and Mulrennan (1993) detailed this scenario and the Committee noted that there appears to evidence of this intrusion attempting to by-pass Shady Camp barrage already.

While levees associated with the billabongs to the south of Shady Camp would confine the tidal influence to some extent these levees are not continuous and lower breaches would enable tidal channels to reach out into the swamps of this paleoestuarine plain. These areas are among the most productive elements of the system with the highest conservation value.

4.1.3 Possible Causes

Recent studies by Woodroffe and Mulrennan (1993) suggest that anthropogenic effects triggered the change experienced in the floodplains over the past 50 years. His studies dismissed other possible causes such as sea level rise, and rainfall variability. It is possible that sediments of the plains have compacted and consolidated over the past 2000 years, effectively lowering the elevation of the plains. This could explain why large areas of floodplains are below high water mark and subject to inundation but does not explain what triggered the change 50 years ago that has had such profound consequences

There is no evidence to suggest that the current change is part of a natural cycle as the highly significant dendritic pattern of tidal channel expansion does not appear to have occurred in the past. There is widespread acknowledgment that high concentration of feral buffalo coincided with channel expansion.

The Committee heard that during the period of high feral buffalo numbers between 1940 and 1980, the floodplains had no stabilising vegetation by the end of the dry season as a result of

this concentrated grazing. Together with the effects of wallowing and pugging, this overgrazing greatly destabilised the levees and cheniers which kept the tidal channels separate from the freshwater billabongs. Coupled with this buffalo impact could have been human activity.

There is anecdotal evidence suggesting that certain cheniers and natural levees were dynamited in the past, while boat wakes have contributed to the widening and deepening of small channels. Irrespective of what triggered the change in this short period, the widening and deepening of the creeks is now driven predominantly by natural internal processes once these creeks come under the influence of saltwater intrusion and regular tidal movement. While the contribution to this expansion process by human activity can not be accurately measured it is assessed that it is significant.

4.2 Lease Arrangements and Land Uses

The land tenure in the catchment is varied and includes Pastoral leases, Crown leases, Aboriginal Freehold and Northern Territory Freehold as shown in Figure 2.

The wetlands are used for a variety of purposes, including:

Pastoralism: A large percentage of the wetlands area is managed for pastoral use. This includes the pastoral leases, Marrakai, Woolner and Annaburro and the Crown leases or buffalo blocks of Carmor Plains, Swim Creek Plains, Opium Creek and Melaleuca Stations.

Mining: A number of mining activities are conducted in the area including sand mining and gold mining. It is understood that the area has a fair to moderate potential for the discovery of gold, base metals and platinum deposits.

Defence: A number of areas are used by the Commonwealth's Department of Defence for training purposes.

Horticulture: A cashew nut plantation is being trialed to the east of Wildman Reserve. There is considerable potential for further horticulture developments.

Tourism: Within the wetlands area there are several sites utilised for tourism. There are boat tours on the river, dinghy hire and general eco-tourism operations and a number of tourism lodges and accommodation facilities.

Recreational Fishing: There is high utilisation of the Mary River by amateur fishermen and tourist fishing charter operators.

Conservation: There are 8 areas managed by the Conservation Commission of the Northern Territory. Research, education courses, and wildlife utilisation activities are undertaken on these sites. The headwaters and part of the catchment of the Mary River are within the Commonwealth controlled Kakadu National Park.

5. PROBLEMS, CONFLICTS and SOLUTIONS

5.1 Integrated Catchment Management

The Committee recognises the strong interrelationship between all the landuses in the Mary River catchment and the need to integrate strategies to deal with individual issues and problems. No one issue can be properly addressed in isolation of others because of the strong interrelationships and interdependencies. The Mary River wetlands are very special and the natural resource values which make it so must be maintained if the area is to sustain the wide range of landuses which it currently supports.

There is a need for careful management of the Mary River catchment and management which ensures that:-

- ongoing development is tied to community need and expectation,
- biological diversity, ecological functions and water quality are protected, and
- the resources of the catchment are used in a sustainable manner for long term community benefit.

An integrated catchment management plan is needed to bring together all the single issue strategies and plans mentioned previously and ensure that they can all coexist and be achievable. The stakeholders of the Mary River identified the need for such a plan at the 1994 Wetland Workshop in their final unanimous resolution.

The plan would:

- ♦ Take account of inter-dependencies between various issues and ecological processes and include catchment wide considerations.
- ♦ Identify and protect key areas which are essential for the long term viability of the mix of ecosystems in the catchment.
- Retain biological and habitat diversity within the catchment.
- Provide for development where it is demonstrated that ecological viability and functioning will not be placed at risk.
- Establish monitoring programs and provide adaptive mechanisms to take action in the light of monitoring results.
- Encourage on-going research into various ecological processes operating in the catchment and their management.

The plan needs to be developed by all stakeholders. The plan would highlight the links between the various strategies and detail the mechanisms of consultation needed between the various stakeholders involved in any one issue.

The Catchment Management Plan would include strategies for dealing with:-

- weeds,
- ♦ fire,
- feral animals,
- water quality,
- habitat management,
- visitors and tourists,
- developments and
- saltwater intrusion.

A resolution from the Wetland Workshop included the establishment of a Task Force to address the problems in the Mary River identified in the Workshop. The Committee supports the establishment of a Mary River Catchment Task Force whose membership represents the key industries, stakeholders and government departments involved in the use and management of the Mary River region.

The Task Force should comprise an independent chairperson plus one representative from each of the following groups:-

Pastoral, Amateur Fishing, Commercial Fishing, Tourism, Mining, the Lower Mary River Landcare Group, Traditional Owners, Department of Primary Industry and Fisheries, Water Resources Division of Power and Water Authority, Department of Lands, Housing and Local Government and the Conservation Commission of the Northern Territory.

Each of these groups and departments should nominate a representative and government should select the chairperson for the Task Force.

Besides addressing some of the urgent actions necessary to treat saltwater intrusion, this Task Force should form the basis of a Catchment Management Committee which would oversee the development of an Integrated Catchment Management Plan and be responsible for its ongoing implementation. This Plan would address all the recommendations made by this Committee and identify the framework for successful coordination and implementation.

The Task Force should also examine the possibility of developing the Plan under specific legislation such as exists within the Water Act or other Resource Management legislation. There are advantages in developing the Catchment Plan under provisions within legislation as it would bind the participants and landholders to the strategies and outcomes specified in the Plan.

5.1.1 Recommendations

The Committee recommends:

- 1. That Government establishes a Task Force to coordinate and plan the range of works and strategies recommended in this report. The Task Force should be chaired independently and have a majority of non government members. The Task Force should have only one representative from the key industry groups and Government departments.
- 2. That the Task Force examines the option of developing the Mary River Integrated Catchment Management Plan under specific legislation which will bind all stakeholders to the plan and its implementation. The development of this plan and its coordination should be administered by the relevant government department with the most appropriate legislation.

5.2 Saltwater Intrusion

Over the last 50 years, approximately 17,000 hectares of grassland and *Melaleuca* swamp on the Lower Mary River plains have been affected by saltwater intrusion. A further 50,000 hectares are now threatened if saltwater intrusion is not controlled.

Saline intrusion causes a great simplification of the system through the conversion of most of the area of deep backswamps and fringing floodplains from freshwater to marine systems. A diversity of wildlife habitats are lost in exchange for a few that are already abundant throughout the region. The freshwater floodplains are highly productive systems generating large quantities of nutrients on which much of the fauna depend including the fish in the system and the marine life in Chambers Bay. The pastoral industry in the region is based on these freshwater floodplains and the grasses these wetlands support.

It was not clear what initiated the recent changes in the system. Circumstantial evidence suggests that the rapid changes may have been triggered anthropogenically. British colonists introduced the water buffalo onto the Coburg peninsula in the 1830's from where they spread throughout the Top End over the next 150 years Feral buffalo activity on the plains in the last 50 years is considered one of the most probable causes. Whatever the cause, it has shown the extreme vulnerability of extensive areas of the floodplain that lie below high tide level. These are being invaded by extension of a tidal creek system which is now expanding through natural processes.

Works undertaken by the Conservation Commission over the last 6 years has been instrumental in slowing the expansion of saltwater channels into new freshwater areas.

However, the two coastal outlets from the floodplain, Tommycut and Sampan Creeks, are continuing to widen and deepen so that tidal effects are extending further upstream. Eventually, the full magnitude of coastal tides will impact at the upstream ends of both creeks. This will mean overtopping of any barrage and the initiation of new channels around any man-made or natural barrier within the reach of each creek and their tributary channels.

Extrapolation of trends in tidal encroachment into Sampan Creek to date suggests that these impacts may occur within the next 2-3 years if nothing is done to limit the amplitude of the tides in the main creeks. Most of the floodplains to the south of Shady Camp will be inundated by saltwater if the major barrier at Shady Camp is breached or circumvented. The resultant destruction of floodplain grasses would not only severely reduce available habitat for a variety of native fauna but also jeopardise pastoral operations.

The Committee was given evidence that if saltwater continues its advance into the Mary River Conservation Reserve to the west of Tommycut Creek, one of the larger stands of *Melaleuca* forest in the Northern Territory will be destroyed. The area would no longer support the wide variety of native fauna or the seasonal grazing of cattle.

In summary, if nothing is done to prevent saltwater intrusion, the remainder of all the wetlands of the Mary River will be seriously threatened and eventually will cease to exist as a freshwater system. Should this occur, the area will then have no pastoral value, greatly reduced conservation or tourism value, and be of limited value for fishing.

5.2.1 Problems

Works constructed by the Conservation Commission and individual pastoralists to halt saltwater intrusion in the lower Mary River have attracted controversy. Representatives of both the amateur and commercial Fishing Industry have expressed great concern over the saltwater intrusion control works that were implemented over the past 6 years.

Much of their concern and criticism stems from the apparent lack of consultation with these groups by the Conservation Commission and landholders prior to the works proceeding. The Amateur Fishermen's Association NT (AFANT) is concerned that decisions may have been taken without full consideration of impacts on fisheries and in particular, barramundi.

Whilst it is acknowledged that consultation with such community groups was limited, the Committee is aware that action was taken quickly to halt saltwater intrusion in strategic areas due to the severity of the problem and the consequences arising from delays in implementing control works. The Committee heard that communication and cooperation between the Conservation Commission and the Fisheries Division of the Department of Primary Industry and Fisheries (DPI&F) has been steadily improving over the past 5 years and that Fisheries research confirmed that the Shady Camp barrage was not impeding fish migration.

It would appear that the main concern of AFANT does not concern the actual works in most cases but that there is no formal consultation mechanism in place. AFANT supports the stopping of saltwater intrusion as they recognise that the future fishing productivity of the Mary River system depends on conserving the freshwater wetlands. A belief also prevails among a few fishing representatives that while the works on the Mary River are stopping saltwater intrusion, similar works on the Adelaide and Wildman River/Love Creek floodplains have been constructed to pond pasture for pastoral purposes rather than halt saltwater intrusion.

The Committee saw evidence that some barrages had the effect of ponding freshwater. The difference between works to block saltwater intrusion and works to pond water for pasture development needs to be defined and agreed by all stakeholders. Landholders need to define the primary purpose for constructing barrages when seeking approval for such works under the *Water Act(1992)*. One property had developed some ponded pastures but this was in an area not subject to saltwater intrusion and did not involve blocking tidal gutters.

The Northern Territory Fishing Industry Council (NTFIC) representing commercial fishing interests supports multiple use of wetlands and understands the problems of saltwater intrusion. They recognise the importance of the Mary River wetlands as a nursery area for a diverse range of marine life and believe that management of these wetlands must recognise this. The issue from their perspective, and to which they wish to contribute a resolution, is the degree of saltwater intrusion which is acceptable and where to draw the line in any restoration program. The NTFIC is not convinced that pre-1945 conditions should be the benchmark and that a gradation and mix of freshwater and saline wetland habitat must be maintained in any restoration program.

They also submit that communication from responsible government agencies was poor in the past and wish to see a consultative process established between all key government agencies and industry representatives which is transparent and ongoing.

The pastoralists in the region recognise the threat saltwater intrusion poses to their future productivity and strongly support the actions of government over the past few years to control it. The Buffalo Industry Council, Lower Mary River Landcare Group and the Northern Territory Cattlemen's Association all believe that saltwater intrusion is one of the biggest environmental problems facing the Mary River wetlands and some form of barrage construction program is essential for its long term control. Like the NTFIC, these groups believe that selection of appropriate sites for control works is crucial to ensure that other problems, such as spread of Mimosa, are not exacerbated.

The Committee also heard that there has been a gradual decline in fish harvest in Chambers Bay over the past 5 years. While the NTFIC have suggested that this decline could be related to the saltwater intrusion control works, scientists have indicated that the decline could be a response to the declining productivity generated by the wetlands as more of this freshwater habitat is lost to saltwater intrusion.

5.2.2 Solutions

5.2.2.1 Tidal Choke

While five alternative major works options to permanently halt saltwater intrusion have been examined for feasibility from a geomorphic perspective, the Committee believes that only one of these will prove both feasible and acceptable on economic and environmental grounds.

Options presented in Woodroffe's report for

- a) total exclusion of saltwater at the coast,
- b) total exclusion of saltwater from freshwater wetlands south of Shady Camp, and
- c) construction of levees and embankments to fully confine saltwater to the main channels of Sampan Creek and Tommycut Creek,

are not favoured following assessment by government scientists and engineers.

The favoured option is control or partial exclusion of saltwater by tidal chokes near the mouths of Tommycut and Sampan Creeks. This could be achieved through constructed works to reduce channel cross sectional areas in the mouth of each creek. The effect of these works would be to dampen tidal energies causing a reduction in tidal amplitudes throughout the upstream reaches of Sampan and Tommycut Creeks. This artificial constriction would still allow flows into and out of each creek, but at greatly reduced rates.

Associated with each tidal choke should be the recharging of offshore shoals from the mouths of Tommycut and Sampan Creeks. These shoals would also effectively reduce tidal energy from entering each estuary.

The most efficient and effective way to reduce the tidal volume entering a creek is to reduce the available energy. The construction of tidal chokes and recharge of offshore shoals appears to be the most viable option, from the perspectives of hydraulics and cost. However, a numerical model of the floodplain channel system needs further refinement to confirm the current appraisal of viability. This model will allow tidal choke options to be simulated and their efficiency and environmental effects to be evaluated.

The design of a tidal choke is still at very early conceptual stage but must involve the careful engineering of a stable and protected creek outlet with predetermined dimensions of width and depth. These would be a great deal smaller than the current outlets of Tommycut and Sampan Creeks and be based on the results of the hydrodynamic modelling. The depth of the creek mouth would be raised so that only a small volume of water exits at low tide and the width substantially reduced so that far less water enters the creek during a tidal cycle.

Trials for re-establishment of offshore shoals at the mouths of Sampan and Tommycut Creeks could possibly proceed during the 1995 dry season to slow the advance of saltwater while investigation of major tidal chokes proceeds. Recharging would involve the placement of an obstruction in the position where river mouth shoals are normally found. This would have the effect of trapping sediments that are moving on tides to and from the river mouth. Dredging and placement of sediment at such sites may hasten their development. Any such works must be closely monitored in view of the fact that little is known of the coastal processes in this area.

The Committee heard from engineers and hydrologists from the Power and Water Authority on a range of studies and actions that should be conducted in the short term and these included:

- Continued monitoring of the main channels and selected tributaries to finalise the construction and calibration of a numerical model.
- Use of the numerical model to evaluate a range of shoal and choke configurations in terms of their effectiveness and impact on the floodplain.
- Prototype works trials on two smaller creek systems as scale models to evaluate designs and construction methods. These scale models should be monitored before and after any works and their effectiveness and impacts reported.
- Coring of the bed at the mouths of Sampan and Tommycut Creeks and the associated near offshore zone should be taken to determine the suitability for choke construction.

5.2.2.2 Barrages

Earthen barrages have a role in exclusion of saltwater from strategically selected areas identified for their conservation, recreation or productive value. They would complement tidal chokes on Tommycut and Sampan Creeks in reducing the expansion of tidal channels. Areas of floodplain on Woolner, Swim Creek Plains and Carmor Plains Stations and within the Mary River Conservation Reserve would benefit from these interventions. Careful consideration should be given to including some form of spillway into these barrages which enables some drainage and fish access during the wet season.

5.2.3 Stakeholder Support

All stakeholders support action to address saltwater intrusion and prevent the rest of the freshwater wetlands in the Mary River from being destroyed by saltwater. To the landholders in the area control of saltwater intrusion is one of their primary concerns and they place a high priority on works such as a major tidal choke and use of strategic barrages. Those representing fishing interests are a little more circumspect on what solutions to saltwater intrusion are most appropriate and in particular where such works are implemented.

At the 1994 Wetland Workshop, all participants agreed unanimously to call on Government to allocate resources for designing and installing effective barrages to stop intrusion. Both the amateur and commercial fishing industry were in favour of major tidal chokes at the mouths of Tommycut and Sampan Creeks provided that the structures did not interfere with fish migration and that they were implemented after a detailed environmental impact study. The fishing industry groups were concerned over the use of some earthen barrages to control saltwater intrusion. The Amateur Fishing Association believes that many barrages constructed were for the primary purpose of developing ponded pasture for livestock production, rather than protecting floodplain from saltwater intrusion. Of particular concern were some barrages constructed on the Adelaide and Wildman River floodplains. The NTFIC also reported on a number of barrages of concern which may impede fish movement.

The Committee inspected these structures and were generally satisfied that they were erected for the primary purpose of limiting saltwater intrusion and rehabilitating freshwater floodplain. On the evidence presented the Committee believes that both the fish stocks and grazing livestock will be the beneficiaries of such restoration works in the future.

The Commercial fishing industry expressed concerns that to use 1940 aerial photography as the benchmark and restore floodplains to pre-1940 conditions was arbitrary and may not recognise the dynamic processes operating between the freshwater and saltwater. Any restoration program must ensure that there are adequate areas of saline and brackish swamps along the coast to provide fish nurseries.

The Committee concurs with the fishing industry that the location of any further barrages should be discussed with the Fisheries Division of DPI&F and representatives of the fishing industry prior to any works proceeding. The establishment of a Task Force or Management Committee to oversee developments in the Mary River would be one effective mechanism to ensure that this consultation occurs.

5.2.4 Recommendations

The Committee considers that the Northern Territory Government must treat the problem of saltwater intrusion most seriously and take urgent and immediate action in order to safeguard and protect the future landuse in the Mary River system. In particular the Committee recommends:

- 3. That pilot works trials be completed into tidal choking in estuarine creeks.
- 4. That engineering investigations, environmental assessment and budgetary planning be completed, in conjunction with the pilot works trials, to establish the feasibility of constructing works within the next 2-3 years which will permanently dampen tidal flows through the mouths of Tommycut and Sampan Creeks.
- 5. That detailed survey and assessment be undertaken to determine the location of key barramundi nursery swamps along the coast between Adelaide river and Wildman river including the determination of key vegetation and hydrological characteristics.
- 6. That no new barrages or blocks be constructed across water channels without consultation with the Fisheries Division of DPI&F and consent from the Controller of Water Resources under the Water Act (1992).

- 7. That the difference between works to block saltwater intrusion and works to pond water for pastures be clearly defined and agreed by all stakeholders.
- 8. That remedial works be constructed urgently and prior to the 1995/96 wet season in the Shady Camp floodplain area as an interim measure to prevent saltwater intrusion advancing further south than its current limits.
- 9. That monitoring of fish stocks and migration patterns continue in the Mary River in order to assess the impact of current and future saltwater intrusion remedial works.
- 10. That research is conducted into fish stock numbers in Chambers Bay to determine why catch numbers have decreased over the past 5 years.

5.3 Weeds

Weeds can have a dramatic impact on the landscape and greatly interfere with the broad productive capacity of land for a variety of purposes. Weeds can out compete native vegetation forming dense monocultures. This reduction in floristic diversity has significant impact on the food chain, especially grazing mammals and other fauna which rely on native vegetation for refuge, shelter and nesting sites. Weeds can alter fire regimes, hydrology and drainage patterns, erosion and siltation rates and available moisture for other plants and animals.

The Northern Territory Noxious Weeds Act lists 63 genera and species whose occurrence in the Territory is to be prevented, eradicated or controlled. Obviously prevention of introduction is preferable but already a number of noxious weeds are well established in the Territory.

Noxious weeds occurring in the Mary River area are mimosa, *Mimosa pigra*, spinyhead sida, *Sida acuta*, flannel weed, *Sida cordifolia*, hyptis, *Hyptis suaveolens*, sicklepod, Senna obtusifolia, coffee senna, *Senna occidentalis*, mission grass, *Pennisetum polystachion* and water lettuce, *Pistia stratiotes*.

The potential for entry of aquatic weeds, salvinia, *Salvinia molesta* and water hyacinth, *Eichhornia crassipes* is a major concern. To date, these have not been introduced to the area although they have occurred in other wetland areas of the Territory. Other noxious weeds which threaten the area are snake weeds, *Stachytarpheta spp.*, candle bush, *Senna alata*, and grader grass, *Themeda quadrivalvis*.

There is considerable debate regarding the introduction of improved pasture species and their effects on the environment. The main species under debate are the floodplain grasses, para grass, *Brachiaria mutica*, aleman grass, *Echinochloa polystachya*, and Olive hymenachne, *Hymenachne amplexicaulis*. Gamba grass, *Andropogon gayanus cv Kent*, primarily an upland and fringing floodplain species is also being widely sown and has caused problems when it is not managed correctly. Both Gamba grass and Para grass have invaded conservation reserves on the Mary River from adjoining properties.

5.3.1 Solutions

Weed control on the Mary River wetlands began in 1980 primarily directed at controlling the spread of mimosa. Despite these efforts Mimosa spread quite quickly in the 1980's throughout the Mary River wetlands, although the control program prevented it establishing a foothold in the upper catchment.

In recent years, landholders have cooperated with government to reduce the stands and density of mimosa through a collaborative and concerted effort. The DPI&F provide technical support and subsidies to landholders as well as conducting much needed research into control methods.

To effectively deal with the scale of problem that Mimosa presents in the Mary River, a greater commitment of resources is required by both landholders and government. While chemical and mechanical control measures are effective, they are also costly. Much effort of late has gone towards biological control as it may offer a more economic solution in the long term.

Seven biological control agents have been introduced into the Territory with 4 of these agents being established in the Mary River wetlands. Unfortunately the establishment of biological agents can not proceed in conjunction with other control measures, as they need mimosa free of chemicals to increase in population to a point where it is self sustaining. This period varies from months to years and even when self sustaining they will not totally eradicate mimosa stands.

The Lower Mary River Landcare Group which represents all landholders in the region have been active in addressing solutions to the weed problem and have held workshops to examine the weeds issue. The Landcare group believe that an integrated weed management strategy is necessary for the catchment. An important element of such a strategy should be stricter control of access by weed vectors to eliminate weed migration and importation. This may include vehicle wash down facilities, stock quarantine areas, and tighter control on hay imports.

The government has also highlighted the need for better control on access to mimosa areas by vehicles, including boats and the provision of wash down facilities. Due to the insidious nature of weed spread there is also a need for a greater education program highlighting the problems that arise from visitors to the region and simple measures the public can take to minimise spread of noxious weeds.

The Committee heard that once mimosa has been removed by herbicides and clearing, the most economic way to keep Mimosa at bay is to plant improved pastures that are competitive and able to suppress new Mimosa seedlings. The DPI&F has promoted this approach to date. However the Committee also heard from CSIRO that their experience in large scale Mimosa control programs at Oenpelli suggests that native floodplain pastures can recolonise these treated areas within two to four years. Reintroduction of native pasture would offer a range of advantages to the ability of the restored floodplain to support both pastoral activities as well as wildlife.

Obviously it is easier to obtain introduced or exotic pasture seed and sow this relatively easily but more effort should go towards re-establishing native pasture species such as hymenachne, *Hymenachne acutigluma*, Rice grass, *Leersia hexandra* and wild rice, *Oryza rufipogon*. These pastures have been acknowledged as very productive pastures and their use in revegetating degraded floodplain following Mimosa removal would offer considerable advantages.

The Committee examines the issue of exotic pasture species in more detail later in this report.

5.3.2 Stakeholder Support

There would appear to be unanimous support for development of a weed management strategy for the Mary River catchment by all stakeholders. Along with saltwater intrusion, Mimosa has been identified by the Lower Mary River Landcare Group as the biggest threat to the wetlands and the ability of the wetlands to support a variety of land uses.

The Landcare Group, the Northern Territory Cattlemen's Association and the Northern Territory Buffalo Industry Council have all called for increases in government commitment to combating Mimosa in the catchment. Any increase in government resources dedicated to controlling Mimosa would be matched by the landholders in the catchment. The local landholders would also like to see a broader range of incentives such as increases in the chemical subsidy to encourage further expenditure in Mimosa control. Mimosa control is labour intensive and requires dedication on the part of all concerned to really make a sustained impact on its presence in the Mary River catchment.

The development of a catchment based weed management strategy is consistent with the draft Weed Management Strategy for the Northern Territory released recently for public comment by the Department of Primary Industry and Fisheries (DPI&F).

5.3.3 Recommendations

The Committee recognises that *Mimosa pigra* infestation is a most serious problem with the capacity to alter the productivity and biodiversity of large tracts of land and in particular, wetlands. The Committee considers the weed as one of national importance and should be treated as such by both the Commonwealth and Territory Governments. The Committee recommends:

- 11. That additional resources are provided by Government for the biological, chemical and mechanical control and containment of Mimosa pigra in the Mary River catchment and such control programs be enhanced as a priority.
- 12. That subsidy arrangements for landholders conducting Mimosa control programs be structured to encourage greater commitment, action and successful outcomes by landholders.

- 13. That DPI&F devote greater research and extension effort into the use of native floodplain grasses for the purposes of revegetating and restoring areas of floodplain where Mimosa has been removed.
- 14. That these issues be incorporated into a weed management strategy for the Mary River catchment and that it be implemented urgently.

5.4 Improved Pastures

5.4.1 Ponded Pastures

The Mary River wetlands' capacity to support a diverse wildlife population depends on the existing diversity of wetland habitats. Variation in depths and duration of flooding in natural systems cause differences in vegetation pattern. This variation in turn provides a range of natural foods and shelter for animals associated with that vegetation, and hence the type and number of animals that the floodplain can support.

Ponded pastures are promoted by DPI&F as a means of improving livestock production from the floodplains. The technique involves using small earth walls or bunds to capture a proportion of incident rainfall and runoff during the wet season and use this to prolong the growing season of pastures on the floodplain. While native hymenachne can be used in such programs, emphasis is currently on exotic pasture species such as para grass, *Brachiaria mutica*, aleman grass, *Echinochloa polystachya* and Olive Hymenachne, *Hymenachne amplexicaulis*. By using ponding techniques water heights can be manipulated to suit the growing depth of a particular pasture species. Liveweight gains in steers raised on these improved floodplain pastures is equivalent to those grazing on native *Hymenachne* pastures.

In the Mary River system, natural backflow swamps and low lying floodplain provide an abundance of naturally ponded pasture where native hymenachne, wild rice, rice grass and sedges maintain growth well into the dry season. Much of the Mary River floodplain is highly productive in its native state and cattle and buffalo grow well on these pastures. Equally these areas of native vegetation are important food and shelter sources to wildlife.

The Committee was informed that widespread use of ponded pastures especially where exotic species are planted, will threaten the diversity of wildlife. The aim of ponded pastures is to contain variation in flooding regimes by trapping freshwater behind low contour banks. Prolonged water retention favours certain perennial grasses, especially some native and exotic pasture species, which tend to form dense monocultures. The cost of this change to favour cattle, is the suppression of native plant species like the sedge, *Eleocharis dulcis* and wild rice, *Oryza rufipogon*. Many birds and mammals are unable to maintain themselves without access to these nutritionally rich native foods.

It has been argued before the Committee that prolonged water retention and production of palatable grasses will favour wildlife. This is only true of a very narrow range of species, chiefly those that are able to subsist entirely on a diet of grass blades. Most wildlife cannot. This argument is particularly misleading in an environment like the Mary River where there is already a large number of deeply flooded sites that hold water for many months. To push the Mary River further in that direction, and so lose the shallower plant communities that fringe the floodplain, has the potential to alter wildlife assemblages as drastically as would a failure to control saltwater intrusion. Experience in Queensland shows that the ponded exotic pasture species cannot be confined to manipulated sites on floodplains. They escape into adjoining areas and damage wildlife habitat.

The Committee was also made aware of concern by the fishing industry over the possible expansion of ponded pasture in the catchment and the effect this would have on fish stocks, particularly barramundi. Specifically there is concern that ponded pasture will alter the floodplain hydrology and reduce the flow of nutrients to the estuarine and coastal fisheries and that fish will be trapped behind ponded pasture walls preventing their natural migration.

5.4.2 Upland Pasture

Unlike the floodplains, the upland country of the Mary River catchment in its native state has a low productive potential for grazing cattle and buffalo. Sustainable stocking rates on the native upland pastures are in the order of 20 - 40 times less than stocking rates that can be supported on the floodplain grasses. These upland areas need to carry stock throughout the wet season and sometime into the dry season until the floodplains are no longer inundated. Since most of the properties in the Mary River region do not have a large ratio of upland to floodplain, pastoralists face dilemmas in choosing between underutilisation of their floodplains and running a much smaller breeder herd or overutilising the upland areas in order to carry the larger herd.

This situation can be alleviated to some extent by improving the carrying capacity of the upland by planting improved pastures. A variety of legumes and grasses have been recommended by DPI&F which will allow carrying capacity to be increased substantially over the native pasture. However the improvement of uplands is costly and involves in most cases clearing of native vegetation. The Committee were told that it costs conservatively between \$300 to \$400 per hectare to fully develop upland areas to good improved pasture. There appeared to be lack of clear cost/benefit information on the development of improved pastures and the outlay and time required before investment could be recouped.

The Committee were also made aware of concerns that some sectors of the community may have to the widespread clearing of uplands to enable improved pasture development. Increased erosion rates, altered hydrology and reduced habitat for wildlife were raised as likely consequences of broad scale clearing in the catchment. The Committee's attention was also drawn to past pasture development programs where ongoing management and maintenance was not optimal, leading to a decline in the pasture quality and a consequential weed invasion of the cleared and disturbed ground. Clearing has not been extensive in the lower Mary River catchment. Approximately 30 km^2 of natural upland has been cleared, mainly for the purposes of planting improved pasture and infrastructure development. Other broad scale clearing has occurred on dense patches of Mimosa infestation with either subsequent planting of pasture or native re-colonisation.

One of the improved pastures used to improve uplands is Gamba grass, Andropogon gayansus, and this has proved to act like a weed by invading sites where it has not been actively planted. This is a concern in the Mary River wetlands where conservation reserves adjoin pastoral properties. Evidence that Gamba grass had moved into these areas drastically altering the fire regimes of the native woodlands, was provided to the Committee. The long term effects of such a shift in the composition of these native woodland areas reserved for conservation purposes is likely to be harmful to biodiversity.

5.4.3 Solutions

There is no question that improving upland country on pastoral land using introduced or exotic species is necessary for the long term viability of these pastoral operations. Clearing of upland country is required for improved pasture development so that carrying capacity becomes more comparable to that of the floodplains.

The clearing of 20m wide strips on a regular pattern may be more cost effective than resorting to broad scale clearing. This has been trialed on some properties. The lower Mary River Landcare group has moved to address this issue by holding workshops to develop clearing guidelines for the catchment which recognise the ecological significance of the Mary River region and the impact that unplanned broad scale clearing would have on the area.

Clearing should occur only after careful planning and examination of the land units and their suitability for improved pasture development. Drainage line corridors, rainforest thickets and areas of unsuitable soils must be adequately protected and maintained in their natural state. Property management planning guidelines are available to encourage this approach. Clearing guidelines which have been published by the Pastoral Land Board may also assist the local landholders in developing and adopting their own clearing guidelines for the catchment. The Committee is aware that clearing control provisions in the Pastoral Land Act only apply to pastoral leases and do not apply to Crown leases or freehold land in the catchment.

Care needs to be taken in deciding on which species of improved pasture should be planted on the uplands. Consideration should be given to foregoing the use of highly invasive species such as Gamba grass in favour of other exotic species. It is acknowledged that other species such as Pangola grass, *Digitaria decumbens*, and Signal grass, *Brachiaria decumbens*, may require more effort to establish and maintain but they have obvious benefits in terms of their lower propensity to move off site.

The Committee is of the opinion that the majority of floodplains in the Mary River system naturally supports large areas of highly productive native pasture, and it would be unwise to continue with programs to pond areas and plant exotic pasture species simply for minor or marginal gains in pastoral productivity. There is reason to plant improved pastures in areas where Mimosa has been removed but the emphasis should be on using native species to restore these degraded areas. The Committee is concerned that on areas outside of the Mary River catchment on drier floodplains of the Adelaide and the Wildman rivers, careful consideration must be given to the impact that exotic pastures and use of ponded pastures is likely to have on the wildlife including fish populations and the hydrology.

5.4.4 Stakeholder Support

The Committee heard widespread support for the development of clearing guidelines for the catchment. The Lower Mary River Landcare Group is already pursuing this approach and it is to be commended. Any restrictions imposed on the improved pasture species which can be planted in the catchment is more likely to be unpalatable to landholders involved in pastoral operations.

The Committee is aware that the fishing industry would support a moratorium on improved pasture development on the floodplains where ponding is involved. However while this would be unacceptable to landholders, the Committee did hear from all stakeholders that the solution to many of the problems is the ability to compromise. While not advocating any ban on exotic species, a serious examination of the range of species and their positive and negative attributes would be a sensible approach to deciding on which species are suitable for the Mary River catchment given the need to conserve the landscape attributes which enable multiple land use to exist and be sustained in this region.

All stakeholders should recognise the difference between ponded pasture development and works to control saltwater intrusion. While an added benefit of addressing saltwater intrusion is the concomitant retention of freshwater on the floodplains for longer in the year it does not necessarily cause or assist the expansion of monocultures of exotic pasture species. The rapid drainage of the floodplains which results from saltwater intrusion is curtailed by control works thereby increasing the nutrient cycling on the floodplains which benefits fish productivity. The drainage is slowed, not stopped and nutrients produced on the floodplains still reach the sea over a longer period.

Given the difference in hydrology of some of the drier floodplains of the Adelaide and Wildman Rivers, careful planning and selection of areas suitable for ponded pasture would seem sensible, and again willingness to reach compromises would help reduce conflict over this emotive issue. The establishment of a Mary River Management Committee or Task Force could again provide the mechanism that assists in reaching such compromises and reduces the need for government to examine legislative or other prescriptive means of affecting this control.

5.4.5 Recommendations

The Committee recommends:

- 15. That no exotic pasture species be planted on the floodplain except as part of an integrated Mimosa control program and that the spread of existing exotic pasture on the floodplains is not actively encouraged.
- 16. That landholders use native pasture species to rehabilitate areas of floodplain degraded by saltwater intrusion or Mimosa.
- 17. That guidelines be developed in conjunction with all landholders in the catchment on the choice of pasture species, the most appropriate sites, method of establishing, and proper management of improved pasture on upland country.
- 18. That alternative pasture species to Gamba grass be identified and that these species be actively promoted as suitable alternatives.
- 19. That the cost of improving the upland country with improved pasture and the associated ongoing management costs be determined so that the full marginal returns on investment are clear, together with the time frame involved.
- 20. That all proposals by landholders to develop areas of ponded pastures on the floodplains be assessed for environmental impacts.

5.5 Land Competition

Within the lower Mary River catchment on pastoral and crown leases, the area of uplands available for grazing is insufficient to fully utilise the grazing capacity of the floodplains. As highlighted previously, the floodplain grasses can support high stocking rates of 1-2 beasts per hectare during the dry season. The upland areas that carry stock in the wetseason have a much lower productive value and in an unimproved state can support about 1 beast per 20 hectares. For many of the properties in the area the ratio of upland country to floodplain is only about 2:1.

Pastoralists may face the dilemma of having to choose between underutilisation of their floodplains or overgrazing of the upland areas. This situation can be alleviated somewhat through planting of improved pasture on the uplands but even through this process the carrying capacity of the improved pastures on uplands does not reach that of the floodplains. Expansion of the upland area available to pastoralists is limited by existing tenure.

This land pressure has caused the pastoralists to look at other means of utilising upland areas outside of their own tenure. The Committee heard of a number of examples where landholders have been able to negotiate grazing agreements with government agencies to utilise some reserved land for specific periods of the year.

Unfortunately there has been raised expectation on the part of many landholders that all Conservation Reserve land in the catchment is suitable for strategic dry season grazing and a negotiated agreement for temporary access is their right. The Committee is aware that grazing agreements currently in place were negotiated out of sound land management imperatives and only considered after careful scrutiny of the capability of the land under question and the implications for conservation.

The Committee is conscious of the difficulties for proper management of reserves that may be created by seasonal stocking including erosion, weed spread and loss of habitat diversity and quality. The Committee considers that further grazing agreements on reserved land should only be considered where there are clear conservation management benefits.

The Committee is also aware of the need to maintain the coastal strip in a natural state wherever possible and while strategic grazing may be possible on some of these coastal areas, there is an urgent need to put in place measures whereby stock can be excluded from these areas. The coastal cheniers, mud flats and mangrove belts are in need of conservation in order to maintain fish nurseries and reduce the likelihood of further saltwater intrusion which grazing stock could help initiate.

The Mary River region also shows much promise for further horticulture development. The current horticulture block contains about 5000 hectares of suitable soils and proven waters. The potential to see a large expansion in plantations of mangoes, cashews and other exotic tree crops is quite high. Given the overall size of the catchment, this projected expansion is likely to further complicate the issue of multiple use and increase the competition for land. Proper environmental impact assessment must be conducted prior to any new horticulture development proceeding and such developments should be controlled through legislative or tenure covenants.

5.5.1 Recommendations

The Committee recognises that there is limited upland country within the lease boundaries of some of the properties to fully utilise the productive potential of the floodplains. Given this restraining parameter, the Committee recommends:

- 21. That such properties only carry breeding herds at levels that the upland country can sustainably support in the wet season. Appropriate authorities should examine economically realistic measures to improve this upland country and provide advice to landholders on ways to diversify their income so that these properties are sustainable in the long term.
- 22. That the primary purpose for Reserve and Park estate in the catchment be for conservation, recreation and tourism. The value of such land should not be compromised by pressures to use this land for other purposes unless there is a express conservation management requirement to do so.
- 23. That coastal cheniers and mangrove communities along the shore line be fenced from the rest of the property to exclude stock from these areas.

5.6 Visitor Impact

The Mary River wetlands are a popular tourist destination and recreation area for Territorians. Recreational activities in the region include dispersed "hands on" activities such as fishing and hunting.

The desired visitor experience in the Lower Mary River is dependent on maintaining a low number of visitors at any one site. This carrying capacity for the region is lower than in other major Top End National Parks such as Litchfield and Kakadu. Maintaining low visitor impact at individual sites helps preserve the natural character and values of the area.

Recreational fishing is the activity most likely to suffer from increasing demand. Overcrowding can detract from the fishing experience as well as potentially deplete the fish stocks. The current fish management program for the Mary with its imposed bag limits is working quite well, but should fishing levels increase drastically then the management plan for the area would need to adjusted accordingly.

The increasing use of waterways for recreational and tourism activities has the potential to exacerbate the problems of river bank erosion and possible tidal channel expansion through larger and more regular boat wake wash. The Committee saw evidence that wake wash from high speed boats was eroding banks of the Mary River downstream of Shady Camp billabong. Excessive use of water craft including airboats may also impact on both vegetation and wildlife especially breeding birds and needs to be regulated. This overuse may also detract from the quality of a wilderness experience which some visitors may seek and will require control in the future.

Landholders in the area are very concerned about trespass and the problems such action poses to their livelihood. Fences and watering facilities and tracks have been damaged and stock shot by visitors to the region who trespass into properties to gain access to fishing spots or commit acts of malicious vandalism. Current infrastructure development in the region can not cope with large numbers of unsupervised or controlled visitors and this increases pressure on properties. Similarly landholders were concerned that during the wet season some fishermen have access across their floodplains and do not respect boundaries which may or may not be clear under flood conditions.

Possible ways of regulating visitor numbers may include restricting access to some sites, by retaining and providing roads of a desired standard, implementing a permit system for some destinations, and regulating the number of tour operators. Without such actions being undertaken within a broader catchment management plan developed in cooperation with landholders, pressures of access and trespass on their land may still occur.

In recent years a number of freshwater aquatic plant species, most notably red lotus, *Nelumbo nucifera*, have proliferated in the lower Mary River. Coverage of the water by these plants separates anglers from the fish, rendering popular fishing techniques relatively ineffective. It is likely that their increase is related to an increase in the proportion of shallow areas within billabongs due to increased sedimentation rates resulting from the range of land management practices and boating activities in the river system.

In some cases it prevents boat access to parts of the system. There have been calls for efforts to control these plants. One experiment has been conducted to determine the effects of physical removal of lotus lilies. It demonstrated that removal is expensive and only effective for a matter of weeks. Observations indicate that lotus lilies are proliferate during drier than average wet seasons and the problem has reduced significantly following good wet seasons and associated high flood levels and flows. Further work on the ecology of the plants could prove useful.

Saltwater crocodiles are an important component of the aquatic biota and provide one of the region's major tourist attractions. While it is desirable that their numbers be maintained, methods should be developed to reduce adverse interactions with land users. Substantial numbers of stock are killed or injured by large crocodiles, and normal pastoral activities can be compromised. Crocodile management programs for the Mary River should include steps to reduce densities of large saltwater crocodiles near the fringe of the floodplains where risks to humans and stock is greatest. Landholders should also take precautions by fencing off the river and billabongs from stock and providing remote watering facilities. This would have the added advantage of protecting river banks and reducing erosion.

5.6.1 Stakeholder Support

Some landholders in the area already cater for tourism while other landholders are interested in diversifying current pastoral activities and pursuing such tourist ventures as fishing, hunting, and other outdoor activities on their land. Such diversification is the choice of the individual landholder. Landholders should not be expected to open up their properties for other activities unless it suits them and they negotiate agreements allowing access.

Fishermen currently use the waterways of the Mary River in both the wet and dry season moving in boats across the floodplains of properties under flood conditions. Landholders have expressed concern over this practice. A legal ruling should be obtained on what constitutes the boundaries of a waterway under flooded conditions and whether under these conditions, the presence of boat outside of normal river boundaries constitutes trespass on a property. These findings need to be disseminated widely to all stakeholders and the public in general. Whatever the findings, the Committee would be in favour of compromise and not resorting to legal argument to find sensible solutions to such problems.

The landholders would support any program that removed large saltwater crocodiles from the rivers and billabongs on or adjacent to their properties. The added safety benefits accruing from such a program would be supported by the tourist industry although part of the attraction of the area is the large saltwater crocodile in its natural state. Viewing platforms have been erected at particular sites to promote this aspect of the Mary River. Removal programs should target problem crocodiles on pastoral properties in the first instance.

5.6.2 Recommendations

The Committee recommends:

- 24. That any plans to develop the Mary region for increased tourism and recreation activities be done under a broader integrated catchment management plan and in close cooperation with landholders in the Mary River catchment.
- 25. That the legalities regarding trespass, waterways and flood conditions be clarified and disseminated widely to all stakeholders.
- 26. That a crocodile management program be implemented to deal with problem crocodiles in waterways on or adjacent to pastoral properties. Such a program should provide for the exclusion of stock from waterways and alternative watering points by landholders affected.
- 27. That controls be placed on marine/aquatic operations and recreational boating activity on Mary River waterways to minimise environmental impacts including further erosion damage to river banks.

5.7 Feral Animals

The biggest feral animal problem in the Mary River catchment is feral pigs. Feral pigs degrade the landscape destroying wildlife habitat and food supplies, predisposing areas to soil erosion in the wet season and making trafficking across floodplains more difficult. They can also carry diseases which can severely affect the viability of pastoral operations if such diseases spread to cattle or buffalo.

Control is labour intensive and usually involves shooting. Some animals can be poisoned but there is a significant risk of affecting non-target animals, while trapping has limited success. Landholders including government agencies managing government estate have utilised pet meaters as a means to curb numbers on properties.

Unfortunately putting a value on feral pigs has the same effect as valuing our wildlife for management purposes. It essentially provides an incentive to protect the species and ensures its future. Pet meaters and landholders who can gain an economic reward from harvesting pigs will be reluctant to eradicate the animal and tend to leave young and females as a breeding base to ensure the viability of the harvesting operation in future years. Landholders should be aware of the problems that would be created for control of an outbreak of an exotic-animal disease should feral pigs be tolerated.

5.7.1 Solutions

The Committee received a very cogent argument on the merits of properly accredited and trained sporting shooters being provided access to land in the Mary River for the purpose of feral animal control. The Sporting Shooters Association of Australia (NT) provided ample evidence where such programs have been conducted in other National Parks in Australia and recommended that a pilot program be operated in the Mary River area. Such a program could only be developed after extensive consultation with all landholders and the application of a range of checks and safeguards to ensure safety standards are maintained.

An eradication program using these organisations should be integrated into a formal feral animal management strategy for the catchment and involve the input and consultation of all landholders from the Mary River and adjacent catchments.

5.7.2 Stakeholder Support

It is likely that many landholders would see merit in using appropriately trained shooters to control feral pigs provided that such a program is well planned and developed in full consultation with the landholders concerned. Some landholders may not view feral pigs as such a pest that eradication is warranted and may choose to continue with harvesting operations as the economic benefit assists in their overall viability. However, the risks posed to the future of livestock industries in the Territory should be considered and Government should not condone such an attitude to feral ungulates of any sort.

Managers of government estate should find such a program attractive as feral pig eradication on conservation land is a priority in order to protect wildlife habitat. By entering into well planned feral control programs with sporting shooters associations, the government would also be partially catering for the demands of such groups for greater access to parks and reserves for recreational hunting. Timing and strategic closure of some areas would be crucial in preserving paramount safety considerations within any reserve land.

5.7.3 Recommendations

- 28. That all landholders treat feral pigs as a serious pest animal and work within their means to eradicate them rather than treat them as a harvestable resource for short term financial gain.
- 29. That an integrated feral pig eradication strategy be formulated by landholders for the catchment.

- 30. That landholders and in particular managers of government estate, are encouraged to consider using qualified and appropriately organised sporting shooters from approved organisations, to conduct feral pig control shoots on land under their control.
- 31. That any shooter licensed to conduct feral animal control operations in the catchment has appropriate certificates in hunting and these operations be carried out in accordance with those certificates developed and issued by recognised and registered Shooting Associations of Australia.

5.8 Bushfires

Over the last five years, there has been at least one wildfire per year in the Lower Mary River area. In some instances, they have burnt for weeks - causing stock, pasture, habitat and "quality of experience" losses, and incurring fire fighting costs and disrupting daily routine. There is need for a comprehensive fire management plan for the Mary River catchment.

Different management objectives require different fire management actions. Because of the range of landuses in the catchment it is necessary to have different plans and objectives for different properties. They should however all be developed under the umbrella of a catchment plan.

On conservation estate, the objectives of a fire management plan may be the prevention of fire entering neighbouring properties and to use fire to maintain a diversity of habitat within the reserve. The adjoining property may wish to exclude wildfire from the property at all times and implements a series of actions to achieve this. Obviously all the landholders must work together in developing the plans and in implementing the actions to achieve the diverse and often conflicting objectives.

5.8.1 Stakeholder Support

The Committee was informed that all landholders in the region support the development of an overall catchment fire management plan. They would also like to see government provide additional resources to the region in order that actions under the plan are implemented correctly and at the appropriate times. The recent provision of a VHF repeater station and radios to landholders to improve communications and fire management has been welcomed by all involved.

Some landholders were concerned that fires on government estate have been poorly controlled in the past with the consequence that wildfire has impacted on their properties causing damage to their pastoral operations and incurring great expense in their unplanned fire control and suppression actions.

5.8.2 Recommendations

The Committee recommends:

- 32. That a fire management strategy for the region be developed and integrated with the other land management strategies which have been recommended.
- 33. That landholders work with government and landholders from adjacent catchments to develop a fire management plan and that its resourcing and implementation be closely monitored.

5.9 Wildlife Habitat Protection

5.9.1 Grazing Intensity

Because of the inherent difference in carrying pastoral capacity of upland country and floodplain, and the shortage of upland area in comparison to floodplain, there is increased grazing pressure on upland areas during the wet season. Overgrazing of upland country causes a variety of land degradation problems, with weed invasion and soil erosion being the most common.

If floodplains are overgrazed, or grazed during the wetseason when the plains are partially inundated, there is great potential for pasture loss or degradation. This enables less palatable and less productive pasture species to dominate, as well as open up areas to weed invasion. Insufficient pasture cover on the floodplains at the start of the wet season, may lead to erosion, and loss of nutrients and seed reserves. Soil erosion can have harmful effects on the water quality and increase the erosive potential of the wet season floodwaters. Fish and other biota may be adversely affected by high sediment levels in the floodwaters.

Should erosion rates increase, the water quality in the river and billabongs would decline through sedimentation. This would reduce sunlight penetration of the water and the productivity of algae and aquatic vegetation would decline which may effect fish growth rates and numbers supported in a section of waterway.

Similarly, overgrazing often results in large quantities of manure being washed into the waterways with the first large storms of the wet season. This can have the opposite effect by generating too much biological activity through the addition of this fertiliser so that available oxygen in the water is used up driving this process. The resultant effect is that fish and other aquatic organisms suffocate through lack of oxygen.

Clearing, along with the introduction of exotic pastures (see also Section 4.3) can have a significant effect on wildlife habitat. Only through careful analysis and planning can the objectives of development and conservation coexist in the Mary River.

5.9.2 Developments in the catchment

Developments and reclamation works in the catchment have the potential to impact on the range of habitats required for fish and in particular barramundi, to complete their life cycles. Barramundi need a mix of coastal swamp and floodplain habitat in order to maintain a large, healthy population in the Mary River system. Barramundi spawn in the mouth of the river and small juveniles enter coastal tidal swamps on high tides in the late dry and early wet season.

If there are rains to fill these tidal swamps the juveniles grow in this coastal habitat. As the wet season progresses these coastal swamps link with the freshwater floodplains and the fish grow in this freshwater environment. Towards the end of the wet season the juveniles migrate upstream and the extent of the wet season often determines how far upstream they progress. The right mix of climatic and seasonal conditions along with a range of habitats is crucial to barramundi breeding cycles.

The size of the freshwater floodplains of the Mary River and the reliability of their inundation even in poor wet seasons, is largely the reason this river system is more productive for fish and wildlife than many larger rivers in the Northern Territory. The productivity comes from the huge amounts of nutrients that are both trapped and generated on the floodplains and ultimately flows into the estuarine and coastal waters.

For barramundi to continue to proliferate in the Mary River system, the freshwater floodplains must be protected and maintained from degradation by saltwater intrusion or overgrazing. However the coastal swamps and natural drainage lines must also be conserved so that juvenile barramundi can grow, migrate and complete their natural cycle. Care must be taken in planning and implementing saltwater intrusion control works to ensure that such problems do not arise.

The possible proliferation of ponded pastures in the future may impact on the existence of, and access to floodplain habitat and its productivity. The Committee heard that large scale ponded pasture development has the potential to hold a significant proportion of water on the floodplains so that normal flows into estuaries are reduced. This could have the effect of diminishing the productivity in the estuaries where marine animals survive on the nutrients flushed from the floodplains.

The Committee is aware that large parts of the Mary River system are dominated by natural ponded pasture and perennial freshwater wetlands and this is what makes the Mary River system so productive. Obviously there exists a balance between freshwater retention on floodplains and the flow of this water and the nutrients it contains to the marine environment. This issue is likely to be more of a concern on the drier floodplains of the Adelaide and Wildman Rivers should development of ponded pastures progress on a large scale.

As a result of over 40 years of saltwater intrusion in the Mary River, water is retained for a much shorter period of time and any nutrients produced on the floodplains are lost very quickly to the coastal waters rather than slowly running to the sea over an extended dry season period as occurred in the past. This rapid drainage exacerbates reduction in the overall productivity of the system as much as through the reduction in area of freshwater floodplains producing nutrients as a result of salinisation.

5.9.3 Stakeholder Support

The Lower Mary River Landcare Group have supported the approach of removing stock from floodplains when inundated, that is during the growing period for floodplain vegetation. Landholders have also recognised that in order that their operations remain viable in the future the productive pastures on which their grazing operations depend must be sustained. Overgrazing is recognised as a serious problem to the wetlands.

Landholders also perceive saltwater intrusion as one of the greatest threats to their existence in the area and want the floodplains protected. The fishing industries and managers also want the floodplains protected in order to maintain a healthy productive system for barramundi production. Conservationists wish to see habitat diversity maintained for the full range of wildlife species now supported. Neither fishermen nor conservationists are prepared to accept that the coastal tidal swamps should be destroyed in the process of restoration nor the migration paths of the fish completely blocked.

The solution lies in carefully determining where the important breeding sites are and not impacting on these. Similarly, other wildlife in the system need to be protected by conserving the appropriate mix of habitat types. Actions should not be taken by any landholder in the catchment which would permanently destroy key areas of habitat.

5.9.4 Recommendations

- 34. That the relevant authorities, in conjunction with landholders, identify sites important to wildlife including fish and other aquatic biota and assess the potential impacts of changed land use practice on those sites.
- 35. That a wildlife conservation strategy for the catchment be developed, that recognises the linkages between different elements of the wetland system and the need for complementary actions on the public estate and privately managed land, and incorporates agreed responses to adverse change.
- 36. That wildlife values and their contribution to commercial activity(eg. Tourism) be explicitly incorporated in any cost benefit analysis undertaken when developing regional land use plans and property management plans.

5.10 Water Quality

Maintaining surface water quality throughout the wetlands is fundamental for full ecosystem functioning including the biological integrity of conservation reserves and for viability of revegetation for wetlands restoration works. Both natural catchment processes and land use and management practices contribute to and impact upon water quality throughout the wetlands. Investigations into the interrelationships between water quality and catchment runoff are in progress but are only in their early stages and clear understanding of their complexity is yet to be established for the region. Some general issues, however, are evident.

Fish and other aquatic biota are frequently killed by anaerobic conditions in billabongs during the late dry to early wet seasons; often following a previous poor wet season. These incidents are well known to occur throughout the region as natural occurrences. It is possible, nevertheless, for them to be exacerbated through alterations in the intensity and quality of catchment runoff as the result of a range of land management practices particularly related to stocking rates and burning practices. Increased intensities of recreational boating use may also cause disturbance in waterbodies which raise the risk of fish kill events.

Inappropriate land management practices on pastoral land may lead to increases in nutrient runoff, sediment and turbidity levels, and the introduction of toxic agents. Excessive stocking rates, overgrazing, clearing, burning, fertiliser application for pasture improvement and herbicide use for control of mimosa may all impact on water quality. Runoff carrying herbicides applied for weed control on reserves is also a potential threat, as is direct pollution from fuel and oil spillage associated with recreational fishing and tourism.

The longer term expansion of horticulture could contribute drainage from cleared and cultivated areas with excessive or inappropriate fertiliser and pesticide application rates. Chemical control of invertebrate pests risks pollution of wetlands and resulting impacts on wildlife and stock. The preferred approach is targeted biological control and integrated pest management which minimises chemical utilisation and wastage to the environment.

The activities of recreational anglers and tourist boat operation has also significant effects on water quality associated with the mechanical disturbance of river banks and dispersal of sediments resulting from the use of outboard motors in shallow waters.

Two mines operate in the Mary River catchment, both discharging waste water into Mount Bundey Creek which enters the floodplain via the Hardies Creek and Corroboree-Rockhole billabong systems. These latter systems are prime natural conservation, tourism and recreational fishing areas and also support pastoral properties.

Waste discharge from Tom's Gully Mine is controlled through a licence granted under the Water Act specifically for the protection of aquatic ecosystems in the floodplain waterways. Licensing is in preparation for Rustler's Roost Mine to achieve the same objective. Local stakeholder involvement is a fundamental component in the determination of waste discharge licences in order that multiple land uses are preserved.

Sand mining also occurs from the Mary River and it is appropriate that an overview of these operations be conducted to establish whether they have any significant effect on sediment transport fluxes to the floodplain waterways. There is at least the potential risk that sand extraction from the river in its upper reaches can impact on floodplain waterways sedimentation processes and also reduce the capacity for natural maintenance of offshore shoals associated with Sampan and Tommycut Creeks.

5.10.1 Recommendations

- 37. That investigation of the interrelationships between natural catchment processes, land use and management practices and water quality in key sections of the Mary River system continues and that results are disseminated widely to all stakeholders.
- 38. That water quality management plans be developed and implemented for the full Mary River Catchment in accordance with the Water Act, with full consultation and participation by stakeholders, so that land use, management practices and any new development in the catchment contribute to the maintenance of beneficial uses of the wetlands appropriate to environmental and production needs.
- 39. That the impacts of sand mining on flow dynamics and the movement of sediment in the Mary River system be carefully assessed and these findings be taken into account prior to any further sand mining leases or licences being issued in the Mary River.

6. CONCLUSION

The Mary River Wetlands are some of the most productive land in the Northern Territory in both a biological and economic sense. The Committee can not stress highly enough the importance of managing this land in a sensitive and proper manner to ensure the long term sustainability of this region for the wide variety of land uses it currently supports. This involves:

- ensuring the long term economic and social sustainability of individual enterprises
- maintaining the resource base on which these enterprises depend;
- promoting opportunities for new enterprises based on as yet unutilised resources;
- conserving and sustaining the regions biological diversity; and
- maintaining essential ecological processes within the Mary River system.

Whilst at this stage multiple use of the Mary River system is in its early development, now is the time to gain acceptance from all landholders, stakeholders from other sectional interests and community groups and Government to accept some constraints on the achievement of their narrower goals. Effective multiple use will vary across the river system.

The Committee is of the opinion that in achieving multiple use of the region it may be necessary to limit development before maximum economic productivity is achieved, if ecological sustainability is to be ensured.

The Committee considers that the problem of saltwater intrusion must be addressed most seriously and urgent action taken in order to safeguard and protect the future land use in the Mary River system.

Engineering investigations, environmental assessment and budgetary planning must be completed, in conjunction with pilot works trials, to construct tidal chokes within the next two years. It can not be emphasised strongly enough, the urgency of undertaking these works with the associated necessary funding, so that they be put in place within the next two years.

The Committee is firmly convinced that if nothing is done about salt water intrusion along the lines of that recommended within the time frame suggested, there will not be any wetlands left to promote multiple use within the Mary River region.

Other Committee recommendations dealing with the range of issues affecting the Mary River wetlands need to be implemented and developed through an integrated catchment management strategy and also with some priority.

It is proposed that these recommendations are developed and implemented through a task force or management committee approach, with representation from key industry groups and government departments concerned in order to make the task force both effective and focussed. The work of this task force should be promulgated in such a way that all stakeholders will be bound to any agreed management plan and its implementation.

The future of multiple land use and its ecological sustainability depends on all stakeholders in the Mary River catchment recognising the interdependence of the issues affecting the catchment and resolving them in a collaborative manner without degrading the inherent values of the natural resources in the region.

7. GLOSSARY

AHD

Australian Height Datum: a surveying term to describe elevation above a uniform elevation which is mean sea level.

Anthropogenic

Caused by or influenced by the activities of humans.

Backwater swamp

A low-lying wetland area, not directly connected to a river or tidal channel, but subject to wet season flooding. Often at the margins of the floodplains

Biological diversity or Biodiversity

The variety of life forms: the different plant, animals and micro-organisms, the genes they contain and the ecosystems they form.

Chenier

A continuous or discontinuous narrow sandy/shelly ridge, usually parallel to the shore, deposited by storm waves upon a plain of fine grained coastal sediments, usually muds.

Chronology

The sequence of events in order of their occurrence.

Dendritic

Branched like a tree: a pattern of stream course in which channels branch irregularly in all directions at any angle.

Floodplain

A relatively flat area bordering a river which becomes submerged during floods, at which time further sediment may be added to the plains.

Geomorphology

The study of the surface configuration of the earth, especially the nature and evolution of present landforms, their relationships to underlying structures and the history of geological activity as represented by such features.

Holocene

The geological epoch of the Quaternary period extending from the end of the Pleistocene period to the present.

Hydrodynamics

The study of fluid motion and fluid-boundary interaction.

Levee

A naturally formed bank of higher ground occurring adjacent to a river and deposited by floodwater. Artificially constructed banks which contain floodwaters are also referred to as levees.

Morphology

The form and structure of landforms, rivers and streams.

Nutrients

A substance or compound that provides nourishment or food.

Paleochannel

A remnant creek or river channel that has been infilled or buried by younger sediments.

Progradation

The gradual seaward build-out of the coast, through accretion and deposition of sediment

Saltwater Intrusion

The penetration of saltwater into previously freshwater environments.

Tidal prism

The total volume of water which flows into a tidal basin with a flood tide and then out again with the ebb. It can be envisaged as the difference between an embayment's or tidal creek's mean high-water volume and its mean low-water volume.

Ungulates

Any hoofed animal.

8. REFERENCES

Woodroffe, C.D. and M.E. Mulrennan, 1993, *Geomorphology of the Lower Mary River Plains, Northern Territory*. North Australian Research Unit, Australian National University.

APPENDIX 1

WITNESSES INTERVIEWED

MARY RIVER TECHNICAL WORKING GROUP

Darwin 3 February 1995

Name	Position/Association
Ms Maria Kraatz	Land Conservation,
	Conservation Commission of the NT
Mr Dick Slack-Smith	Fisheries, Department Primary Industries and Fisheries.
Mr Dave Williams	Water Resources Division,
	Power and Water Authority
Mr Peter Whitehead	Principal Wildlife Scientist
	Conservation Commission of the NT
Ms Libby Sterling	Park Ranger
	Conservation Commission of the NT
Mr Ian Miller	Weeds
	Department of Primary Industry and
	Fisheries
Mr Barry Lemcke	Agriculture
-	Department Primary Industries and
	Fisheries.
Mr Bob Karasczewych	Pastoral Branch
	Department of Lands & Housing and
	Local Government

APPENDIX 1 Continued

WITNESSES INTERVIEWED CONTINUED

PUBLIC HEARINGS

Darwin 13 - 14 February 1995

Name Mr. Gra

Mr Graeme Sawyer Mr Alex Julius Mr Dave Williams Mr Roland Griffin Mr Mike Frazer Mr Deiter Moeckel Mr Ian Smith Ms Kezia Purick

Mr Rodney Johnston Mr Mark Hillier Mr Joe Fisher

Mr Matti Urvet Mr Roger Smith

Mr Peter Whitehead Ms Maria Kraatz Mr Ian Baker Mr Lawrence Ah Toy Mrs Clair O'Brien Mr Denis Howison

Mr Graeme Fagan Ms Libby Sterling Mr Paul Jonauskas Mr Jim Forwood

Position/Association

Vice President, Sporting Shooters Association Amateur Fishing Association Water Resources, PAWA **Dept Primary Industry & Fisheries** President, NT Fishing Industry Council Secretary, NT Fishing Industry Council Executive Officer, NT Fishing Industry Council Executive Officer, NT Chamber of Mines and Petroleum Director, Kakadu Resources **Boral Resources** Director, WJ & EE Fisher, Exploration and Mining Consultants Director, Conservation Commission of the NT Deputy Director, Conservation Commission of the NT Wildlife, Conservation Commission of the NT Landcare, Conservation Commission of the NT Executive Officer, Buffalo Industry Council Member, Buffalo Industry Council President, Lower Mary River Landcare Group Manager, Wildman River Wilderness Park, Member LMRLG Owner, Marrakai Station, Member LMRLG Ranger, CCNT Land Management, CCNT Chairman, Farmers & Graziers, Lower Mary **River** Area

APPENDIX 1 Continued

WITNESSES INTERVIEWED CONTINUED

PUBLIC HEARINGS Continued

Darwin 15 March 1995

Mr Peter Blake	Secretary,
	Department Primary Industry & Fisheries.
Mr Tony Hooper	Director, Agriculture,
	Department Primary Industry & Fisheries
Mr Wayne Mollah	Director, Land Resources Management
	Department Primary Industry & Fisheries
Mr Darryl Grey	Director, Fisheries
	Department Primary Industry & Fisheries

APPENDIX 2

WRITTEN SUBMISSIONS RECEIVED

Submission No.	Name of Individual or Group represented
MRW001	NT Tourist Commission
MRW002	Mr Terry Baldwin
MRW003	Northern Land Council
MRW004	Land Resources Management & Education
MRW005	Additional Mr Terry Baldwin refer MRW002
MRW006	Dr A Johnston, Environmental Research Institute of the
	Supervising Scientist
MRW007	Buffalo Industry Council
MRW008	Farmers and Graziers, Lower Mary River Wetlands Area
MRW009	Northern Territory Government
MRW010	Sporting Shooter's Association of Australia (NT)
MRW011	Amateur Fishing Association
MRW012	Mr G Cook, CSIRO
MRW013	WJ & EE Fisher Pty Ltd
MRW014	Fishing Industry Council
MRW015	NT Chamber of Mines and Petroleum
MRW016	Northern Territory Shooters Council
MRW017	Lower Mary River Landcare Group
MRW018	Fisheries Division, Department Primary Industry & Fisheries



