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This study was made possible with the financial support of WWF Australia and the Shorebird Conservation Project funded by the Natural Heritage Trust. Additional project coordination and material support provided by the Southern Gulf Catchments Ltd including 4wd vehicles for the field trip is also gratefully acknowledged.
Executive Summary

This study has its origins in the Shorebird Conservation Project (SCP), funded by the Natural Heritage Trust and coordinated by WWF Australia. The Gulf of Carpentaria is one of ten priority shorebird sites that have been selected across Australia for a range of community-driven shorebird conservation projects.

The Gulf region is a vast, flat, seasonally dry savanna landscape drained by large seasonal rivers and is primarily comprised of large pastoral properties, some of which are owned by Aboriginal groups and also supports commercial and recreational fishing industries and a mining industry. Collectively the river basins of the southern Gulf are thought to represent one of the largest, highest integrity depositional environments in the world (Hydrobiology 2005). The wetlands of the Gulf are one of the most important environmental asset in the region and critical to the sustainability of the prawn and fin-fish industries, recreational fishing, tourism, grazing and the health and lifestyle of indigenous communities. More than 22,000km² of wetlands in the south-eastern Gulf of Carpentaria are listed in the Directory of Important Wetlands in Australia and most of these provide habitat for shorebirds (EA 2001). The south east Gulf region contains approximately half of the migratory shorebirds that occur in Queensland.

Little is known about management of important wetlands in the coastal and sub-coastal Gulf region. After more than 100 years of grazing of this region by domestic stock the wetlands have in the past generally been assessed to be in good condition. However, in recent decades it has become increasingly clear that pressures – invasive weeds, feral animals and the intensification of pastoralism and other agriculture - on Gulf wetlands are increasing. Without concerted efforts to manage these important wetlands, it is likely that their health will decline along with the biodiversity they sustain and the ecological services they provide. In this context, it is important to document current and historical wetland management practices to provide a benchmark critical to developing management guidance for wetland managers.

This project’s scope encompasses a range of objectives encapsulated under three heading areas:

1. Wetland habitat management awareness raising,
2. Documenting wetland manager practices and needs,
3. Devising a simple land manager operated wetland health monitoring system.

Methods used to pursue these three objective areas included literature and interview based research, field work and land manager and public consultation.

Findings from the land manager interview responses indicated that while all land managers recognised and appreciated the non-production values of wetlands none employed specific wetland management practices other than several examples of exclusion fencing which was principally established to avoid stock losses. Wetland management as practiced was universally ‘integrated’, as part of broader property management and conservative stocking was the primary approach cited for ensuring sustainability of wetland habitats. Few of the properties surveyed had developed property management plans and those that had been developed only considered natural resource management from the perspective of sustaining production. Most land managers gave upbeat assessments of wetland condition on their properties while recognising that there was some degradation concerns principally associated with weeds and feral animals and the indirect impacts of cattle i.e. soil erosion. Few cited cattle as a direct degradation risk to wetlands.

This contrasted with the wetland management aspirations and resource needs identified by land managers in which fencing and off stream/wetland watering point infrastructure for decreasing cattle impacts on wetlands figured prominently. Other needs identified included increased support for strategic weed and feral animal control and information and expertise to guide wetland management.

Overall landholders were very supportive of efforts to improve the management of wetlands though wanted the time, personnel and financial constraints of pastoral operations recognised. All were supportive of involvement in the East Asian Australasian Flyway Site Network, most were interested in becoming involved in wetland and bird monitoring activities and greater than half were supportive of Traditional Owner involvement in wetland management. All reserved their support for conservation agreements, tenements or wetland convention designation pending seeing specific proposal details. Most land managers nominated wetland management initiatives that could be undertaken on their properties including a number of very high value sites within mapped wetland aggregations in the directory of important wetlands in Australia (EA 2001).

Incidental observation of wetland condition made during the field trip confirmed that ecological pressure on the southern Gulf wetlands is substantial. Though observed conditions were exacerbated by the failed 2004/5 wet season it was apparent that pressures associated with cattle grazing and trampling, feral animals, weeds, soil erosion and associated water quality decline and altered fire regime are at risk of changing the ecological character of the southern Gulf’s wetlands. A broader assessment of threats also identified climate change as a key emerging threat to the Gulf’s wetlands.

Following a review of other monitoring systems and consultation with researchers and land managers, a proposal for a simple wetland condition monitoring system which is based primarily on the use of fixed photo points and digital cameras was developed by the project for further trialling and refinement.

Based on the findings of the interview and literature based research and field observations a number of key recommendations concerning priority wetland management needs, shorebird, waterbird and waterfowl specific priorities, research needs and areas of strategic investment for NRM and conservation organisations have been made for the southern Gulf’s wetland resources (below).
Summary Recommendations

Priority Wetland Management Needs
- A reduction in cattle grazing and trampling pressure on wetland habitats,
- A reduction in soil erosion and sediment loading within wetland catchments,
- Targeted weed and feral animal control,
- The development and adoption of sustainable wetland habitat focussed property management planning,
- Better incorporation of broader stakeholder interests (i.e. Traditional Owners, Conservationists) in Pastoral leasehold land management,
- Increased technical understanding by land managers of wetland habitat and ecological condition and associated management needs, and
- Adoption of wetland condition monitoring by land managers.

Shore Bird, Water Bird and Waterfowl Specific Priorities
- Compilation of current knowledge of bird distribution and abundance to underpin site specific management needs (including those associated with limited beach habitat and coastal flock roosting sites),
- Facilitation of a broader (than land manager only) bird monitoring program involving external expertise and regional / external volunteer participants,
- Community (public, schools, landholders) education in bird identification and monitoring techniques,
- Improving the capacity of land managers to understand bird habitat management needs,
- Development of local ‘birding’ network within the southern Gulf, and
- Extending wetland bird habitat management planning beyond the focus on migratory shorebirds to resident shorebirds, waterbirds and waterfowl.

Research Needs
- In situ (existing) grazing regimes (including exclusion areas) and associated wetland condition,
- Impact of fire, weeds, feral animals and grazing on the viability of wetland bird habitats (with a particular focus on fringing vegetation),
- Impact of excavation and bunding on the habitat values of wetlands,
- Relationship between shorebird distribution and abundances and the habitat value and condition of freshwater wetlands,
- Potential impacts to southern Gulf wetlands associated with climate change and associated sea level rise and appropriate adaptive management responses.

Areas of Strategic Investment for NRM and Conservation Organisations
At the property scale investment is required to support:
- Property scale inventory and mapping of wetlands including identification of issues for property management planning (case studies will have major communication merit),
- Provision of information, material resources (maps, air photos) and expertise to engage land managers in Participatory Property Management Planning,
- Access to devolved funding for material resources that help deliver reduced grazing pressure on wetlands i.e.
  - Fencing
  - Off stream / wetland watering point infrastructure, and
- Resourcing for increased weed control capacity (Including non-declared species).

At a regional scale strategic investment opportunities are identified in:
- A program to supporting the adoption of wetland condition monitoring by land managers,
- Building the technical capacity of land managers to undertake wetland condition and bird (& other biota) monitoring,
- Developing wetland specific management guidelines and associated extension materials for Gulf wetlands,
- Supporting Traditional Owner organisational vehicles in their aims of delivering Cultural and Natural Resource Management on wetland ‘country’, and
- Developing a regional management plan for the southern Gulf’s wetlands.

A regional wetland management plan for the southern Gulf’s wetlands is considered a keystone recommendation in that it could provide the framework for co-ordinating all of the regional scale wetland
management capacity building activities and the delivery of on-ground management outcomes across the range of stakeholders and agencies with interests in the Gulf's wetland resources.
> Project Background

**Project Origins**

This project has its origins in the Shorebird Conservation Project (SCP), funded by the Natural Heritage Trust and coordinated by WWF Australia which aims to increase awareness, understanding and involvement by communities in the conservation of shorebird habitat, and where possible enable communities to conserve and wisely manage important shorebird sites. The Gulf of Carpentaria is one of ten priority shorebird sites that have been selected across Australia for a range of community-driven shorebird conservation projects.

In May 2004 the Shorebird Conservation Project supported a *Southern Gulf Birds and Wetlands Forum* in Karumba to raise awareness about values of important wetlands in the southern Gulf and build support for their conservation and wise use. The forum was convened by WWF Australia in collaboration with the Northern Gulf Resource Management Group and the Southern Gulf Catchments Ltd and facilitated interaction and networking among wetland managers, Traditional Owners and those with expertise in shorebird and wetland management.

At the forum participants worked up concepts for future shorebird and wetland management projects in the southern Gulf. Ideas raised included wetland inventory and condition assessment, assessment of human use and impacts on Gulf wetland resources, establishing monitoring for birds and wetlands, establishing cooperative wise use management agreements, development of a strategy for the management of important wetlands in the Gulf, and others.

This project builds on the outcomes of the Southern Gulf Birds and Wetlands Forum, by targeting education and awareness raising efforts at land managers and users and positioning wetlands and their management as a priority for Natural Resource Management in the Gulf. The project is a collaboration between WWF and the Southern Gulf Catchments Ltd. (SGC) and fits within the SGC’s Regional Investment Strategy. SGC has assisted the project through coordination of landholder liaison and provision of 4wd vehicles for the fieldwork. WWF has supervised and coordinated the project and provided funding through the NHT National Shorebirds Project and through its own general funds. A WWF staff member (Russell Kelly) also assisted in the field work deliver in particular the promotion of the East Asian Australasian Flyway Network.

**Project Area & Context**

The Gulf region is a vast, flat, seasonally dry savanna landscape drained by large seasonal rivers and is primarily comprised of large pastoral properties, some of which are owned by Aboriginal groups and also supports commercial and recreational fishing industries and a mining industry. Collectively the river basins of the southern Gulf are though to represent one of the largest, highest integrity depositional environments in the world (Hydrobiology 2005).

The wetlands of the Gulf are one of the most important environmental asset in the region and critical to the sustainability of the prawn and fin-fish industries, recreational fishing, tourism, grazing and the health and lifestyle of indigenous communities. More than 25,000km² of wetlands in the south-eastern Gulf of Carpentaria are listed in the Directory of Important Wetlands in Australia and most of these provide habitat for shorebirds (EA 2001). The south east Gulf region contains approximately half of the migratory shorebirds that occur in Queensland. A maximum count of 224,000 shorebirds has been recorded in March 1999 (Driscoll 2001). Two thirds of these birds use the coastline while one third occur in sub coastal freshwater or grassland habitat and along the banks of tidal rivers. The major coastal shorebird roost sites are known and documented and most of the inter-tidal coast is utilised as feeding habitat. Vast areas of ephemeral freshwater wetlands are also utilised by shorebirds many of which persist well into the dry or over some years. Consequently the Gulf is recognised as the most important site for shorebirds in Queensland and one of the three most important sites for shorebirds in Australia. The region supports internationally significant populations of 16 species of shorebird (Garnett 1989, Driscoll 2001).

Little is known about management of important wetlands in the coastal and sub-coastal Gulf region. After more than 100 years of grazing of this region by domestic stock the wetlands are generally assessed to be in good condition (Garnett 1989, Blackman et al 1999). The Gulf Plains bioregion has been identified as relatively resilient to grazing (Stafford Smith et al 2000). However, in recent decades it has become increasingly clear that pressures – invasive weeds, feral animals and the intensification of pastoralism and other agriculture - on Gulf wetlands are increasing. Without concerted efforts to manage these important wetlands, it is likely that their health will decline along with the biodiversity they sustain and the ecological services they provide. In this context, it is important to document current and historical wetland management practices to provide a benchmark that will be critical to developing management guidance for wetland managers.

An overall approach to manage threats to the Gulf’s wetlands requires cooperation between the Traditional Owners (eg. the Kortijiar, Kukatj, Gkuthaarn, Ganalidda, Peoples), management groups (eg. landowners/managers, Northern and Southern Gulf NRM Groups, local government, state government agencies), user groups (eg. fishing and mining industry), and technical experts. Regional natural resource management is only just being developed in the Gulf region and regional NRM bodies are interested in developing wetland management strategies. A critical first step in this process is to collect information from wetland managers about their management needs and in particular, what assistance may be necessary to deliver optimal wetlands management.
> Aim & Objectives

**Aim**
The general aim of this project is to support the conservation of important wetlands in the southern Gulf of Carpentaria by gathering information critical to their future management, building awareness of wetland values and management issues among wetland managers and facilitating the engagement of managers in the monitoring of wetland values.

**Objectives**
The specific objectives of the study are to:

1. Raise awareness among wetland managers of the important shorebird and other habitat values and associated management challenges of wetlands in the southern Gulf,
2. Promote the East Asian Australasian Flyway Site Network with wetland managers
3. Document current and historical wetland management practices on southern Gulf properties,
4. Document land managers’ identified wetland management support needs required to deliver effective wetlands management,
5. Develop a simple land manager operated wetland health monitoring system for future provision to motivated land managers,
6. Recommend priority areas for NRM body investment in the management needs of southern Gulf wetlands.

Ultimately to underpin:
- More targeted engagement and support of southern Gulf landholders concerning wetland management,
- Identification of strategic priorities for the Southern Gulf Catchments Inc. Regional Investment Strategy (RIS), and
- Improved wetland management outcomes on pastoral properties of the southern Gulf (as part of a regionally developed wetlands Strategy).

> Project Scope & Methods

As identified above, the project’s scope encompasses a range of objectives which can be encapsulated under three heading areas:

4. Awareness Raising,
5. Documenting Wetland Manager Practices and Needs,
6. Devising a simple land manager operated wetland health monitoring system.

Methods used to pursue these three objective areas included literature and interview based research, field work and land manager and public consultation. A field trip by 4wd vehicle to the southern Gulf was undertaken between the 16th and 29th of May 2005 in the company of four co-workers:

- Russell Kelly (WWF Australia) – Project Coordinator
- Jim Tait (Econcern) – Principal investigator
- David Milton (Shorebird Consultant Queensland Wader Study Group)
- Sandra Harding (Shorebird Consultant Queensland Wader Study Group).

The Southern Gulf Wetland Aggregation SGA (EA 2001) was the primary focus of the field trip as it is recognised to be one of the three most important areas for shorebirds in Australia and the largest continuous estuarine wetland aggregation of its type in northern Australia (Blackman et al/ 1999). Sites in contiguous wetland aggregations i.e. Marless Lagoon, and Nicholson Delta wetland aggregations (Blackman et al/ 1999), were also visited. All landholders within the SGA were contacted prior to the field trip and access was gained to eight of the ten individual land holdings within the SGA. From west to east visited properties included Old Doomadgee, Escott, Armraynald, Wernadinga, Inverleigh, Magowra, Muttonhole and Delta Downs. A landowner from one of the unvisited properties within the SGA (Inverleigh West) was subsequently interviewed by phone.
Properties visited were primarily pastoral leases but also included several Traditionally Owned areas two of which (Old Doomadgee and Muttonhole), had been de-stocked and part of the latter recently alienated from a pastoral lease to form a Conservation Park.

All Traditional Owner groups of the SGWA were consulted and interviewed. From the west to the east: these included the Gangalidda, Kukatji, Gkuthaarn and Kurtjjar. A public meeting of Traditional Owners was convened in Normanton of the 27th of May to consult the three eastern Traditional Owner groups.

Following face to face consultation with land owners or managers, wetlands were visited in the field at the invitation and sometimes in the company of landowners. At two properties (Escott and Wernadinga) aerial inspections of wetland areas were provided in a station helicopter and light aircraft (respectively) by the property owners. Overnight field camps and Station residence stays were had at three properties (Old Doomadgee, Wernadinga and Magowra) at the invitation of land owners and managers.

**Awareness Raising**

All consulted landholders, Traditional Owners and the Southern Gulf Catchments Inc. Board members were given copies of a Shorebird Monitoring Kit that was developed specifically for the southern Gulf region as part of this project by Queensland Wader Study Group members and consultants to this project David Milton and Sandra Harding (Appendix 4).

Two PowerPoint presentations, one on shorebird ecology and the second on wetland bird identification were given to one landholder and to representatives of three traditional owner groups at the Normanton public Traditional Owner meeting. Otherwise, land managers were briefed verbally and with the use of photocopies, maps and posters including one that depicted the East Asian Australasian Flyway Site Network. This poster provided a basis for discussing objectives, implications and process of joining the East Asian Australasian Flyway Site Network with land owners.

**Documenting Wetland Manger Practices and Needs**

Prior to the field trip available literature concerning wetland management practices and needs on grazing properties in tropical Australia was reviewed with specific reference to Gulf drainage systems where possible. A set of open ended questions were prepared (Appendix 2) to canvas landholder held values regarding wetlands, their attitudes to wetland management (for both production and conservation values), management practices (past & present), and material and/or other resource needs they considered would support them to deliver improved wetland management. This set of questions were not formally or sequentially presented to the interviewee but were used to guide open structured interviews with landowners and managers.

Findings were compiled per individual property and aggregated across all properties for this report (Appendix 1). These findings were then analysed and interpreted in terms of the open ended question topic areas (see section Interviewee Responses – Findings Discussion).

**Devising a Simple Land Manager Operated Wetland Health Monitoring System**

Several steps were pursued in undertaking this task including:

1. A review of available literature for tropical Australia was conducted with regard to:
   - Key drivers of wetland impact (especially those associated with properties under grazing land use),
   - Existing wetland health / condition monitoring frameworks,
   - Suitable measurable attributes for a simple landholder based (i.e. photo point) monitoring program
2. Wetland bird colleagues were communicated with regarding the potential and usefulness of bird abundance monitoring as a component of the proposed Wetland Health monitoring framework,
3. Tropical wetland researchers were communicated with regarding existing and developing monitoring frameworks and the scope for associated database development, and
4. Initial concepts and monitoring attributes were trialled during the southern Gulf field trip and discussed with land managers during the field based consultation.

Based on these developmental steps a Simple Wetland Assessment and Monitoring Proforma (Appendix 3) was then developed for future trialling in conjunction with the Shorebird and Waterbird Monitoring Kit (Appendix 4). This proforma was designed to support a primarily photo point based monitoring approach that captures key indicators of wetland health and habitat condition (see section Proposed Wetland Health Monitoring System for Landholders).

During the Gulf field trip incidental observations of wetland birds and habitat condition were made at all visited sites. However, this study was not intended to provide a formal assessment of wetland and associated bird habitat condition or threats on visited properties. Observations of wetland habitats and birds were made on an opportunistic basis and were ancillary to the study’s major focus on interview based research on wetland management practices and needs and awareness raising of shorebird conservation. Observations were biased toward readily accessed properties and areas within those properties and cannot be considered representative of the broader suite of wetland sites or types within the southern Gulf.
Broader assessment of the threats that confront the southern Gulf’s wetlands were drawn from the literature and the personal experience of the researchers, and where possible interpreted in terms of field observations and interviewee responses (see section Threats to Wetland Habitat Condition and Observed Impacts).

Broader assessment of shorebird habitat values and management needs were also drawn from the literature and the personal experience of the researchers, and where possible interpreted in terms of field observations and interviewee responses (see section Shorebird Habitat Management – Implications / Discussions).

Findings from all components of the project including literature and interview based research, public consultation and field observations were used to develop recommendations on the key southern Gulf Wetland management needs and strategic investment priorities for NRM bodies and non-government conservation organisations (see section Conclusions and Recommendations).

> Interviewee Responses - Findings / Discussion

Tabulated responses obtained from land managers to the open ended questions (Appendix 2) concerning wetland values and management practices are presented in Appendix 1.

**Wetland Values**

- Most landholders readily identified natural values of wetlands and expressed personal interest in wetland natural history.
- Production values were not generally cited as paramount except in cases where wetlands provided the main stock watering opportunities.
- One Traditional Owner group cited commercial production values as secondary to all others.
- Three managers (one a Traditional Owner) identified pastoral values of wetlands (green feed, nutritionally better grasses later in year) as of primary importance and specifically identified the value of wetland associated pastures (coastal marine couch).

**Discussion:**
One of the potential implications of these findings is that more conservative management of wetland resources (i.e. some reduced grazing access) might not be too prohibitive in terms of production impacts to pastoral operations.

**Property Management Planning (PMP)**

- Formal property management plans only existed for two properties, both corporately owned (one now a Traditional Owner corporation).
- One existing PMP had been developed by property consultants largely in response to vegetation management needs associated with tree clearing legislation.
- The other PMP focussed primarily on production and infrastructure issues (fences, paddock configurations, watering points, pasture spelling arrangements) and did not incorporate NRM issues generally or wetlands specifically.

**Discussion:**
In the absence of formally developed PMPs the opportunities for formally addressing specific wetland management needs at a property scale are limited.

Investment in Property Management Planning is a worthy focus area for SGC and provides an opportunity for undertaking more comprehensive inventory and management planning for the southern Gulf’s wetland (and other natural) resources at a property scale. Property scale maps that identify the location, type and values of wetlands and associated habitat and property management issues would provide the foundation needed for integrating wetland conservation into property management planning.

**Integration of Wetland Management**

- Other than considerations of wetlands as watering points and the development of ponded pastures within bunded artificial wetlands, none of the interviewed land managers claimed to manage wetlands as a specific resource and all integrated wetland management as part of broader property management.
- Conservative stocking was cited as the primary approach adopted to maintain wetland values though there was no evidence that paddocks containing wetlands were stocked or grazed differently to other areas of properties.
- Several properties had established riparian or wetland exclusion fencing though in these instances preventing cattle bogging was cited as the primary motivation.
Discussion:
Where wetlands are not managed as a specific resource the sensitivity of management actions at a property scale may not be as successful in maintaining their condition, particularly where there are a diverse suite of wetland types within a single property.

The ubiquitous claim of land managers that conservative stocking is the primary sustainable management approach adopted for natural resource protection appears at odds with some other sourced information that suggests the Gulf's cattle herd is larger now than historically and needs to be assessed against suitable benchmark marks for the land systems concerned. Examples of wetlands under considerable grazing based pressure were observed on most properties on the short field excursion (see photos 11-20) which was not, nor intended to be, a representative or objective assessment of a property's wetlands condition.

Development of specific wetland grazing management practices are an appropriate target to be pursued in Gulf PMP.

Specific Wetland Management Practices
- As discussed above there were few examples of wetlands receiving specific management that were cited by land managers other than their treatment as watering points which included associated fencing configurations to spread grazing pressure in adjoining paddocks and bunding and excavation to increase the retained water volume of some wetlands.
- Several properties had existing or defunct cattle exclusion fencing for river frontages and wetland sites or drainage lines. In most instances this fencing had been established to prevent cattle bogging or escaping across rivers. Prevention of erosion on 'break away' banks of river channels was one NRM reason cited for riparian fencing.
- In contrast most landholders could readily identify opportunities for establishing specific wetland management practices such as remote (from wetland) watering points, exclusion fencing and extended spelling (discussed below).
- Less than half of the surveyed properties practice annual or seasonal paddock spelling and unless wetlands occur within intentionally spelled paddocks only receive default spelling associated with wet season inundation.
- Most properties had established additional watering points and fencing in recent decades to more evenly spread grazing pressure away from existing watering points including wetlands. One result of this has been a general increase in overall carrying capacity and herd size per property.
- The extent of properties burnt each year varied greatly from no intentional burning up to 50% of area per annum. Where practiced, burning regimes were relatively uniform in terms of being conducted late in the dry season and usually subsequent to the first storm rains to minimise risks to pasture reserves in the event of a failed wet season. Most burning is undertaken to target rank grass growth and reduce woodland thickening and woody weeds. On one Traditionally Owned property extensive burning commenced earlier in the dry season and was undertaken solely for traditional 'country management' purposes. On another TO property rubber vine control has been a primary motivation for fuel load accumulation and burning in recent years.

Discussion:
Given the diversity of wetland types and values within the southern Gulf it is a reasonable assumption that some degree of specific, tailored management would be optimal for their ecological maintenance. The fact that wetland systems and values have been retained within the Gulf landscape to date is probably due to a combination of factors including: historically low stocking densities, default wet season spelling and some level of inherent ecosystem resilience.

With an intensification of pastoral production now apparently occurring on many Gulf properties there is a concern that the mechanisms that have served to protect the Gulf's wetlands may not remain effective. While conservative stocking was commonly cited as the underlying approach being used to maintain wetland values its effectiveness as a wetland management tool has not been specifically assessed. In the context of wetlands being used as open watering points for stock there is ample justification (including field observations) to be concerned that unsustainable pressure may be exerted on wetland ecology.

The diversity in fire regimes across properties is noteworthy. There is clearly no tailoring of fire to take specific account of maintaining wetlands biodiversity and no consensus in general about fire use. This is an important area for research utilising willing landholders.

The development of a wetland condition monitoring framework for adoption by landholders (as proposed by this study), property scale wetland resource inventories (including condition assessments) and the associated establishment of wetland specific grazing management regimes is a high priority for strategic NRM investment within the southern Gulf catchments. Establishment of pilot projects and demonstration sites is likely to be a valuable approach for developing this capacity.
Assessed Condition

- Most pastoralists considered their wetlands to be in pretty good condition and one claimed they were as good as when Aboriginal people left them.
- Several pastoralists recognised some of their wetlands to be showing signs of degradation primarily associated with weeds, feral pig damage and erosion.
- One pastoralist cited cattle grazing and watering as the greatest threat to wetland condition.
- Traditional Owners (including pastoralists and non land managers) more readily identified degradation issues and considered most wetlands to be degraded and declining in condition.
- One Traditional Owner land manager identified their wetlands to be in ‘good as you’ll find’ condition which they nominated was due to the de-stocking of cattle from the property.

Discussion:
The generally upbeat assessment of wetland condition by land managers was in contrast to cursory field examinations that identified stark comparisons between grazed and de-stocked properties (photos 21-26) and a number of degraded sites on pastoral properties which exhibited impacts to fringing and emergent vegetation and water quality. Several factors may be associated with this finding.

One is that landholders may have a limited understanding of wetland ecological values (c/f production values) and therefore do not ‘see’ ecological impacts or do not place much weight on their significance. Another is that some of the degradation processes occur on generational time scales and many pastoralist managers were relatively new to the properties they were managing and therefore may not have the ’corporate’ or historical knowledge to recognise condition decline. In a few instances wetlands may also have been recovering from historically recent poorer condition (i.e. greater feral animal densities, lack of fencing) and therefore the current status was assessed favourably.

Given the apparently relatively uniform grazing management practices observed to be operating across most pastoral properties of the southern Gulf there a few examples of wetlands undisturbed or less disturbed by grazing to provide comparative benchmarks. Land managers could also understandably be sensitive about providing negative assessments of natural resource condition that may impact unfavourably upon their management practices or industry’s sustainability credentials.

Interestingly Traditional Owners (including pastoralists) who may have a more vested interest in the broader ecological condition of wetlands and less sensitivity to the identification of grazing based impacts readily cited degraded and declining condition being the case for many southern Gulf wetlands.

This finding points toward the need to improve the technical capacity of land managers for identifying wetland condition decline and associated management needs.

Historical Changes in Wetland Management

- The identification of historical changes was limited by the short tenure (<3 yrs) of approximately half of the land managers interviewed.
- Historically recent destocking of significant numbers of feral animals (cattle and brumbies) associated with the government sponsored Tuberculosis program was noted for several of the properties.
- Increases in watering points, associated fencing and herd numbers were identified for many properties, with one manager noting that there was greater stocking density and overall grazing pressure today in the Gulf than there was 50 years ago.
- One traditionally owned property had been destocked of cattle in recent times.
- On two properties there had been historically recent abandoning of fencing in coastal wetland areas and on one other exclusion fencing on freshwater wetland sites and drainage lines had come into disrepair.
- Increased numbers of weed species and weed density was noted across the study area, although some species were noted to have cyclical abundances (noogoora burr, parkinsonia).
- Increased densities of native woodland trees (woodland thickening) primarily Gutta-percha were linked to large flood events by several interviewees
- Changes to black soil surface topography (greater roughness) were also linked to large flood events by two interviewees

Discussion:
There are several indications of potentially reduced pressure on the southern Gulf’s wetland resources i.e.

- reduced feral horse and cattle numbers,
- increases in watering point number and
- distribution of coastal grazing pressure by additional fencing,

Many noted historical changes also point toward the potential for increased pressure on wetland ecosystems particularly observations of two key indicators;
- increased herd sizes and
- weed abundance.

In the case of increased herd size, associated increases in watering point number should limit grazing pressure at any one site. However, with larger herds there is still the potential to place high grazing pressure on habitats that may present preferential seasonal foci for cattle grazing (i.e. ephemeral wetlands). There were also indications that at some sites fencing configurations established to spread grazing pressure in paddocks adjoining wetlands/watering points used the existing watering point as a focal point for adjoining paddocks in which case overall pressure on the watering site may have increased.

The primary implication that emerges from these considerations is that the potential for ecological pressure to be increasing on wetland systems within the southern Gulf is significant and that management efforts additional to existing practices will be required to maintain wetland values into the future. This again underpins the need to develop wetland specific grazing regimes and management practices (discussed below).

**Primary Threats / Degradation Issues**

- The two primary degradation issues identified by land managers were weeds and feral animals.
- Weeds were a ubiquitous issue across the southern Gulf although the number of weeds and infestation abundances appeared and were reported to be greatest in the eastern southern Gulf.
- The level of significance attributed to feral animals varied significantly across the Gulf.
- Overgrazing by native animals (wallabies) residing in weed infested riparian corridors was cited as a degradation issue on one property.
- On one de-stocked Traditionally Owned property feral animals were solely responsible for reported (& observed, though generally lower levels of) grazing, trampling and physical disturbance of wetlands.
- Pig population levels and associated degradation concerns were related to level of exercised control via baiting, hunting and/or commercial harvesting on a number of properties.
- Pigs were recognised as being particularly threatening to wetland ecosystems on two properties due to specific physical impacts additional to grazing and trampling associated with most feral animals including destruction of waterfowl nesting habitat, competition for food sources (i.e. sedge tubers) and predation of fauna (i.e. mussels and geese eggs).
- Few (two) land managers cited grazing pressure directly as a degradation issue affecting wetlands.
- Soil erosion and associated siting of wetlands inferred to be due to unmanaged cattle access were cited as a degradation issue by a further two land managers.
- Natural woodland thickening particularly involving Gutta-percha was reported by half the interviewees.
- Tourism pressure and other human access associated pressures (i.e. pig hunters) were also reported as a wetland degradation issue on several properties.
- Sea level rise associated incursions of the tidal interface and associated salinisation of freshwater wetlands was noted on one property and cyclonic storm surge associated purging of freshwater swale swamps with sea water on another property.

**Discussion:**

The range of degradation issues cited for wetlands in the southern Gulf are relatively typical for northern Australian rangelands generally and the impression gained was that some interviewees were identifying with degradation issues relevant to the overall property rather than wetland resources specifically. However some key degradation issues identified i.e. weeds do cut across both pastoral production and wetland value protection concerns and present opportunities for management approaches built on strategic partnerships with property owners.

Several of the key weed species identified by landholders (Calotrope, Noogoora Burr, Grader Grass) remain undeclared under State legislation and are not recognised as Weeds of National Significance (WONS). Broader assessment of the potential impact of these weed species within the Gulf with a view toward their declaration under Qld legislation or listing as WONS to attract greater management resourcing would appear warranted.

Pigs are an example of a degradation issue that potentially impacts wetland ecosystem values more than pastoral production. The lower significance attributed to pigs as a degradation issue is probably a reflection of this and also of the control effected by management practices on some properties. The variability of the severity of pigs as a degradation issue also presents the prospect that some level of control can and is being achieved.

The low number of pastoralists that cited grazing pressure directly as a wetland degradation issue possibly represents a black spot in wetland condition perception or more likely reflects sensitivity toward industry criticism. The later is supported by the fact that most readily cited exclusion fencing and off stream watering points as options for improving wetland management on properties. Again adoption of wetland condition assessment monitoring is suggested as a way forward toward improved understanding and acknowledgement of grazing and stock based impacts to wetlands.
The impact of tourists and wetland recreators (including uninvited fishers and pig hunters) was identified by more than one land manager and Burke Shire Councillors as a wetland issue warranting increased management attention. Given the significance of tourism to the regional economy of the Gulf these issues would appear to be best resolved through improved on-ground management capacity rather than increased access prohibitions alone. Land and Sea management rangers proposed as part of Traditional Owner affiliated ‘Land and Sea Management Centres’ provide a potential model for providing this capacity on traditionally owned lands and country with negotiated access or management rights.

The credible identification of sea level rise associated impacts to coastal Gulf wetlands is an ominous finding given the scale of measured sea level rise to date and predicted global warming associated sea level rise in forthcoming decades. The implications of this emerging issue in terms of potential wetland degradation and appropriate adaptive responses needs to be examined for all of coastal Australia but is particularly significant to the Gulf in terms of its flat coastal topography and high value coastal wetland complexes. Although not identified specifically by land managers as a degradation issue, climate change interpreted as less reliable wet seasons and more extreme rainfall patterns was raised in informal conversation with several as an emerging factor contributing to additional pressure on the Gulf’s natural resources.

**Wetland Management Aspirations / Opportunities**

- Improved wetland management aspirations identified by landholders given the availability of sufficient resources included three main proposal areas:
  1. Wetland fencing that provides opportunities for improved protection of wetland environmental and cultural values through specific grazing management regimes ranging from extended wet season spelling to total grazing exclusion usually in association with establishment of off stream/wetland watering point infrastructure (in the case of the latter),
  2. Improved weed control programs through the provision of funding, material (chemicals) or personnel (work team) support,
  3. Increased control of feral animals (pigs, horses) through support for targeted control programs or commercial harvest operations.

- Wetland sites nominated by land managers as being suitable candidates for improved wetland management initiatives included a host of large and regionally significant wetlands recognised to form high value elements in the overall Southern Gulf Wetland Aggregation (photos 67-76).
- The reinstatement of Traditional Owner access to and management of wetland country possibly through the organisational vehicle provided by the establishment of ‘Land and Sea Management Centres’ and rangers was a key management aspiration of most Traditional Owners.
- Other wetland management aspirations included the designation of a nature refuge for property wetlands and improved fish passage on a constructed (weir) barrier.

**Discussion:**

The ready identification of specific wetland grazing management practices and sites for such initiatives bode well for the accomplishment of improved wetland management in conjunction with land managers of the southern Gulf. Proposals for key sites nominated by interviewed land managers represent ‘instant starters’, ‘no regrets’ options for funding consideration by community NRM bodies and non-government conservation organisations, and should be pursued by such bodies as strategic investment opportunities for furthering sustainable wetland management in the southern Gulf.

Management aspirations concerning weeds and feral animals cut across both pastoral production and wetland value protection concerns and present opportunities for approaches that build strategic partnerships between pastoralists, Traditional Owners and NRM organisations.

The limited existing access to wetland country of some Traditional Owner groups is an impediment to the delivery of Traditional Owner management practices that seek to maintain cultural and environmental values which are often more sympathetic to wetland ecosystem needs than pastoral production motivations alone. Opportunities for the empowerment of Traditional Owner wetland management aspirations and facilitation of dialogue between TOs, Pastoralists and other wetland stakeholders need to be integrally pursued as part of improved wetland management generally within the southern Gulf.

**Specific Resourcing Needs**

- Most of the resourcing needed for improving wetland management on southern Gulf properties were materials associated with the three main wetland management aspiration proposals (listed above) and included:
  - Fencing
  - Off stream/wetland watering point infrastructure
  - Chemicals (for weed control)
Baiting and trapping programs

- In the case of weed and feral animal control programs work team support was also seen as desirable by several land managers and as an employment / training opportunity by Traditional Owners.
- One landholder expressed a preference for using his own labour force for the implementation of weed control programs.
- Several landholders proposed that they would provide labour to erect fencing if material needs were met through external funding
- At least three land managers expressed a desire for improved access to expertise and wetland management relevant information particularly remote sensed / aerial imagery and interpretation concerning key degradation issues.

Discussion:
The wetland management resourcing needs identified by land managers are practical and in conjunction with proposed in-kind contributions highlight opportunities for cost effective wetland management actions in partnership with NRM and Conservation organisations. While many of the proposed material resources also potentially benefit pastoral operations, regionally significant wetlands across the southern Gulf provide a clear focus for ensuring investment is strategic.

The provision of aerial imagery, remote sensing and GIS information that provides land managers with the resources needed to pursue broader NRM and property management planning may provide an attractive ‘front end’ for the dissemination of wetland value information by NRM or conservation organisations targeting wetland management planning at property scales. The use of a property case study for identifying and applying wetland management information needs is a worthy funding proposition.

Potential for Wetland Monitoring Programs

- All but one interviewed land manager was interested in participating in a wetland condition and/or bird monitoring program.
- The one landholder that reneged on direct involvement in monitoring indicated that he was supportive of others undertaking monitoring on his property.
- All other landholders also agreed to allow systematic bird surveys by experts on their properties.
- The key provisos identified by potential participants in a wetland monitoring program were that it was:
  - not too time consuming,
  - supported materially by program managers, and
  - contributed usefully toward research and management outcomes.
- Traditional Owners identified monitoring as a capacity building opportunity for proposed Land and Sea Management Rangers,
- The use of digital cameras or video as an easy monitoring tool was supported by most land managers.
- Bird counting was identified as an activity additional to photography that most land managers were willing to consider participating in.
- All interviewed land managers were prepared to join the voluntary East Asian Australasian Flyway Site Network.

Discussion:
It is very encouraging that one of the most sorely needed wetland management activities (condition monitoring) elicited the highest level of support amongst interviewed land managers. Further development and adoption of a simplified wetland monitoring framework as proposed by this study (see appendix 3) is a high priority for investment in wetland management in the southern Gulf.

Support for Traditional Owner Involvement in Management

- Half of the non Traditional Owner pastoralists were supportive of TO involvement in the management of wetlands on properties under their management with provisos including:
  - management of litter,
  - no guns, alcohol or dogs,
  - respect for pastoral operation and managers authority,
  - protocols to spell out access arrangements and on-site behaviour.
- One third of the non Traditional Owner pastoralists were not supportive of TO involvement in the management of wetlands due to issues associated with:
  - non-traditional hunting practices
  - lack of mutual access agreements to TO managed land
• littering
• experiences regarding fires, illegal access and stock losses.

- One non Traditional Owner pastoralist was undecided due to concerns that negotiated access agreements could pave the way for recognition of ‘continuous affiliation’ (with traditional land) and for supporting native title claims against the pastoralist’s interests.

Discussion:
Reconciliation between Aboriginal people and the broader Australian community is an actively pursued policy of Australian Governments. Empowerment of Traditional Owner land management aspirations has been identified as a key action on the path to reconciliation, a goal for community based NRM plans and a means of facilitating NRM sympathetic with government policy goals of Ecologically Sustainable Development. Traditional knowledge concerning wetland resources and their management needs provides a longer term and broader perspective to management than that provided by either science or pastoral production paradigms.

While several TO groups in the Gulf have been successful in gaining access to traditional country through native title claims or property purchase a couple of groups retain practically no access to traditional country. The involvement of TOs in wetland management across the southern Gulf provides the opportunity for significant environmental and social value outcomes.

The favourable response of half the non TO pastoralists to the issue of TO involvement in on-property wetland management provides the foundation for further progress toward negotiated access agreements and management arrangements. The provisos provided by these respondents and the negative responses of a third of the interviewed land managers highlight challenging issue areas that need to be addressed in progressing such arrangements.

Perceived Merits of Conservation Agreements / Tenements / Convention Designation

- Several of the managers interviewed were not prepared to respond to the question of merit concerning conservation tenements / agreements/ conventions as they felt it could only be responded to by the property’s owners.
- Most property owners identified they would need a specific proposal to be able to assess its merits.
- Traditional owners were generally not supportive of such conservation arrangements due to concerns that they would potentially obstruct traditional resource exploitation rights, although some merits was seen in potentially associated training opportunities and/or management resourcing.
- One Land manager whose property was formally a Fauna Sanctuary under earlier fauna protection legislation was attracted to the potential merits of Nature Refuge designation including management resourcing and increased public access and behaviour controls.
- Two land managers indicated that they would only be supportive if the arrangements delivered significant and tangible benefits to their pastoral operation such as financial incentives to cover environmental value focussed management or improved security of tenure.
- One respondent to this question also took the opportunity to lament the operation of NRM and environmental grant funding programs with suggestions that pastoral businesses did not have the time resource required to invest for the potential return of relatively limited dollars. It was suggested that a preferable funding model would be to provide significant funding to the broader region for identified regional NRM management priorities with devolved funding distributed to individual project sites within the region using simplified site scale criteria.
- All interviewed land managers were supportive of involvement in the voluntary East Asian Australasian Flyway Site Network.

Discussion:
While there remains some interest in the merit of conservation tenements / agreements/ conventions for protecting wetland values on properties the primary response is one of guarded precaution. The provision of benefits to property owners and pastoral operations appears currently to be the key consideration property owners assess in determining their likely support for such arrangements.

Given that the use of such conservation tools remains an attractive option within the broader spectrum of conservation management arrangements for wetlands of the southern Gulf, there needs to be a suite of potential conservation arrangement case study options worked through to be able to present more specific proposals to landholders. These would need to clearly articulate the likely benefits to their pastoral operations or land management aspirations associated with the adoption of such arrangements.
Threats to Wetland Habitat Condition and Observed Impacts

This study was not intended to provide a formal assessment of wetland and bird habitat condition or threats on visited properties. Observations of wetland habitats and birds were made on an opportunistic basis and were ancillary to the study’s major focus on interview based research on wetland management practices and needs and awareness raising of shorebird conservation. Incidental observations are biased toward readily accessed properties and areas within those properties and cannot be considered representative of the broader suite of wetland sites or types within the southern Gulf.

At the time of the field visit (May 2005), the Gulf was experiencing unseasonably dry conditions due to a failed 04/05 wet season. Observed cattle grazing and land degradation pressures were also influenced by conditions generated by the continuing drought in inland Queensland. Market forces and drought conditions on inland Queensland properties traditionally used to fatten cattle produced on some Gulf properties had resulted in the retention of larger than normal cattle herds within the southern Gulf.

Threats and Observed Wetland Condition Impacts

Generic threats facing wetlands and other flow dependent ecosystems in the Gulf of Carpentaria have been reviewed most recently as part of the development of the Water Resource Plan for the Gulf's river basins (Hydrobiology 2005). The key threats facing the Gulf's wetlands are extensive and pervasive in nature i.e. total grazing pressure, weeds, feral animals and altered fire regimes and typical of those affecting most of the extensive land use areas of northern Australia (Myers et al 2001, NLWRA 2002). However, threats associated with intensification of land use are also relevant to the Gulf given a history of continued intensification of pastoral production and ongoing proposals for water resource development. Evidence of some wetland condition impacts related to most of the ecological threats identified for the Gulf River systems as a whole were observed during the study’s field trip. This finding contrasts with earlier studies (Garnett 1989, Blackman et al 1999) in which the level of perceived threats facing southern Gulf wetlands were generally assessed to be low and observed condition impacts negligible.

Grazing and Trampling by Cattle

Cattle were the cause of the most readily apparent condition impacts at visited wetland sites. The direct impacts of cattle on aquatic ecosystems within Australia have been well documented (Rutherford 2000, Possingham et al 2002). Cattle are also associated with indirect impacts driven through increased rates of soil erosion, promotion of weed infestations and water quality degradation (discussed below).

At visited field sites the observed impact of cattle grazing and trampling on wetlands included reduced cover and diversity of fringing and emergent vegetation including aquatic macrophyte beds, bank compaction and pugging, disturbance of bottom sediments and associated increases in water turbidity and localised eutrophication / algal growth (photos 11-20). At the most heavily impacted sites there had been a complete loss of ground cover and fringing emergent vegetation and disturbed water bodies were highly turbid. The use of freshwater wetlands as stock watering points was a key cause of higher levels of impact observed at some sites. One of the starkest demonstrations of cattle grazing and trampling impacts came from observation of wetland habitat conditions on de-stocked properties (photos 21-26).

Disturbance or loss of edge habitat and aquatic vegetation has potentially serious implications for biota including birds that roost, feed, reproduce or nest in these areas. Alternatively, the grazing of rank grass by cattle has also been considered to improved habitat for some resident species of shorebirds i.e. Little Curlew and Oriental Pratincole (Garnett 1989). As noted above, drought and larger than normal herd sizes were contributing factors to the high level of grazing pressure observed in the field. The timing of the field trip (early dry season in a dry year) probably also contributed to the stressed condition state assessed for many wetlands. During the wet season, inundation of low lying coastal and floodplain areas delivers default spelling from cattle impacts for many wetlands in the southern Gulf. Given that this is a period of maximum biological activity and productivity in the wetlands, many wetland systems may be spared from the greatest potential impacts associated with stock grazing and trampling.

Few marine and brackish wetlands were visited during the field trip. The general assumption is that the lower pastoral production potential of these areas limits their exposure to cattle grazing and trampling impacts. The good pasture value attributed to marine couch by interviewed pastoralists and the observed stock numbers and grazing pressure in some of the coastal margin wetlands (photo 7) gives cause to reassess this assumption.

The potential significance of cattle grazing and trampling impacts on wetlands is likely to be greatest where the wetlands provide regionally important dry season refugia.

Weeds

Weeds are a ubiquitous land degradation issues in the rangelands of northern Australia affecting both production and biodiversity values. At least three types of weed issues are significant within the southern Gulf, woody weeds, herbaceous weeds and native vegetation thickening (photos 43-50). In terms of direct impacts to wetland habitat values some of the primary species nominated as a land degradation issue in terms of pastoral production (i.e. woody weeds such as Prickly Acacia) do not appear to represent major direct threats to wetland ecosystems, although may generate indirect impacts by increasing grazing pressure on wetlands. The weeds of greatest significance to wetlands in other regions of Australia i.e. floating aquatic weeds and aquatic...
grass species are not yet widely established in the wetlands of the southern Gulf though are prevalent in several river basins of the north eastern Gulf (Hydrobiology 2005). Interestingly the diversity of weed species and levels of infestation appeared to increase toward the eastern southern Gulf highlighting the possible infestation route of new weed species from eastern drainages (Hydrobiology 2005). The more limited infestation levels observed in the western southern Gulf present some prospect of establishing lines of control.

The greatest weed threat currently impacting southern Gulf wetlands are weeds of riparian vegetation communities including rubber vine, noogoora burr, calotrope and parkinsonia. The greatest wetland condition impacts observed were associated with rubber vine and parkinsonia. Rubber vine has degraded many riparian communities to a collapsed tangled canopy dominated by vine towers. This results in direct loss of habitat for species dependent on riparian forest and understorey and longer term impacts to bank stability and water quality.

While Garnett (1989) did not consider calotrope or rubber vine to represent a significant threat to shore bird habitat he was concerned by the prospect of Mimosa (Mimosa pigra) infestation. Parkinsonia has the capacity to develop growth habits and infestation levels of an equivalent nature to Mimosa. Parkinsonia directly impacts wetlands by invading into the margins of ephemeral wetland basins (photo 48). The long term viability of Parkinsonia seed presents the prospect of this species emerging as a major weed issue if successive years of good recruitment conditions are experienced. 50-100 ha thickets of parkinsonia were observed at some sites (photo 47). These thickets reduce the habitat value of wetland margins for many native fauna species by replacing native wetland vegetation that provides important feeding habitat and reducing open space required for predator safe roosting. Most landholders did not perceive parkinsonia to pose a major land degradation issue and considered its infestation to be a cyclical phenomenon. Existing infestation levels are causing wetland condition impacts at some sites.

At one site the relatively recent invasion of native riparian communities by escaped ornamental and horticultural species including poinciana, yellow oleander and custard apple was observed (Photo 45). All of these species are recognised weeds of riparian vegetation in tropical eastern Queensland drainages (Pers. Obs., Grice 2001). This highlights the prospect of further ‘sleeper weed’ species being present within Gulf river basins.

Although exotic ponded pasture systems have been established within the Gulf (photos 63-64) no evidence of ponded pasture species becoming naturalised was observed at visited wetland sites. However, the prospect for this remains a real concern particularly at sites where more conservative grazing or grazing exclusion is practiced as part of existing or future conservation based management of wetlands.

Many land managers made reference to the woody ‘weed’ issue of native woodland thickening and cited gutta-percha as a wetland associated species that has historically increased recruitment density. Although many examples of dense gutta-percha recruitment were observed it was difficult to interpret these in terms of a land degradation issue as baseline conditions are undocumented. Experience in tropical rangelands elsewhere in Queensland would suggest that such thickening may be associated with grazing pressure and land management practices reducing grass competition for seedlings and the frequency and intensity of recruitment controlling burns (Scanlan 2002).

Soil Erosion

The highly seasonal dry climate and associated intensive rainfall patterns experienced by Gulf landscapes generate naturally high levels of soil erosion (NLWRA 2002). This does not negate the potential importance of soil erosion as a catchment management issue in Gulf river basins. There is some evidence to suggest that contemporary soil erosion rates in the Gulf are at least an order of magnitude higher that historical conditions (Hydrobiology 2005). The potential wetland impacts associated with elevated soil erosion rates include elevated turbidity and sedimentation of wetland basins.

Numerous examples of soil erosion gullying, drainage line breakaways, sub soil scalds and exposed tree root balls were observed within the catchments of visited wetlands (photos 17-18, 31, 35-36). The exposure of relatively young tree root balls would suggest that contemporary rates of erosion are very high in some instances. Other than potential photo interpretation of historical air photos, no baseline data exists to fully assess the extent to which current erosion rates have been elevated by land degradation. Intuitively the relationship of total grazing pressure to soil erosion rates and the observed contrasts between erosion impacted and non-impacted sites would suggest that much of the observed soil erosion is a land degradation issue and occurring at rates greater than natural background levels. At one riparian site it was apparent that extensive river bank break away erosion had been relatively recently stabilised by stock exclusion fencing. Sedimentation of wetland basins cannot be readily identified in the field without reference to historical conditions but was reported as an issue by several land managers.

Many of the wetlands visited had turbid water (photos 12,28,31). While many river systems within the Gulf have naturally turbid water quality, a relationship between site turbidity and local catchment erosion status was observed on several properties suggesting the turbidity was an indication of degraded catchment condition rather than natural conditions (photos 27-34). In many instances these wetland impacts could be readily related to local catchment conditions due to the failed wet season recently experience in the Gulf which resulted in many drainages receiving predominantly localised run off rather than overland or catchment through-flows.

Feral Animals

Impacts to wetland condition caused by feral animals primarily pigs, were observed across the southern Gulf but appeared to vary in severity between properties. Pigs cause the greatest direct impact to wetland habitats
through rooting and wallowing at the water’s edge and the browsing of wetland macrophytes. Bulkuru sedge swamps which are a particularly high value wetland feeding and nesting habitat were observed to be targeted by pigs for the succulent sedge tubers (photos 37 & 40). Landholders also reported pig predation of waterfowl nests and mussels. Garnett (1989) noted pig predation also poses a threat to ground and beach nesting shorebirds. Pig damage of wetlands was less apparent on properties that had active control programs including baiting or harvesting.

Horses are also a significant feral animal issue in the Gulf (photos 38, 39 & 42) with some properties reportedly holding 1000’s of head of feral horses. The observed wetland impacts associated with horses included trampling and grazing of fringing and emergent wetland vegetation (including bulkuru sedge), pugging of banks and disturbance of muddy bottoms. In recent decades several properties have drastically reduced the feral horse population through culling programs. The wetland condition benefits associated with this activity could not be readily quantified in the absence of baseline data but are likely to be significant on some properties. The impact of feral pigs and horses was most readily observed at a number of wetlands were commercial grazing had ceased and cattle had been de-stocked.

Feral cattle are also an issue in parts of the southern Gulf though their numbers have been reduced in recent decades through the government sponsored brucellosis control program and the trend toward more intensive management practices of properties including additional fencing.

The other feral animal of significance to wetland ecosystems in the Gulf are cane toads and feral cats. The full impact of the former has never been fully documented for the Gulf but anecdotal observations and more recent experience from their invasion of NT wetlands would suggest that impacts on biota have been significant. Relatively large population densities of adults and juveniles were observed at many visited wetlands though their observed condition was generally poor (photo 41).

The impact of feral cats on wetland biodiversity was indicated by several observed piles of feathers which appeared to be bird kills most likely attributed to feral cats. A large number of wetland vertebrates particularly ground nesting or roosting birds and small reptiles are vulnerable to cat predation.

**Water Quality**

Water quality issues particularly high turbidity were apparent at many of the wetlands visited (photos 27-34). However the relationship of observed conditions to pre-European land use conditions cannot be fully ascertained in the absence of baseline data or adequate control sites. As discussed under soil erosion and cattle impacts (above) there was some evidence that observed turbid conditions could be related to increased rates of soil and bank erosion in contributing catchments and disturbance of edge and bottom sediment by cattle and feral animals.

Ecological impacts associated with elevated turbidity include reduced primary productivity, reduced abundance of submerged macrophytes and associated population impacts to aquatic organisms that are visual predators, filter feeders or macrophyte egg layers. These impacts can flow on to consumer organisms such as birds that utilise plankton and aquatic animals as their main food source.

Other potential water quality threats to wetlands within the Gulf have not been widely realised but could be associated with nutrient loading resulting from limited areas of more intensive land uses (agriculture, aquaculture, settlement) and water chemistry changes due to groundwater exploitation, acid drainage and metal contamination associated with mineral mining; processing and shipping operations (Blackman et al 1999, Hydrobiology 2005).

The potential for water quality impacts associated with prospective aquaculture development was a specific threat to southern Gulf shore bird habitats identified by Garnett (1989). Ultimately any water quality issue that has the capacity to affect the composition of coastal alluvial muds which provide the most important feeding habitat for shore birds could presents a threat to their populations.

**Fire Regime**

Wetland condition impacts associated with fire regime were not readily identified at visited wetland sites other than some mature riparian palms apparently killed by hot fires intended to provide rubber vine control (photo 61). Other more cryptic impacts were probably present in the form of woody weed infestations and woodland thickening associated with reduced burning of some southern Gulf landscapes. Many longer term resident landholders reported historical changes toward greater woodland density in the southern Gulf. On several Traditionally Owned properties the continued practice of dry season burning was obviously providing significant control of recruiting tee saplings (photo 62). By inference, areas not practicing such extensive and regular burning regimes may be experiencing woodland thickening.

The significance of altered fire regimes to the conservation of wetland biodiversity in the Gulf is poorly understood, though experience in other regions of northern tropical Australia would suggest that it is important in determining the structure and floristics of fringing and emergent wetland vegetation communities (Whitehead 2001). Amongst current burning practices there is an apparent conflict in the use of hot fire regimes to control rubber vine in riparian vegetation which is generally recognised to be comprised of relatively fire sensitive communities.
**Built Infrastructure**

Several forms of built infrastructure were observed to be generating impacts on wetland condition within the southern Gulf. These included dams, weirs, irrigation systems, watering points, fences and stream road crossings (photos 55-60).

Other than stream road crossings all of these infrastructural developments were related to the need for water resources to underpin successful primary production in a seasonally dry climate. The most significant impacts both negative and positive were associated with the development of larger dams and weirs for domestic, stock and irrigation supply. In most instances these dams had resulted in the inundation and loss of the original riparian vegetation upstream of the dam and created in-stream barriers for the upstream dispersal of fish. However, these mounds have also created valuable artificial wetland habitats that were utilised by a wide range of wetland biota including rare duck species and shorebirds. Where dams were within watercourses with more stable water levels valuable riparian habitats had re-established in relation to the new water level range.

Watering point density and associated fencing configuration are acknowledged to be one of the most significant drivers of biodiversity condition in Australia’s rangelands (Landsberg et al 1999). The implications for wetland biodiversity, particularly where wetlands are used to provide the watering points has not been specifically researched. Natural wetlands were observed to commonly be used for the provision of cattle watering points in the southern Gulf. In some instances they provided the focal point for fencing configurations that distributed grazing pressure in adjoining paddocks but increased potential stock pressure at the wetland (photos 55-56). The sighting of longer lasting constructed watering points and dams in close vicinity to ephemeral wetlands (photo 53) also exposed these wetlands to greater grazing and trampling pressure than would have occurred prior to permanent watering point establishment. At some sites the seasonal water holding capacity of natural wetlands had been extended by the excavation of deeper holes within the basin or by the creation of earth bunds across the drainage depression hosting the wetland (photo 54). Waterlogging of riparian trees was apparent at some of the bunded sites. The implications of basin excavation were not readily assessed and would probably depend upon site specific run in volume and basins cross section characteristics.

Although more specifically affecting riverine biota than wetland biota, road crossing were observed to be impacting aquatic habitat connectivity and creating a number of significant fish passage barriers across the southern Gulf.

**Intensive Production Systems and Production Intensification**

The southern Gulf is characterised by extensive land uses predominantly rangeland beef cattle grazing. However, several small areas of more intensive production systems were observed during the field trip including irrigated ponded pasture and fodder cropping.

The latter was developed on black soil plains and employed a closed circulation drainage system. Other than the loss of some seasonally inundated grasslands and the extraction of surface water supplies from an adjoining river no apparent impacts to wetland habitat were observed.

In the case of the large irrigated ponded pasture development observed on one property, a major dam had been constructed to provide water supplies and bund walls had been used to establish several hundred hectares of ponded pasture on what was previously a seasonally inundated grassland (photos 63-64). Smaller areas of ponded pasture were also observed to have been established in ephemeral wetland basins on this and one other property. This larger production system was observed to have caused some localised wetland impacts not all of which were negative in terms of habitat loss. However, the threat to wetland condition posed by the expansion of this type of intensive production system and associated infrastructure into other wetland types and sites or the naturalisation of ponded pasture species would be significant if allowed to proceed. In eastern Australia ponded pastures are considered to be one of the key threats confronting coastal wetlands (Lukacs 1993). Currently a moratorium on further ponded pasture development in tidally influenced areas of Queensland is limiting the prospects of the worse forms ponded pasture development occurring.

The prospect of other forms of irrigation development occurring within the greater southern Gulf basin remains a likelihood that should not be discounted in terms of the potential for impacts to flow dependent ecosystems (Hydrobiology 2005). Indirect impacts to wetland associated with such development could include alterations of river flow and the associated deposition and composition of coastal alluvial muds (key shorebird feeding habitat), nutrient loading and agro-chemical contamination. The maintenance of coastal Gulf wetland ecosystems is a primary consideration for water resource development planning currently occurring (Hydrobiology 2005).

In the past, prawn aquaculture is another intensive production system that has been mooted for the coastal Gulf (Garnett 1989). Other than small scale fish hatchery establishment and trial crayfish ponds, extensive aquacultural development has not eventuated in the southern Gulf. However the prospects for such development to impact on the wetland resources of the Gulf is an issue that should remain in consideration given the demonstrated risks to wetland condition posed by intensive aquaculture elsewhere in Australia and overseas.

Related to the development of intensive production systems is the ongoing intensification of existing production systems. Although the extent of pastoral production intensification occurring within the southern Gulf can not be assessed with out a full analysis of herd size statistics, several landholders made reference to the larger herd sizes and more intensive use of Gulf pasture resources that occurs today relative to previous decades. This intensification has come about through changes in cattle breeds, the use of supplementary licks, increased numbers of watering points, more extensive fencing of paddocks, greater stock transport capacity and pasture...
Climate Variability / Change

The climate is a primary driver of wetland condition and recent climatic events had a significant influence on the condition of wetlands observed in the field. With the increasing recognition of the role of climate change in driving greater variability and extremes in weather patterns (AGO 2003), the question arises as to what extent the impacts attributed to failed wet seasons, drought and associated cattle grazing pressure can be justifiably attributed to the larger threat posed by directional climate change as opposed to ‘natural’ inter-annual variability. Amongst many longer term residents of the southern Gulf there appears to be an emerging consensus that climatic patterns and associated biophysical system responses are moving outside the realm of their own personal experience. From the author’s personal perspective of a relationship with the environments of the southern Gulf that is approaching 30 years, aquatic ecosystem condition indicators observed in the field trip this year and in recent years that are unprecedented include a cessation of flow in the historically perennial Gregory River system at the Doomadgee road crossing (2003) and the lack of a cleansing base flow through the lower Nicholson River system which remained turbid at the time of this years field visit.

Although such indicators are hardly conclusive evidence of climate change driven impacts it does present the spectre that climate change may be increasing the exposure of the southern Gulf’s wetland ecosystems to increased levels of condition impact. This prospect underpins a need to increase wetland management efforts in the region to deliver improved ecosystem resilience as a primary adaptive management approach to the serious threat posed by global climate change (NTGMCB 2003).

The ancillary threat to climate change is sea level rise. Satellite data obtained in the last decade suggests that rates of sea level rise globally are now approaching 4mm / annum (Nerem 1995). In a region as low lying and flat as the Gulf the potential impact of sea level rise on coastal wetlands is significant. Elsewhere in northern Australia projected and observed impacts of sea level rise on coastal wetlands are very significant (Baylis et al 1998, Finlayson 1998, 2001).

At one site visited during the field excursion landholders noted that tidal influence and incursion of marine waters now extended significantly further inland than their childhood memories. On another property the landholder noted that in recent cyclonic events previously freshwater beach dune swale swamps were purged by ocean storm surges. On this same property dead, apparently salt affected terrestrial vegetation was observed from the air at the marine tidal interface (photos 65-66).

Although such condition impacts were not more broadly observed across the southern Gulf and can not yet be readily attributed to global warming driven sea level rise alone, the prospect of future wetland condition impacts being generated by sea level rise in the southern Gulf may ultimately be one of the most significant threats coastal Gulf wetlands face and warrants a close examination of appropriate adaptive management planning.

> Shorebird Habitat Management - Implications / Discussions

Constraints of Field Investigations

As previously noted (above) this study was not intended as a shorebird survey nor habitat condition assessment and reported observations are ancillary to the study’s main objectives. The study’s field trip was also undertaken at a time (May 2005) when large numbers of migratory shorebirds were unlikely to be present. Thus, any assessment of regional shorebird habitat values is probably not relevant to the period of high shorebird abundances (October – March). The type of wetland habitats observed during the field trip were also biased toward more readily accessed permanent and seasonal freshwater systems inland of the coastal marine habitats important to the largest proportion of the migratory shorebird species (photos 1-10) which occur in the southern Gulf (Garnett 1989, Driscoll 2001).

Other than Australian Pratincoles less than 20 migratory shorebirds of two species were seen during the entire two week trip. Thus, any assessment of the value of the observed freshwater habitats of the region can only be made in the most general terms. However, knowledge of the habitat needs of shorebirds has been used to make summary comments in relation to wetland management needs.

Shorebird Habitat Use

Shorebirds use almost all of the large range of wetland habitat types (permanent and ephemeral, freshwater and marine, natural and man-made) that occur in the Southern Gulf Wetland Aggregation at different times of the year (Garnett 1989, Blackman et al 1999, Driscoll 2001). Garnett (1989) identified six feeding habitats utilised by migratory and resident shorebirds:

1. Tidal Mudflats
2. Sandy Shores
3. River Banks
4. Seasonal Freshwater Swamps
5. Grasslands
6. Salt Flat Pools

Of these six habitats tidal mudflats, particularly the alluvial mud at the mouths of rivers emptying to the sea constitute the most important habitat for the majority of shorebird species within the southern Gulf. Up to two thirds of total shorebird numbers within the Gulf occur in coastal habitats. While all other habitats have some level of importance to some shorebird species, seasonal sub coastal freshwater swamps also stand out in terms of their international importance to migratory shorebirds and national importance to resident shorebirds. They can account for up to one third of total shorebird numbers at the end of the wet season (Garnett 1989, Driscoll 2001). Most species that utilise seasonal freshwater swamps do not depend solely on this habitat type. Their use of freshwater swamps is dependent upon the availability of suitable feeding, roosting or nesting habitat relative to alternative coastal and riverine tidal habitats. Thus, they may favour freshwater wetlands at different times of their seasonal or annual residence (particularly the peak wetland productivity period mid – late wet), or when migratory species are departing (end of wet) and require high quality food intake.

A distinguishing feature of the southern Gulf shorebird populations in comparison to other Australian sites is that up to 40% of non breeding season (wet season) shorebird population remain in the region through the breeding season (winter). These over-wintering birds are mostly young birds or non-breeding adults which remain in the region or arrive from southern Australia (Driscoll 2001).

Roosting habitat is also essential for shorebirds. Garnett (1989) recognised three modes of roosting practiced by southern Gulf shorebirds including:
1. Large flocks on beaches or dunes
2. Individually or small flocks in the open
3. Individually or small flocks in vegetation.

A key requirement of coastal roosting sites is that they have access to areas above tidal inundation. Open roosting sites include sand, shingle, saltpan and grassland areas while vegetated roost sites include mangroves (particularly mangrove roots) on the coast and vegetated margins of sub coastal freshwater swamps. Large flock roosting sites can include many thousands of birds.

**Land Management Practices and Shorebird Habitat Values**

Shorebirds are an integral part of wetland biodiversity. Most management issues relevant to shorebird habitat conservation are generic to the management of the ecological integrity of wetlands. The greatest conservation benefit for shorebirds in the southern Gulf would be achieved by ensuring that the full diversity of wetland habitat types are retained and managed on a regional scale.

To do this the full suite of threats affecting the condition of wetland habitats (discussed in preceding section above) need to be addressed by land managers where appropriate and possible. The two threats most directly related to the dominant land use pattern (pastoralism) are (1) direct cattle grazing and trampling of habitat and (2) associated (indirect) soil erosion, sedimentation and water quality deterioration.

Cattle were particularly observed to be having a large impact on the quantity and quality of fringing and emergent vegetation of many wetlands. The vegetated margins of freshwater swamps are recognised as critical feeding, roosting and breeding habitat for a number of migratory or resident shorebirds (Garnett 1989). However, the greatest direct impacts of cattle on fringing vegetation appear be during the dry season which is a period of lower abundance of migratory shorebirds and is not when resident species would use the vegetation for breeding, although some species such as Sharp-tailed Sandpiper do utilise it for roosting habitat through winter (Garnett 1989).

Other threats also related to pastoral land management i.e. weeds; feral animals, fire regime and built infrastructure are also significant in terms of wetland impacts but are currently less well understood in terms of direct implications for shorebird habitat values.

Property management plans that address wetland habitat conservation at a property scale are needed on all southern Gulf properties if ecosystem and wetland management are to be integrated with current pastoral and land management practices.

Other potential and existing land use scenarios in the southern Gulf i.e. irrigated agriculture, aquaculture and tourism, present other land and water management considerations for shorebird conservation which are mentioned under recommendations below.

**Information and Resource Needs of Landholders/Managers**

**Landholder and Community Capacity and Skills**

There was no evidence that landholders had a sound technical knowledge of the types and extent of freshwater wetland habitats on their properties. There was also limited capacity amongst landholders or managers to undertake shorebird monitoring, although several spouses showed general interest and knowledge of waterbirds on their property. These people could be encouraged to participate in shorebird and waterbird monitoring, given further training in identification and the development of a local birding network.
Burke Shire Council mayor, Annie Clarke, identified a need for public shorebird and waterbird education and awareness raising. She suggested that the annual regional school camp each September presented a valuable opportunity to present educational material and conduct field identification classes with school children.

**Wetland Habitat Resources**

Before any landholder can undertake effective wetland management, the extent and diversity of wetlands on their properties needs to be documented and mapped. Ideally such an exercise should be undertaken using a GIS that landholders could then be trained in the use of to help achieve integrated wetland property management planning. There is also currently a lack of accessible site-specific data on shorebird distribution and abundances that allows landholders to understand the values of their freshwater wetlands for shorebirds.

Recognising existing capacity constraints amongst landholders including in the use of GIS, provision of at least ‘hard copy’ property scale mapping of the region’s wetlands and compilation of current knowledge of shorebird and waterbird distribution and abundance is needed in the first instance to provide the information required to underpin integrated wetland management. Such information is also needed to assess, plan and implement regional-scale management practices (eg fire, weed, feral animal or stock management) designed to maintain wetland diversity and viability across the entire Southern Gulf Wetland Aggregation.

**Relationship of Wetland Condition to Shorebird Habitat Values**

There is currently no specific data available on the impact of cattle, weeds, feral animals, fire regime or built infrastructure on the viability of wetlands for shorebirds. Scientific studies on these practices would greatly enhance advice to landholders for best-practices. Students at regional universities should be encouraged and supported to undertake studies that advance our understanding of the threats of these activities to shorebirds.

**Recommendations for the Conservation of Important Shorebird Habitat**

The most important shorebird habitats are coastal and marine (photos 1-10). The majority of marine habitats are not exposed to pastoral activities or terrestrial invasive species. However some potentially important elements of coastal habitats including beaches, dunes and marine plains are exposed to such threats and there is a need to gain a better understanding of this threat level.

**Pastoral Land Management Recommendations**

Sub coastal freshwater wetlands and seasonally inundated grasslands are the shorebird habitat types most exposed to threats associated with the dominant pastoral land use of the southern Gulf. Surveyed wetlands that were heavily impacted by cattle access had few shorebirds. Resident shorebird abundances were highest on wetlands with fringing vegetation that provided greater protection to shorebirds from predators. Recommendations concerning this and other pastoral land use management practices include:

- The value of wetlands to shorebirds be enhanced by reducing cattle access and allowing the regrowth of natural fringing vegetation.
- Water extraction from natural freshwater bodies be kept to a minimum to conserve freshwater habitats for shorebirds.
- Realignment, reshaping and dredging of natural freshwater wetlands be discouraged as it can lead to reductions in the quality of the shorebird feeding habitats on the verges of these wetlands.
- Land management practices that increase and retain natural vegetation buffers adjacent to watercourses and vegetation cover within contributing catchments are needed to protect water quality and slow the rate of sedimentation of many freshwater wetlands.
- Effective control of wetland invading woody weeds (specifically Parkinsonia), needs to be pursued to prevent the loss of habitat to impenetrable thickets.
- The appropriate fire regimes required to prevent weed infestation and maintain the full diversity of wetland habitat types across the southern Gulf need to be identified and implemented across the region.

**Other Land and Water Use Management Recommendations**

These recommendations consider the broader habitat management needs of shorebirds as opposed to those directly related to pastoral land management and are partially drawn from Garnett (1989).

- The limited area of beach habitat in the southern Gulf be recognised and appropriate controls put into place to prevent increased disturbance from tourists, fisherman or property personnel particularly during shorebird breeding by vulnerable species such as Beach Thick Knees or roosting by migratory shorebird species.
- Identified large flock roost sites on the southern Gulf coastline need to be physically protected and educational or other measures employed to prevent their disturbance during critical roosting periods.
- The southern Gulf’s mangrove lined coast and rivers need to be protected against physical disturbance and loss associated with any future coastal development.
- Water resource and infrastructure management planning within contributing Gulf River basins and estuaries needs to ensure that flows or alluvial deposition processes responsible for forming intertidal mud flats utilised by shorebirds are preserved.
> Proposed Wetland Condition Monitoring System for Landholders

Need

For land managers to be able to manage wetlands in an ecologically sustainable manner it is necessary for them to have a clear understanding of the relationship between land management actions and the ecological condition of wetlands. Currently the relationship between management practices on southern Gulf pastoral properties and wetland habitat condition is poorly understood particularly in regard to specific habitat values for waterbirds, shorebirds and other biota. This not only applies to land managers but also to wetland ecologists and biologists.

There are currently no prescribed ‘best management practices’ for southern Gulf wetlands which in any case are likely to vary across the diverse array of wetlands that occur within the region. Developing this knowledge and management capacity can only come from careful monitoring of wetland condition related back to operating management practices, seasonal conditions and other condition driving events (i.e. fire, floods) through the process of adaptive management i.e. learning by doing.

There are no hordes of wetland agency field officers, willing students of ecology or nature conservation volunteers within the southern Gulf. If wetland condition monitoring is to be conducted within the southern Gulf, the most likely recruits will be the land managers themselves. These people are generally time strapped individuals engaged in intensive pastoral production operations that have little time or technical ecological knowledge to apply to the task of wetland condition monitoring. However, responses from land managers interviewed as part of this project indicated an almost universal willingness to become involved in wetland condition monitoring if it meets three provisos:

1. It's simple,
2. It not time consuming,
3. It produces useful information that gets used.

The need therefore is for a simple wetland condition monitoring system that can be implemented by land managers to capture good quality ecological data while requiring a minimum of effort or ecological technical training. To be successful such a system will in the first instance most likely have to be dependent on wetland ecologists to undertake the data interpretation needed to identify condition issues that warrant management responses. However, one ecologist is capable of analysing the data from many wetlands which is ultimately more resource efficient than attempting to get one or more field ecologists to monitor many wetlands in the field or to get many land managers to become ecologists. Ultimately through participation in a monitoring program some of the latter is likely to occur as land managers develop an improved capacity for understanding the ecological condition of wetlands and management implications.

If implemented such a monitoring system would not only serve the development of specific wetland management practices by landholders but would also serve biodiversity conservation by improving the ecological understanding of wetland condition dynamics across the southern Gulf region as a whole and facilitate the development of a regional management approach to the southern Gulf’s wetlands.

Limitations Existing Monitoring Frameworks

Within the time constraints of this project a limited review of some existing wetland monitoring frameworks was undertaken (Bolton 2001 a, b, c, d, Dixon et al 2005, Finlayson 2003, Finlayson et al 1999, 2002, van Dam et al 1999, van Dam and Finlayson 2004, Wetlandcare Australia 2005). Early in the review it became apparent that all existing monitoring systems including those designed for community use had some critical limitations in terms of the design provisos set for landholder conducted wetland monitoring in the southern Gulf. In general terms these limitations included:

- Require high level of ecological knowledge particularly plant taxonomic skills,
- Measured attributes require specialist monitoring equipment particularly water quality parameters
- Require more than one operator,
- Take significant period of time (~>hr) to conduct,
- Applicable to only specific type of / non-tropical / non-seasonal wetlands,
- Focus on riparian systems rather than wetland basins.

One area where monitoring programs have been specifically designed for use by grazier landholders is in the monitoring of pasture condition. A range of programs have been developed or operated by Queensland agencies i.e. TRAPS, QGRAZE, Grass Check, Aussie GRASS (NLWRA 2001). Some elements of these programs are capable of being applied to wetland condition monitoring particularly for assessments of fringing vegetation condition and ground cover. However, most still require a reasonably high level of skill in the identification on grass species, the use of quadrats, transects and other means of quantifying vegetation structure. Some systems employ the use of photo points to capture site conditions at fixed time periods. The analysis of associated data captured using cameras has developed in conjunction with the use of photo point methods.
With the advent of relatively cheap digital cameras large numbers of field images can now be efficiently captured and stored digitally and readily accessed, used or distributed. The author’s personal experience is that digital cameras provide a ready means of monitoring many wetland site conditions (Wetlandcare Australia 2004) and that much quantitative information can be interrogated from digital photos subsequent to rapid field collection. They can also be effectively used by relatively inexperienced operators. Consequently their use formed the primary focus for the development of a simple wetland monitoring system.

Drivers and Indicators of Wetland Condition
For monitoring to be useful it needs to capture measures of attributes directly related to key drivers and/or indicators of wetland condition. Recent reviews of the key direct drivers of change in wetland condition in northern Australian (Finlayson et al. 2005) identify:
- Feral animals
- Weeds
- Water pollution / quality
- Grazing / trampling
- Vegetation clearing or destruction
- Saltwater Intrusion
- Fire regime
- Hydrological Change
- Climate Change
- Tourism and recreational activities

All of these wetland condition drivers have been identified to be significant in the southern Gulf. Capturing data associated with most if not all of these drivers or indicators of their impact has been considered in the Simple Wetland Assessment and Monitoring Pro-forma (SWAMP) developed by this project (Appendix 3).

Monitoring Wetland Condition Driver / Indicator Attributes
In the Simple Wetland Assessment and Monitoring Pro-forma (SWAMP) developed by this project (Appendix 3) site photographs and a register of key events have been proposed as the means by which data on key wetland condition divers and indicators can be captured (Table 1). Simply, the monitoring framework proposes taking four digital photos at four points (16 in all) along a transect perpendicular to the bank of the wetland on at least four seasonally stratified occasions during the year. The proposed orientation of photographs at each point include straight ahead (across wetland basin), to left parallel to bank of wetland, to right parallel to bank of wetland, and vertical to the ground. Short written records for up to eight described types of events including a generic ‘other’ are also suggested (Appendix 3).

Data Interpretation
It has not been possible within the constraints of this project to assess the capability for interpreting all nominated data for wetland condition drivers listed in Table 1. As it stands the SWAMP is a wetland monitoring framework proposal that needs to be tested and validated in the field under a range of seasonal conditions with the assistance of volunteer land managers.

Previous field experience of the report author in the use of photo points for wetland monitoring (Wetlandcare Australia 2004), and limited field trailing during the southern Gulf field trip provide confidence that such an approach will meet most wetland condition monitoring needs required to underpin improved management of southern Gulf wetlands. However, critical to achieving this outcome will be the concomitant commitment of resources to developing a dedicated database system and data interpretation methodology.

Database Development
The primary data that will be generated by the use of this monitoring framework as proposed will be digital image files and filled pro-forma sheets. The latter could be collated in hard copy or digitally with the later being preferable but dependent upon the computing and word processing capacity of the individual undertaking the monitoring. Where internet access is available (most Gulf properties) the ultimate process in terms of centralised data management would be to establish a dedicated web site to which image files and filled data sheets could be posted or filled on-line. Obviously such an operation would require considerable resourcing to establish.

It is too pre-empive to consider the database requirements for data interpreted from the primary data though most standard database formats or spread sheet formats would most likely be suitable. Access to analysed secondary data outputs and summary information reports at the same web based receptacle described above would be ideal and would serve to provide wetland monitors with a ready means of receiving management relevant feedback for their invested effort.
Table 1. Wetland Condition Measures and Means of Data Capture Using the SWAMP.

<table>
<thead>
<tr>
<th>Direct Driver of Wetland Condition</th>
<th>Data Captured by Photograph</th>
<th>Data Captured by Event Register</th>
<th>Potential Measure</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feral animals</td>
<td>Yes</td>
<td>Yes</td>
<td>% bank area disturbed. Qualitative high, medium, low disturbance of bank or fringing vegetation. Description of disturbance.</td>
<td>Sometime difficult to distinguish from domestic stock.</td>
</tr>
<tr>
<td>Weeds</td>
<td>Yes</td>
<td>Yes (if new species occurs or other information i.e. flowering / seeding recorded)</td>
<td>% bank area dominated % ground cover / species. Relative dominance Biota responses**</td>
<td>Species need to be discernable in photographs.</td>
</tr>
<tr>
<td>Water pollution / quality</td>
<td>Yes</td>
<td>Possibly if polluting event or run off observed.</td>
<td>Descriptive / qualitative classes i.e. turbid, dark, clear, eutrophic. Biota responses**</td>
<td>Primarily only suspended solids / ity.</td>
</tr>
<tr>
<td>Grazing / trampling</td>
<td>Yes</td>
<td>Only in case of cattle being introduced to spelled wetland.</td>
<td>% bank area disturbed (i.e. pugged). % ground cover (per affected species). Qualitative high, medium, low disturbance. Biota responses**</td>
<td>Sometimes difficult to distinguish from feral animal impacts.</td>
</tr>
<tr>
<td>Vegetation clearing or destruction</td>
<td>Yes</td>
<td>Only if associated with known event.</td>
<td>% bank area / length cleared. Descriptive high, medium, low disturbance. Biota responses**</td>
<td>Unlikely under current legislative arrangements.</td>
</tr>
<tr>
<td>Saltwater Intrusion</td>
<td>Probably not</td>
<td>Only if evidence observed or occurs at time of monitoring.</td>
<td>Qualitative classes i.e. fresh – salt Height of intrusion level above known point. Vegetation responses.</td>
<td>May require establishment measurement metre and event based (high tide) monitoring.</td>
</tr>
<tr>
<td>Fire regime</td>
<td>Yes</td>
<td>Only if evidence observed or occurs at time of monitoring.</td>
<td>% bank area burned. Qualitative classes cool, medium, hot burn. Biota responses**</td>
<td>Probably best served by event based (time of burn) monitoring.</td>
</tr>
<tr>
<td>Hydrological Change</td>
<td>Probably not</td>
<td>Only if evidence observed or occurs at time of monitoring.</td>
<td>Description nature of change.</td>
<td>Could include earth works, pumping or instream structures.</td>
</tr>
<tr>
<td>Climate Change</td>
<td>No</td>
<td>No</td>
<td>Description of unseasonable conditions or extreme climatic events.</td>
<td>Indications may emerge over time from other measures.</td>
</tr>
<tr>
<td>Tourism and recreational activities</td>
<td>Possibly*</td>
<td>Only if evidence observed or occurs at time of monitoring.</td>
<td>Description nature of activities.</td>
<td>* Where major disturbance of bank, extensive littering or activities photographed.</td>
</tr>
</tbody>
</table>

** Besides incidental capture of biota responses in the events register the main opportunity will come from concurrent use of the bird monitoring kit (Appendix 4) and by detailed assessment of floristic and structural changes in fringing and emergent vegetation captured by site photographs.

Management Applications
In a pastoral management context the key management information that may be gleaned from wetland condition monitoring will most likely concern issues associated with:
- appropriate grazing regimes including stocking pressure and timing and duration of possible wetland spelling,
- development of wetland specific fire regimes, and
effective approaches and biota responses to weed control.

Initially such information will be best interpreted with the help of wetland ecologists and biologist but once key indicators have been identified it is likely that land managers themselves will be able to interpret wetland condition trends and responses from raw data i.e. site photos and registered events.

Potentially one the most significant developments in southern Gulf wetland management capacity that could come from the widespread adoption of wetland condition and bird monitoring would be a regional overview of wetland condition trends and responses for a broad suite of the Gulf's wetland types. This could provide the basis for the development of regional approach to wetland management that recognises the regional distribution of wetland values and resources and their seasonal and inter-annual responses to climate.

> Conclusions and Recommendations

Priority Wetland Management Needs

The wetlands of the southern Gulf are an internationally, nationally and regionally important resource for cultural, production and biodiversity values. Although they have proven to be relatively resilient to ecological pressures associated with over a 100 years of pastoral production there is ample evidence indicating that these pressures and new ones are increasing. Consequently the ecological character and associated values of many of the southern Gulf’s wetlands particularly the freshwater systems are now facing greater degradation risks than historically and these are likely to be realised unless there are specific management efforts directed at wetland resources. From the findings of the interview based research of land managers within the southern Gulf and cursory observations of wetland condition observed in the field, the following emerge as priority management needs for the southern Gulf’s wetlands:

- A reduction in cattle grazing and trampling pressure on wetland habitats,
- A reduction in soil erosion and sediment loading within wetland catchments,
- Targeted weed and feral animal control,
- The development and adoption of sustainable wetland habitat focussed property management planning,
- Better incorporation of broader stakeholder interests (i.e. Traditional Owners, Conservationists) in Pastoral leasehold land management,
- Increased technical understanding by land managers of wetland habitat and ecological condition and associated management needs, and
- Adoption of wetland condition monitoring by land managers.

Shore Bird, Water Bird and Waterfowl Specific Investment Priorities

While the values of the Gulf's wetlands span a broad suite of biodiversity resources including nationally significant fishery resources, it is their particular significance to birds, particularly migratory shorebirds that has provided much of the impetus for this study. In considering the particular needs of wetland birds including shorebirds, several recommendations to support improved habitat management have emerged. These include:

- Compilation of current knowledge of bird distribution and abundance to underpin site specific management needs (including those associated with limited beach habitat and coastal flock roosting stes),
- Facilitation of a broader (than land manager only) bird monitoring program involving external expertise and regional / external volunteer participants,
- Community (public, schools, landholders) education in bird identification and monitoring techniques,
- Improving the capacity of land managers to understand bird habitat management needs,
- Development of local ‘birding’ network within the southern Gulf, and
- Extending wetland bird habitat management planning beyond the focus on migratory shorebirds to resident shorebirds, waterbirds and waterfowl.

This latter point has emerged from the realisation that while the needs of migratory shorebirds are considered an issue of national significance addressed by commonwealth and State governments through international agreements and associated legislative protection, the needs of resident shorebirds and more particularly resident waterbirds and waterfowl do not receive such a high level of government attention. From the findings of this project it is apparent that in many instances the ecological pressures facing southern Gulf wetlands are disproportionately affecting the habitat needs of resident wetland birds rather than the majority of migratory shorebird species which predominantly utilise coastal habitats less affected by existing land management
practices. Therefore it is recommended that the habitat management needs of wetland birds per se’ rather than a primary focus on the higher profile migratory shorebirds should be used to provide a more equitable basis for addressing improved management of bird habitat values in southern Gulf wetlands.

Research Needs

Wetland management needs to be underpinned by good information. In some instances the information needed to support improved management of wetlands in the southern Gulf exists and the primary challenge lies in its compilation and provision in an accessible form to land managers. However, in more cases the information is not yet available as the issues surrounding particular management needs have not been specifically researched, at least not in the environments of the southern Gulf. Some issues i.e. climate change, are only just emerging as a priority focus for management. Identified research needs include:

- Insitu (existing) grazing regimes (including exclusion areas) and associated wetland condition,
- Impact of fire, weeds, feral animals and grazing on the viability of wetland bird habitats (with a particular focus on fringing vegetation),
- Impact of excavation and bunding on the habitat values of wetlands,
- Relationship between shorebird distribution and abundances and the habitat value and condition of freshwater wetlands,
- Potential impacts to southern Gulf wetlands associated with climate change and associated sea level rise and appropriate adaptive management responses.

Encouraging students from regional universities to undertake applied research in wetland management is identified as one cost effective option for progressing research needs.

Areas of Strategic Investment for NRM and Conservation Organisations

To meet the priority management needs identified for the wetlands of the southern Gulf there are a number of areas that have been identified as strategic investment opportunities for community and government based natural resource management (NRM) organisations and non-government conservation organisations. These investment priorities span a suite of initiatives from meeting the material and information needs identified by land managers for improved on-ground management of wetlands on individual properties, through to capacity building and strategic planning efforts that would serve improved management of wetlands at a regional scale.

At an individual property scale investment is required to support:

- Property scale inventory and mapping of wetlands including identification of management issues,
- Provision of information, material resources (maps, air photos) and expertise to engage land managers in Participatory Property Management Planning,
- Access to devolved funding for material resources that help deliver reduced grazing pressure on wetlands i.e.
  - Fencing
  - Off stream / wetland watering point infrastructure, and
- Resourcing for increased weed control capacity (including non-declared species).

Delivery of this property scale investment would be best achieved as a regional initiative with strategic targeting of properties with high value wetlands lying within the nationally important mapped wetland aggregations of the Southern Gulf, Marless Lagoon, Nicholson Delta and Buffalo Lake (Blackman et al. 1999). During the field consultation with land managers of the southern Gulf a number of potential wetland management project sites were nominated by land managers within these areas (see photos _ ), and these would represent good prospective start-up proposals for such an initiative.

At a regional scale strategic investment opportunities are identified in:

- A program to supporting the adoption of wetland condition monitoring by land managers,
- Building the technical capacity of land managers to undertake wetland condition and bird (& other biota) monitoring,
- Developing wetland management guidelines and associated extension materials for Gulf wetlands,
- Supporting Traditional Owner organisational vehicles in their aims of delivering Cultural and Natural Resource Management on wetland ‘country’, and
- Developing a regional management plan for the southern Gulf’s wetlands.

A regional wetland management plan for the southern Gulf’s wetlands is considered a keystone recommendation in that it could provide the framework for co-ordinating all of the regional scale wetland management capacity building activities and the delivery of on-ground management outcomes across the range of stakeholders and agencies with interests in the Gulf’s wetland resources.
> References


WetlandCare Australia (2004). *Developing use of grazing as a riparian and wetland management tool in the lower Burdekin*. Information Bulletins 1 – 8 prepared by Jim Tait for Wetlandcare Australia.

WetlandCare Australia (2005). *The Revised Wetland Assessment Technique*. In ‘Wetland Assessment, Prioritisation & Mapping Project’ Report to the Northern River Catchment Management Authority, May 2004

> Appendix 1. Tabulated Interviewee (Land Manager) Responses

From 8 southern Gulf Property land managers.

1. Wernadinga
2. Armraynalnd
3. Magowra
4. Old Doomadgee
5. Inverleigh
6. Inverleigh West
7. Delta Downs
8. Escott

Note: Sequence of responses have been scrambled to preserve anonymity of interviewees.

**Question 1.) Value(s) attributed to wetlands on property?**

- Production (green feed, nutritionally better grasses later into year).
- Bird life (has interest in natural history).
- All values appreciated – production, nature, and aesthetics.
- Primarily cultural values including bush tucker (ducks, geese, turtles) and special dreaming places. Not engaged or in pastoral production and current stock numbers not commercial. May develop economic aspirations (incl. tourism) in longer term.
- Production – watering points.
- Salt couch country productive pasture.
- Birdlife, i.e. Brolga (& Saurus Cranes) nest on property.
- Production (watering, feed), Nature (especially birdlife).
- Bird watchers who camp @ station waterhole have recorded 120 species.
- Don’t recreate in most (but know intimately, and have bird ID manuals).
- Water ski @ station waterhole.
- Bird watch & count birds @ station waterhole.
- Fish in River.
- Integral part of maintaining biodiversity and ecosystem health
- Flow on effects such as soil stability
- Productive pastures – especially marine couch.
- Culturally important sites.
- Hunting and fishing places.
- Commercial fishing resources.
- Ecotourism resource base.
- Wildlife values – appreciate and have active interest in birdlife and concerned by observed impacts.
- Production.
- Wildlife (likes to observe waterbirds on waterholes).

**Question 2.) Wetlands managed as a specific resource or integrated in broader property management?**

- Most wetlands open to broader grazing system and management integrated.
- Some fenced ‘Bullock Hole’, ‘The Lake’ to prevent cattle bogging.
- Wetland management integrated into broader property management.
- Integrated with broader property management, conservative stocking key approach adopted to protect values.
- Integrated
- Wetlands not separately managed – integrated with whole of property management.
- Management integrated.
- Integrated as part of broader property but does include specific – inclusion fences.
- Integrated management.
- Conservative stocking main approach.
Question 3.) Developed or intend to develop a property management plan?

- Yes. Have PMP developed primarily for production purposes i.e. paddock configuration, fences, and water points.
- Property management plans being developed across the Company to include environmental management considerations.
- Has PMP developed by company a couple of years ago to address vegetation management plans.
- No formal property management plan. Operational management reviewed on approximately quarterly basis.
- No. Could develop in longer term as part of Land and Sea Management Centre activities.
- No formal PMP.
- No formal PMP. Paddock spelling and water point development planned out to about 2 year planning horizon but also manage opportunistically in response to seasonal conditions and resource ($) availability.
- No formal PMP, each year assess carrying capacity and stock accordingly.
- Informal plan in manager’s head.

Question 4.) Condition wetlands considered to be in?

- Some good, some have some degradation.
- Generally good.
- Good.
- Good as you’ll find
- Pretty good.
- Same as when Aboriginals left it. Probably better condition now than historically recent (see below). Seek to have good trend in wetland condition to underpin economic sustainability.
- Only few in good condition – most others degraded.
- Pretty good.

Question 5.) Any historical changes in condition of wetlands or management practices?.

- Not well positioned to answer (short time <2 yrs on property). Historically less fencing and watering points and greater population of feral cattle.
- Grazing scalded areas apparent on property mainly due to previous management. Today believe there is less pressure on lake areas.
- Not aware of any – relatively new managers.
- Historically de-stocking of feral cattle in coastal parts of property (TB program).
- More recent years establishment of fencing west of GinArm Crossing and culling of 5-7000 head of brumbies – major reduction in feral grazing pressure.
- Mid 80s big decline in horse numbers associated with TB de-stocking program.
- Old coastal fencing has fallen down.
- Greater number of water points (& more bird life).
- Salinity (associated with sea water) intruding further inland.
- Increasing number and density of weeds.
- Recently burning has reclaimed previously rubber vine infested sites.
- Historically cattle moved around more but now have more watering points therefore stock tend to stay put.
- New manager (1 year) – don’t know saltwater country.
- Gutta-percha – spreading with floods (post 74 & 91 observed to increase) and ground (black soil) also reportedly more roughed up than historically.
- Coastal country previously fenced – now given up due to maintenance (fence rusting) costs.
- Historically less weeds and more turbid water (due to horses).
- Greater stocking density (& overall grazing pressure) today than 50 years ago.
- Also more watering points (3X dams c/f historically) and fencing (of waterholes showing pressure) therefore now more even spread of pressure.
### Question 6.) Specific practices associated with management of wetland values on your property?

- Fencing of several (‘Bullock Hole’, ‘The Lake’) to prevent cattle bogging – generally maintain complete exclusion.
- 2 paddocks per year spelled out of total of 27 paddocks.
- 2200 km² property with 28,000 head.
- ~50% of paddock burnt per year. October start to burning and target where lightening misses.

<table>
<thead>
<tr>
<th>Detailed Practices</th>
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</thead>
<tbody>
<tr>
<td>2 paddocks spelled per wet season to allow grass growth to develop through to grass seeding.</td>
</tr>
<tr>
<td>Conservative stocking ultimately key factor in wetland (&amp; weed) management.</td>
</tr>
<tr>
<td>Fire approximately 1/8 property/yr from October onwards targeting rank growth.</td>
</tr>
<tr>
<td>Have created artificial wetlands (dams &amp; ponded pastures).</td>
</tr>
<tr>
<td>Have tried to sow ponded pastures directly to natural wetlands without success.</td>
</tr>
<tr>
<td>Have fenced off most of Leichhardt River frontage breakaway country.</td>
</tr>
</tbody>
</table>

- No specific practices.
- Conservative stocking.
- Only spell black soil plain paddocks – 1 paddock for whole year.

<table>
<thead>
<tr>
<th>Detailed Practices</th>
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</thead>
<tbody>
<tr>
<td>Burning every year from about September on –‘all’ property every year.</td>
</tr>
<tr>
<td>Downstream of Flinders Crossing all wetlands are also watering points (cattle and wildlife).</td>
</tr>
<tr>
<td>Bunding to increase water volume retained.</td>
</tr>
<tr>
<td>US freshwater reaches of the Flinders, riparian areas fenced off (&amp; cattle exclusion) in the 70s to prevent cattle bogging – DS floods inundate levees therefore not possible.</td>
</tr>
<tr>
<td>Fire regime – some occurs naturally before wet otherwise target ~10% property per year with focus on woody weeds and rank grasses.</td>
</tr>
<tr>
<td>Spelling not done except for holding paddocks – conservative stocking main approach.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detailed Practices</th>
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</thead>
<tbody>
<tr>
<td>140700 ha &amp; ~21000 cattle</td>
</tr>
<tr>
<td>Burn about 5% of property per annum at storm time.</td>
</tr>
<tr>
<td>Fenced off lower 10 km of Flinders.</td>
</tr>
<tr>
<td>Wet season spelling occurs by default as stock stay on ridges.</td>
</tr>
<tr>
<td>Creation of large artificial wetland by weir construction (40s) and raising (1988) on L Creek.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detailed Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burning every year focussed on rubber vine infested sites (new manager yet to do and some rubber vine coming back).</td>
</tr>
<tr>
<td>1 000 ha &amp; 38000 head</td>
</tr>
<tr>
<td>Wetlands get default spelling in wet.</td>
</tr>
<tr>
<td>Inland more conservative stocking.</td>
</tr>
<tr>
<td>Spelling based on observed / monitored condition.</td>
</tr>
<tr>
<td>Irrigated Hymenache and alleman grass pondage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detailed Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 000 ha &amp; 10,000 head</td>
</tr>
<tr>
<td>Burn off once rains arrive (not before due to pasture risks 2-3&quot;) 20-30% of property / year targeting rank growth and woody thickening.</td>
</tr>
<tr>
<td>Stocking would like to do but holding onto extra stock.</td>
</tr>
</tbody>
</table>
### Question 7.) What are the primary threats / degradation issues affecting wetlands?

<table>
<thead>
<tr>
<th>Threats / Degradation Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeds are the key issue – rubber vine, noogoora burr, calotrope.</td>
</tr>
<tr>
<td>Overgrazing by wallabies also issue in river riparian corridor – uncontrolled population size. Wallabies take refuge in weed infested riparian vegetation corridor.</td>
</tr>
<tr>
<td>Grazing pressure on wetlands.</td>
</tr>
<tr>
<td>Weeds primarily rubber vine and Calotrope.</td>
</tr>
<tr>
<td>Stock use for watering and grazing.</td>
</tr>
<tr>
<td>Feral animals i.e. pigs and brumbies.</td>
</tr>
<tr>
<td>Weeds – primarily rubber vine invading along drainage lines.</td>
</tr>
<tr>
<td>Pigs and Brumbies – cause disturbance to waterbird nesting habitat, dig up sedges (Gulgunga) and impact water quality.</td>
</tr>
<tr>
<td>Weeds – rubber vine showing up, calotrope (tobacco bush) present in coast</td>
</tr>
<tr>
<td>Woody weeds and Thickening up (native woodland) and rubber vine especially on the coast. NB access to coastal frontage very limited therefore weed control difficult.</td>
</tr>
<tr>
<td>Parkinsonia on some wetland margins and rubbervine in coastal country.</td>
</tr>
<tr>
<td>Parkinsonia &amp; Prickly acacia appears to grow in cycles – latter controlled with pellets. Chinnee apple also showing up and therefore working toward its control.</td>
</tr>
<tr>
<td>Feral animals not too bad few horses, dingoes and pigs (+ plenty of pig chasers).</td>
</tr>
<tr>
<td>Uncontrollable people access and camping (leave rubbish and gates left open)</td>
</tr>
<tr>
<td>Pigs, rubber vine and calotrope</td>
</tr>
<tr>
<td>Pigs observed to impact geese nesting sites and predate on eggs.</td>
</tr>
<tr>
<td>Calotrope has exploded in abundance in last 5 years.</td>
</tr>
<tr>
<td>Has spent ~100K on prickly acacia control.</td>
</tr>
<tr>
<td>Parkinsonia easily controlled by fire.</td>
</tr>
<tr>
<td>Most waterholes overgrown with rubber vine.</td>
</tr>
<tr>
<td>Erosion - Many waterholes sitting up.</td>
</tr>
<tr>
<td>Many weeds – rubber vine, parkinsonism, noogoora burr, stinking Rodger, grader grass, prickly acacia, calotrope (only particular soil types).</td>
</tr>
<tr>
<td>Pigs (controlled by TO shooting)</td>
</tr>
<tr>
<td>SL rise promoting erosion of country.</td>
</tr>
<tr>
<td>Siting breakaway – Upstream on eastern side.</td>
</tr>
<tr>
<td>Gutta-percha filling in holes.</td>
</tr>
<tr>
<td>Tourism also emerging issue – excessive access and associated erosion site disturbance</td>
</tr>
<tr>
<td>Weeds – biggest issue, primarily Calotrope.</td>
</tr>
<tr>
<td>Prickly acacia also issue (recently spent 40K on control).</td>
</tr>
<tr>
<td>Rubber vine along drainage lines.</td>
</tr>
<tr>
<td>Parkinsonia not seen as a problem – cyclical occurrence.</td>
</tr>
<tr>
<td>Pigs not too bad.</td>
</tr>
<tr>
<td>Horses shot out (700 – 800 head) 10 years ago.</td>
</tr>
<tr>
<td>Erosion developing issue on Buffalo Lake (NB distinction between local and map identified Lake – local ‘Buffalo Lake’ is smaller water body).</td>
</tr>
</tbody>
</table>
### Question 8.) Changes to wetland management that would implement if resources were available?

- Fencing of alluvial levee along Leichhardt River to allow for better weed management via fuel load accumulation (previous application made).
- Fencing off of more wetland areas for extended spelling (shut off during growing season and open up later).
- Establishment of more off stream/wetland watering points
- Greater weed control/management.
- Fencing off of large wetlands (i.e. Cockatoo) and some drainage lines i.e. Wild Horse Creek – estimate cost at around 100K
- Priority is fencing off Wetlands on Old Doomadgee. Target would be sensitive and culturally special sites.
- Harvesting of pigs and horses to send to market.
- Country looked after by traditional managers incl via land and sea management centre rangers.
- Improved weed control.
- Establish fencing along creeks so that cattle don't cross creeks to get to watering points and reduce erosion
- Fencing off of coastal wetlands
- Nature refuge designation for weir/ wetland plus possibly selected natural wetlands.
- Better pig control.
- Better weed control.
- Fish passage structure for weir.
- Permanent waterholes fenced off and developed off stream watering points for cultural and biodiversity values.
- Weed control – getting into place Kurtijar people trained in chemicals, chain saws – pulling down old fences.
- Fencing off of Buffalo Lake if affordable (NB distinction between small 3-4 km fencing and large 20km fencing) to provide extended spelling through wet with reintroduction of stock once dried to access pasture reserves.

### Question 9.) Specific material, financial or other resource needs?

- Time and labour are the biggest limitations to further environmental management issues however these are being slowly addressed through broader Company initiatives
- Fencing material.
- Off stream watering point infrastructure.
- Additional staff/contractors for weed control.
- Key materials required fencing and off stream water point infrastructure.
- Prefer to use own labour.
- Fencing.
- Weed control materials.
- Resources to assist with weed control program – rubber vine and Parkinsonia key weeds.
- Aerial photography, satellite images and interpretation especially of degradation.
- $ Support for pig baiting program (N0.1)
- Fencing resources to help implement better control of coastal wetland country – willing to implement additional fencing.
- Information and aerial images regarding wetland management.
- Off stream watering point infrastructure –costly up to 5 components (pipes, fencing, pumps, solar panels, troughs).
- Weed control resources.
- Information, communication that reaches out to grass roots.
- Weed control program support (chemicals, labour)
- Bio-control for calotrope.
Question 10. Prepared to participate in a wetland monitoring program?

- Yes, if requirements simple but subject to time constraints and provided there was an alignment with Company objectives.
- Supportive of involvement depends upon if feel results are really useful, simplicity of monitoring requirements and time availability factor.
- Not really as time availability too critical. Willing to let others come onto property for monitoring purposes.
- Yes – again possible role for land and sea management centre rangers.
- Prepared to be involved in monitoring except for wet season (would require chopper).
- Willing to be involved in monitoring – suggest using video to cover birds in wetlands.
- Prepared to be involved in monitoring program.
- Interested in supporting wetland monitoring program.

Question 11.) Support for TO involvement in the management of wetlands?

- Yes are TOs
- TO involvement not supported due to perceived double standards re: non-traditional practices, lack of mutual access arrangements to TO managed lands and concerns re: rubbish left behind.
- Yes. Access already permitted to specific Traditional Owner family groups to some wetland areas for turtle fishing.
- Some limitations to further involvement as a result of ongoing native title claims in the area.
- Supportive of involvement with proviso that TOs also respectful of cattle operation. Need protocols regarding access and on site behaviour.
- Not really, other than private arrangements with employees. Too much bad experience in past regarding burning, illegal access and stock losses.
- TO involvement would be OK if they ensure rubbish is not left behind. Doesn’t appreciate some arrogant attitudes that have been encountered.
- Would have to think further about TO access as have concerns regarding promoting ‘continuous affiliation’ that may provide basis for native title claims. Key requirements would be no guns, dogs alcohol.
- Yes are TOs

Question 12.) Whether see merit in the use of conservation agreements / tenements or wetland /Heritage convention designation for wetland management and provisos?

- Concerns with the long term limitations imposed by such agreements that would prevent or restrict pastoral activity even if the environmental concerns were addressed.
- Nature refuge could be possibility as previously station was declared Fauna Sanctuary under previous legislation and gives some additional statutory ability re control of public access and shooters.
- Yes, supportive of conservation framework if includes incentives as provide opportunity for whole of society to contribute to economics of conservation and viability of operation. Suggest that if ‘middle path’ approach taken toward conservation will get more support from landholders. Previous experience with environmental grant application process disappointing: Need commitment to ongoing support. Need programs that readily fund identified priorities and promote collaborative efforts by adjoining properties eg riparian fencing – no good if only properties one side of river bank participate.
- Possibly. Would need to investigate merit of specific proposal.
- Unsure, need specific proposal, may consider if offers resources or training support. Concerns regarding interference of conservation tenures with traditional practice rights.
- Not really – don’t want to be bound by legislation prefer to self manage environmental values.
- Not in position to comment as manager c/f owner.
- Would only be interested if provided a way to obtain improved security of tenure 2-way street i.e. conservation value secured for public via conservation agreements – production values secured by landholder via freehold tenure.
<table>
<thead>
<tr>
<th>Question Area</th>
<th>Eastern Southern Gulf Traditional Owner (Kurtjar, Kukatj, Guthaarn) Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.) Value(s) attributed to wetlands on property.</td>
<td>Bush tucker resource values paramount – want to conserve wetlands &amp; waterbirds to support continued traditional harvesting. Some also culturally significant sites.</td>
</tr>
<tr>
<td>2.) Wetlands managed as a specific resource or integrated in broader property management.</td>
<td>Wetland management integrated with grazing management (Delta Downs).</td>
</tr>
<tr>
<td>3.) Developed or intend to develop a property management plan.</td>
<td></td>
</tr>
<tr>
<td>4.) Condition wetlands considered to be in.</td>
<td>Degraded and declining.</td>
</tr>
<tr>
<td>6.) Specific practices associated with management of wetland values on your property.</td>
<td>N/A – most don’t have access to land.</td>
</tr>
<tr>
<td>8.) Changes to wetland management that would implement if resources were available.</td>
<td>Reinstall traditional management of wetlands. Harvest feral pigs for profit. Establish contract weed management teams to work on country including that owned and operated by white pastoralists.</td>
</tr>
<tr>
<td>9.) Specific material, financial or other resource needs.</td>
<td>Material support / training for weed management teams. Support funding + other for Ranger program. Rangers could undertake cultural management activities concurrently with other wetland management needs.</td>
</tr>
<tr>
<td>10.) Prepared to participate in a wetland monitoring program.</td>
<td>Happy to be involved, if supported materially.</td>
</tr>
<tr>
<td>11.) Support for Traditional Owner involvement in the management of wetlands.</td>
<td>Need access to traditional lands – negotiated, claimed or purchased. New initiative needed to overcome the past. Lots of history presents barriers to negotiated access arrangements with pastoralists. Need arrangements that bring management practices together (cultural, conservation, grazing).</td>
</tr>
<tr>
<td>12.) Whether see merit in the use of conservation agreements / tenements or wetland /Heritage convention designation for wetland management and provisos?</td>
<td>Generally have concerns regarding potential impact on traditional practice rights.</td>
</tr>
<tr>
<td>Other Comments / Identified Issues</td>
<td>- Lack of access to traditional lands key issue – cant be involved in wetland management if have no access. Building relationship of trust with pastoralists is the challenge. - Envirofund model does not work for scale of project required for wetland management in southern Gulf. Funds too limited. Need large project dollars. - Have insufficient information re: how to access multiple funding buckets. - Cultural heritage management objectives need even footing with biodiversity in program funding guidelines. - Although not considered strategic weed management resourcing also needs to come to bottom of river basins to ‘get on top’ of burgeoning weed problems. - SGC and WWF should use wetland meetings as opportunity to bring graziers, conservationists and TOs together.</td>
</tr>
<tr>
<td>Issues Raised / Discussed with Burke Shire Councillors</td>
<td></td>
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<tr>
<td>-------------------------------------------------------</td>
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<tr>
<td>- Riparian fencing merits of exclusion versus controlled grazing.</td>
<td></td>
</tr>
<tr>
<td>- Instances of observed increased erosion potential associated with cattle exclusion due to woody regrowth (i.e. white wood (<em>Atalaya</em> sp) shading grass and reducing protective ground cover (NB role of sympathetic fire management)).</td>
<td></td>
</tr>
<tr>
<td>- Tourist impacts to Shire’s natural areas – significant management issue.</td>
<td></td>
</tr>
<tr>
<td>- Problem with environmental /NRM funding continuity – need for some form of revolving fund.</td>
<td></td>
</tr>
<tr>
<td>- Many stations have limited capacity for implementing NRM on ground projects associated with labour shortages</td>
<td></td>
</tr>
<tr>
<td>- Concerns regarding fire regime management practices in Gulf including that of TOs equated to bush clearing due to late season intensity.</td>
<td></td>
</tr>
<tr>
<td>- Burke Shire Council mayor, Annie Clarke, identified a need for public shorebird and waterbird education and awareness raising. Suggested that it would be valuable to present educational material and conduct field ID classes for school children during the annual regional school camp each September.</td>
<td></td>
</tr>
</tbody>
</table>
> Appendix 2. Open ended questionnaire:

By way of general introduction the interview with landholders hopes to ascertain:

*What do they value about their wetlands, how are they currently managing them, what do they see as the key management issues and could they manage them better if supported financially, materially or otherwise?*

1.) What value(s) to you attribute to the wetlands on your property? i.e. high – low (& describe) for
- Production
- Conservation
- Cultural
- Recreational
- Other?

2.) Are wetlands on your property managed as a specific resource or integrated as part of broader property management (how)?

3.) Have you developed or do you intend to develop a property management plan for the natural resources (including wetlands) of your property?

4.) What condition do you consider wetlands on your property to be in (& why)?

5.) Are there any historical changes you have observed or are aware of in the condition of wetlands on your property (describe)?

6.) What specific practices (describe) are associated with the management of wetland values on your property and have they changed in recent times or historically?
- Grazing regime / intensity
- Fencing configuration
- Burning Practices
- Weed management
- Feral animal control
- Hydrological manipulation
- Improved / ponded pasture establishment
- Resource condition monitoring
- Other?

7.) What are the primary threats / degradation issues affecting wetlands on your property and what evidence do you see of these?
- Weeds
- Feral animals
- Fire regime
- Grazing pressure
- Hydrological changes
- Other?

8.) Are there any changes to wetland management that you intend to implement or would if resources were available to, on your property?

9.) Are there any specific material, financial or other resource needs that you can readily identify that if available you would use to support improved wetland management on your property?
- Fencing
- Labour
- Chemicals
- Information
- Expertise

10) Would you be prepared to participate in a wetland monitoring program if established and supported on your property?

11) Would you support Traditional Owner involvement in the management of the wetlands on your property and if so, what form of involvement do you believe would best serve your wetland management needs?

12) Do you see any merit in the use of conservation agreements / tenements or wetland /Heritage convention designation for the management of wetlands on your property and if so what provisos would you nominate?
Appendix 3. Simple Wetland Assessment Monitoring Pro-forma (SWAMP)

Background:
This pro-forma provides a guide for landholders to undertake simple wetland assessment and monitoring using seasonal collection of digital photos at a fixed photo point transect and recording of key events that relate to the wetland’s condition and management. The photo points and events register have been designed to capture the maximum amount of information with the least amount of effort by time strapped land managers. The information collected by this monitoring scheme will prove invaluable for tracking the ecological condition and character of wetlands in response to management actions and seasonal conditions and will underpin improved management of specific wetland types on pastoral properties of northern Australia. The information that can be gained from analysis of data collected using this monitoring is described in a separate report (Econcern 2005).

Figure 1. Schematic figure of wetland basin and cross section monitoring points (A, B, C, & D).

Wetland cross section photo monitoring points:

A. Water’s edge (not a fixed point, moves with seasonal levels).
B. Point midway between water’s edge and basin margin (not fixed).
C. Margin of wetland basin (fixed point), represents highest stable (non-flood flow) water level and usually defined by the boundary between wetland and dryland vegetation types.
D. ‘Average’ flood flow water level.

Direction and framing of four photos required at all monitoring points (A, B, C, & D i.e. 4 X 4 = 16 photos per monitoring occasion) include:

1. **Looking across wetland** (perpendicular to bank) with the photo framed to include the immediate foreground (1-2 m in front of photographer) and opposite bank of wetland.
2. **Looking to left parallel to bank** with the photo framed to include the immediate foreground (1-2 m in front of photographer) and furthermost visible bank of wetland.
3. **Looking to right parallel to bank** with the photo framed to include the immediate foreground (1-2 m in front of photographer) and furthermost visible bank of wetland.
4. **Looking at ground / water** immediately in front of photographer’s feet i.e. close as possible to plan (vertical) view.
Any opportunities to capture oblique views of the wetland aerially from a mustering helicopter or light aircraft at any time of the year or (ideally) at the same time as ground based monitoring should be taken.

**Recommended Annual Monitoring Times:**
The best information on how a wetland's condition varies through a year and between years is gained from monitoring that is stratified across seasonal conditions. For the seasonally dry tropics at least four monitoring occasions which roughly correspond to the four traditional seasons (Spring – Winter) are recommended (below). Additional event based (see below) or opportunistic monitoring is also desirable.

1. **Late (hot) dry** (~Spring) October – December (stressed conditions precedent to the wet)
2. **Wet season** (~Summer) January – March (wettest period, main growing season, reproductive peak for a lot of biota)
3. **Early (warm) dry** (~ Autumn) April – June (beginning of water level drawn down - drying, end of growing season and period of seeding for much wetland flora)
4. **Middle (cool) dry** (~Winter) July – September (drying up period for smaller water bodies, period of senescence / dormancy for much wetland flora).

**Events Register**
To support the interpretation of information captured by photo monitoring it is valuable to know when events that may be affecting the observed condition of the wetland occur. In the case of more remote or less accessible wetlands the day on which some events occur may not be observed and a more general indication of the time of occurrence may be recorded i.e. in the week of X – Y or in the month of … etc.

To record an event the minimum information required includes:
- **Event (Name)**
- **Date / Time**
- **Details (described below)**

While some events (i.e. water bird nesting) may be observed during regular seasonal monitoring, other events (i.e. wetland drying) may occur between monitoring occasions and others (i.e. burning, cattle introduction), may present a reason to conduct a specific event based monitoring of site conditions i.e. monitoring conducted at the time of the event. Key events at a pastoral property wetland that are worth recording in terms of being a potential condition ‘driver’ or indicator include:

**Fill event.**
For a seasonal wetland this would be the rainfall or flow event that was considered to refill the wetland following the dry season. Details recorded in addition to date and time should include the precedent rainfall (mm / days) and whether the run-in was local run off or part of a larger overland flow and whether there was more than one flow event involved in filling the wetland.

**Flood event.**
In the case of wetlands hosted within active stream channels, flood events involving inundating flows can significantly affect the subsequent condition of the wetland. Useful details to record where possible include precedent rainfall, recorded flood heights (at associated river gauging stations or fixed landmarks) and flow / height duration.

**Dry out.**
In seasonal or ephemeral wetlands the duration of the water body is a key determinant of productivity and potentially an indicator of condition in relation to impacts driven by catchment water use patterns or climate change. The key record for this event is the date as near as possible that the wetland dried out. Collecting additional records of water depth at a fixed point (where possible) during each monitoring occasion would also be valuable for assessing water level recession rates in relation to wet season conditions and filling events.

**Saltwater Intrusion**
Many coastal Gulf wetlands are subject to tidal influence at some period of the year. The impacts of sea level rise is also being realised by further incursions inland than historically of sea water. Pertinent details to record concerning saltwater intrusion include: date, time, evidence, associated tide height.

Cattle on / off
On many pastoral properties in northern Australia some level of rotational spelling of paddocks from grazing is practiced. The frequency, timing and duration of spelling is recognised to be a key determinant of pasture and wetland condition. Where monitored wetlands lie within paddocks or fenced off areas that result in the seasonally spelling of the wetland from grazing, the introduction and removal of grazing from the wetland represents an important event that should be recorded. Pertinent details include date, no. head and class of cattle.

Fire.
In the seasonally dry tropics fire is a major ecological force that shapes the condition of ecosystems including wetlands. If possible the date, time, extent, estimated intensity (hot – cool) and origin of fires that encroach onto a monitored wetland are valuable information to be recorded where possible.

Fauna / Flora / Weeds / Ferals.
One of the more conspicuous and most readily monitored components of wetland biota is birdlife. A complimentary waterbird and shorebird monitoring kit that can be used in conjunction with the SWAMP is attached separately. At this early stage of development of the SWAMP several other areas of potential fauna / flora observational records are suggested. Some of these features will be captured by the photo point monitoring and may not need to be separately described in text.

- Germination, flowering &/or seeding of conspicuous flora including weed species.
- Incidental observations of fauna, including conspicuously abundant species, feeding and reproduction associated behaviours i.e. mating, nesting, and recruitment of young.
- Feral animal abundance and disturbance / damage – numbers sited, extent and nature of disturbance / damage.

‘Other’.
At this developmental stage of the SWAMP it is not possible to envisage all of the wetland condition events that may be able to be observed by regular monitoring of a wetland site. Any event that appears noteworthy probably is. Possible other events important to record could include fish kills, algal blooms major storms etc.
Monitoring Occasion Record Taking Check List

**Season** (circle): Wet (Jan-Mar), Early dry (Apl – Jun), Mid dry (July – Sep), Late dry (Oct-Dec)

**Wetland Site Name:** ________________________________

**GPS Co-ordinates:** Latitude_______________________ Longitude________________________

**Date:** ____________________ **Time:** ____________________

**Weather Conditions** (circle all relevant): clear, overcast, rain, storms, humid, dry, hot, cool, cold, windy, calm.

**Water Conditions** (circle all relevant): Fresh, Brackish, Salt, Clear, Dark, Turbid, Dry.

**Point A** (four photos forward, left, right, down)

Image File Numbers __________ to ____________ (insert after downloading to PC)

**Point B** (four photos forward, left, right, down)

Image File Numbers __________ to ____________ (insert after downloading to PC)

**Point C** (four photos forward, left, right, down)

Image File Numbers __________ to ____________ (insert after downloading to PC)

**Point D** (four photos forward, left, right, down)

Image File Numbers __________ to ____________ (insert after downloading to PC)

**Events Register** (see above for details to record). Any of the following where appropriate: Fill, Flood, Dry, Saltwater, Grazing, Fire, Flora / Fauna / Weeds / Ferals

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COUNTING SHOREBIRDS AND WATERBIRDS ON YOUR PROPERTY

There are a number of simple steps to follow if you want to start counting shorebirds and waterbirds on wetlands. This sheet is designed to give these steps, with sufficient detail for you to be able to start undertaking counts of shorebirds and waterbirds on your property.

Determine the wetlands on your property with large (>100) populations of shorebirds or waterbirds.
Include dams, waterholes or lagoons, and seasonally flooded grasslands

Visit wetlands and determine how to gain access to vantage points where you can observe the birds.
This may mean walking or driving around the wetland until you get to a point where it is easiest to see the largest section of the wetland.

In larger wetlands, no single vantage point will provide visibility to the entire wetland. In these cases, counts from more than one vantage point may be required.

Gather the material and equipment you need to count the birds
This will include:

- Shorebird and waterbird ID sheet
- Folder with count forms
- Global Positioning System (GPS)
- Pencil (or pen) for recording the counts and eraser to fix any mistakes
- If possible, also take binoculars and/or a telescope

Visit the wetland to count shorebirds and waterbirds

- Record on the count sheet the name of the wetland, the date and start time.
- Take a GPS fix from your vantage point and record that on the sheet.
- Mark the habitat code for the wetland with the codes from the tables over the page.
- If this is the first count you have made of the birds in this wetland, draw a mud map on the bottom of page one of the count sheet.

Count the different species of shorebird and waterbirds
Try and keep sufficiently far from the birds that they do not get initially disturbed (usually > 75 m). Try moving closer if the birds appear unconcerned. This will allow you to see better and assess if you have missed any small or shy species.

Record the total numbers of each species or species-group on the appropriate row on the count sheet. If all birds cannot be counted, try to estimate the total rather than put a range of values. This should be done carefully and to the best level of accuracy that is possible.

Move along the wetland edge, if possible, to see if any birds have been missed or to count a new group that were in the distance.

When you have counted birds in the accessible parts of the wetland or recorded all birds, then record the finish time

File your count sheets for your records and/or make copies for NRM or shorebird study groups such as the Qld Wader Study Group or Australasian Wader Studies Group.
Habitat Codes

Habitat codes are used to classify each roost site. For example, an inland flooded swamp with mucky margins would have a 3 letter habitat code of IFM, whereas, a coastal non-tidal freshwater lagoon would have a code like NLFM. If you think other characteristics would help separate a wetland from other types of wetland on your property, then additional letters can be added. There is no correct combination for any particular wetland.

<table>
<thead>
<tr>
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<tr>
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<td>T</td>
</tr>
<tr>
<td>Coastal non-tidal</td>
<td>N</td>
</tr>
<tr>
<td>Coastal open water</td>
<td>O</td>
</tr>
<tr>
<td>Coastal bay, inlet or estuary</td>
<td>E</td>
</tr>
<tr>
<td>Coastal lake, swamp or lagoon</td>
<td>L</td>
</tr>
<tr>
<td>Inland (&gt; 10 km from sea or estuary)</td>
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Water definition

<table>
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Substrate

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<td>M</td>
</tr>
<tr>
<td>Rock</td>
<td>R</td>
</tr>
<tr>
<td>Other (specify)</td>
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</tbody>
</table>

Additional Notes

Count frequency

Ideally, each wetland should be counted once per season (every three months) and where extra counts are possible, these should be done in March-April and September-October when the migrant shorebirds are likely to be using your wetlands when they arrive from Siberia.

Types of wetlands that are important

All types of wetlands are of equal importance for monitoring, including temporary wetlands that only fill after the monsoon or local, heavy rain storms. If large numbers of birds are using the wetland then it’s important.

Count Forms

Count forms similar to those enclosed can found at the following website

http://www.wetlands.org/WWC/docs/census_proc.htm

Useful addresses

Ms Linda Cross
Qld Wader Study Group Count Coordinator
40 Thompson Rd
Bellmere, Caboolture Qld 4510.
Email: xenus@big.net.au

Dr David Milton
Chair Qld Wader Study Group
Ph: (07) 3390 2179
Email: piita@qil.com.au

Australasian Wader Studies Group:


The project is a cooperative effort between Qld Wader Study Group, WWF, NHT (National Shorebirds Project) and Southern Gulf Catchments Ltd.
# Shorebirds and Waterbirds Count Sheet

<table>
<thead>
<tr>
<th>Shorebird Species</th>
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<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Black-fronted plover</td>
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<td></td>
</tr>
<tr>
<td>Black-tailed godwit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-winged stilt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bush thick-knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common greenshank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little curlew</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marsh sandpiper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masked lapwing</td>
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</tr>
<tr>
<td>Australian pratincole</td>
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<tr>
<td>Red-kneed dotterel</td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Red-necked stint</td>
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<tr>
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**Mud Map and Notes**
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<td></td>
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<tr>
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<tr>
<td>Pied heron</td>
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<td></td>
</tr>
<tr>
<td>Plumed whistling-duck</td>
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<td></td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>Radjah she/duck</td>
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<tr>
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<td>Grey teal</td>
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</tr>
<tr>
<td>Australasian grebe</td>
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</table>

The project is a cooperative effort between Old Wader Study Group, WWF, NHT (National Shorebirds Project) and Southern Gulf Catchments Ltd.
**Common Greenshank**

Breeds on wide open tundra and upland grasslands from Scotland, through northern Europe, across to eastern Russia. Non-breeding birds occur throughout Africa, the Middle East, southern and SE Asia to Australia and New Zealand. The population estimate for the East Asian-Australasian Flyway (EAAF) is 55,000 birds. Of these its estimated 18,000 occur throughout Australia on any suitable freshwater wetland or coastal mudflats. The other important countries during the non-breeding season are China (20,000) and Thailand (4,000). In Australia, Common greenshanks tends to be more solitary than other shorebirds and are usually seen singly or in small groups of up to 10 birds.
Sharp-tailed Sandpiper

One of the most common smaller shorebirds that are believed to regularly use the freshwater wetlands in the southern Gulf catchments. Sharp-tailed sandpipers are most common in the southern Gulf during northward migration and less so during southward migration or the summer non-breeding season (November – February). They breed in the far northern Siberian Arctic in north-eastern Russia where they nest on hummocks in peat bogs.

They only occur in the East Asian-Australasian Flyway, with over 140,000 (88%) of the estimated 160,000 Sharp-tailed sandpipers spending their non-breeding season in Australia. The only other countries where substantial numbers occur are China, Indonesia and Papua New Guinea.

During the non-breeding season, they form large flocks that often break into smaller groups during feeding.

Sharp-tailed sandpipers have flexible habitat requirements in Australia favouring grassy margins of shallow freshwater wetlands and flooded paddocks as well as estuarine mudflats. They also tend to roost amongst taller grass clumps around the edges of their wetland feeding areas.

Little Curlew

Almost the entire world population of Little curlew (180,000) spend their non-breeding season in northern Australia. Unlike many other migratory shorebird species, they spend most of their time away from wetlands on dry open grasslands. Recent studies in the southern Gulf region have found up to 25,000 Little curlew use sub-coastal grasslands during the wet season. This preference for open grassland habitats in Australia contrasts with their breeding habitat. They prefer to nest in clearings in sub-arctic forests in NE Russia. Once they leave the breeding grounds, they tend to move into rice fields and grasslands in inland China on their way south to Australia.

Map showing regular breeding locations and non-breeding rest zones for the Little curlew
Red-necked Stint

Red-necked stints are the most numerous shorebird species in Australia during our summer. They are also the smallest species of shorebird to regularly migrate to Australia. Many make spectacular migrations of up to 12,000 km between southern Australia and their northeastern Siberian breeding grounds. In Australia, a 22 g Red-necked stint can put on almost 90% of its weight as fat (to 41 g) in the month leading up to northward migration. This additional fat provides the fuel that enables them to fly such long distances. On the breeding grounds, it nests in the coastal tundra of northeastern Siberia and adjacent Alaska. From there, over 250,000 of the estimated 315,000 Red-necked stint find their way to Australia. Other countries where Red-necked stints occur in significant numbers are China (20,000), Philippines (10,000) and Malaysia (6,000). In most countries they feed in large flocks in coastal mudflats. Smaller numbers will feed on shallow coastal freshwater wetlands with exposed mud.

Marsh Sandpiper

Breeds on open river flats and margins of swamps from Bulgaria to central Russia. Spends the non-breeding season on freshwater wetlands in southern Africa, southern Asia and SE Asia across to Australia. Australia only has about 9,000 of the estimated 90,000 in our Flyway. Most occur in China (20,000), Indonesia (10,000), Malaysia (10,000) and Thailand (5,000). In Australia, Marsh sandpipers tend to be solitary or in small groups often associated with Common greenshanks. They prefer shallow freshwater swamps, flooded paddocks or bore drains where they feed on larvae of aquatic insects and small crustaceans.
**Australian Pratincole**

As their name suggests, Australian pratincole occur almost exclusively in Australia during our summer. Unlike the other migratory shorebird species, Australian pratincoles breed on open bare grounds in northern Australia in October-November. In March most birds fly north to Papua New Guinea and eastern Indonesia for the winter. Like the Little curlew, Australian pratincoles avoid wetlands and prefer open short grassland, claypans and other dry habitats. There are no estimates of the numbers of Australian pratincole in the southern Gulf region, although the entire Australian population is estimated to be about 60,000. The birds are so dispersed in Australia that the population estimate is based on counts of birds on southward migration in west Timor.

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**Black-tailed Godwit**

Breeds in marshy areas and on wet farmland right across Europe, from Iceland all the way to eastern Russia. They spend the non-breeding season in the Mediterranean, central Africa, India, SE Asia and Australia. An estimated 160,000 live in the East Asian-Australasian Flyway, with about 70,000 in Australia and another 62,000 in Indonesia. The southern Gulf of Carpentaria is the main non-breeding area in Australia and has about 25,000 birds. Black-tailed godwit are rare south of Brisbane on the east coast and Eighty Mile Beach in the west. Prefers muddy coastal habitats, but many also occur on shallow, seasonal wetlands and lakes.
Oriental Pratincole

The Oriental pratincole is another bird of the dry, open plains and claypans in northern Australia. As its name suggests, its breeding grounds are in the Orient, opposite to the Australian pratincole. In that region most birds breed on high, dry grasslands in southern Russia, Mongolia, western China and northern Myanmar. In most years they also breed in southeast Asian countries like Cambodia, Malaysia, Thailand, Vietnam and Taiwan. From the breeding grounds birds migrate to Australia by island hopping along the Indonesian chain of islands. Until 2004, the world population was estimated to be 75,000 birds and almost all spent their non-breeding season in northern Australia. Then in February 2004 some shorebird enthusiasts counted an incredible 2,880,000 at Eighty Mile Beach, south of Broome in north-western Australia. Somehow, most of these birds remain undetected in most years and only became obvious when they congregated in huge flocks on Eighty Mile Beach. This discovery shows how little we know about many species of shorebird in Australia.


Map showing regular breeding locations and non-breeding rest zones for the Oriental pratincole

The project is a cooperative effort between Qld Wader Study Group, WWF, NHT (National Shorebirds Project) and Southern Gulf Catchments Ltd.

Text by David Milton, QLD Wader Study Group. Published by WWF-Australia, PO Box 710, Spring Hill, QLD 4004. May 2005
Appendix 5. Field Images

Coastal Shore Bird Habitats

Photo 1. The expansive complex of salt pans, intertidal flats, tidal channels, mangrove forests and beach ridges that forms the coastal margin of the Southern Gulf wetland aggregation is the primary habitat utilised by migratory shorebirds during the summer wet season.

Photo 2. Gore point at the mouth of Disaster Inlet is a regionally significant roosting site for shore birds hosting up to >5000 individuals comprised of 14 species. Deposition of alluvial sediment is one of the most important catchment processes in terms of the formation of key shore bird habitat.

Photo 3. Exposed intertidal river banks such as these on the lower Leichhardt River are an important feeding habitat for up to 16 species of shore birds.

Photo 4. Coastal intertidal flats are important feeding habitat for the greatest number of migratory shore birds species. Exposed sand bars such as this one east of the Leichhardt River mouth are important flock roosting areas for shore birds.
Identifying Existing Wetland Management Practices and Needs on Southern Gulf Pastoral Properties

Appendix 4 Shorebird and Waterbird Monitoring Kit July 2005

Photo 5. Seasonal freshwater swamps are important habitat for up to 13 species of Shore Birds. The early drying of seasonal swamps in the southern Gulf due to a failed wet season contrasts with the retention of water in swamps that had received better wet season rains in the western Gulf (right).

Photo 6. The seasonal variability in water retention within ephemeral swamps due to patchy wet season rainfall highlights the importance of a broad regional approach encompassing the entire coastal wetland complex for the management of biodiversity values.

Photo 7. The extensive network of cattle pads crossing the marine plains indicate that this habitat does receive significant grazing pressure.

Photo 8. Tidally replenished salt flat pools are an important habitat for up to 8 species of both resident and migratory shore birds. These types of habitat have been the focus of aquaculture development in eastern Australia.

Photo 9. During the summer wet season many of the salt pans backing the coastal tidal channels become filled with fresh water forming highly productive shore bird feeding habitat.

Photo 10. This beach lying between the Leichhardt River mouth and the mouth of Disaster Inlet is the most extensive occurrence of this habitat type in the Southern Gulf. Prevention of human disturbance of beaches is critical to the conservation of migratory and resident shore birds.
Cattle Grazing and Trampling Impacts

Photo 1. High grazing and trampling pressure on fringing and emergent vegetation was apparent at many of the freshwater wetlands visited in the Southern Gulf.

Photo 2. At the most heavily grazing impacted sites ground cover and fringing vegetation was completely absent and water turbidity high.

Photo 3. Cattle are not averse to wading into deeper water wetland habitats to access aquatic grasses and macrophyte beds.

Photo 4. At some sites the growth of algae appeared to be correlated with the disturbance of nutrient rich bottom sediments by cattle pugging.
Photo 5. Fringing macrophyte communities at some sites appeared to have some inherent resilience to grazing pressure but there is limited baseline information on which to make such assessments. Stock exclusion plots could provide useful insights.

Photo 6. The pasture resource value of many wetlands limit the prospect for extensive exclusion of cattle grazing and sustainable grazing regimes developed in conjunction with pastoralists provide good management prospects.

Photo 7. Exposed root balls of riparian Gutta-percha trees adjoining this channel hosted wetland indicate the volume of soil loss that has occurred in decadal time scales at this sub-soil exposed erosion scalded site.

Photo 8. Exposed root balls of riparian red gums at the same site as left, suggest that the severe bank disturbance caused by watering cattle may be responsible for accelerated bank erosion at this site.

Photo 9. An example of a site heavily impacted by watering cattle and Parkinsonia thickets (back ground). No ground cover remains and aquatic macrophytes have been reduced to a vestigial stand in the deepest margin of the water body.

Photo 10. A good illustration of the impacts of watering cattle at an isolated freshwater wetland in the coastal Gulf. All emergent vegetation has been lost and a bare ground scald has formed adjoining the wetland, sheet erosion has initiated and water quality is highly turbid due to disturbance and sediment loading.
De-stocked Sites

Photo 11. The level of ground cover, rank grasses and diverse emergent vegetation community distinguishes this ungrazed site from most of the visited wetlands that were exposed to cattle grazing.

Photo 12. A broad band of Bilkuru sedge an important waterfowl habitat. Where encountered this community was often observed to be heavily impacted by pigs and cattle at other sites visited in the Southern Gulf.

Photo 13. The good water clarity apparent at this ungrazed site could possibly be related to high levels of grass cover in the contributing catchment and a lack of cattle pugging.

Photo 14. Sesbania pea thickets such as these were seldom observed at cattle grazed sites. They are a recognised important moulting habitat for waterfowl.

Photo 15. A wet meadow community covering the exposed bottom of a seasonal wetland on a de-stocked property. This type of habitat setting represents a productive feeding areas and was seldom encountered on grazed properties.

Photo 16. Feral horse pads on a property de-stocked of cattle highlight that it is not only domestic animals that contribute grazing and trampling pressure on Southern Gulf wetlands.
Water Quality Impacts

Photo 17. This drainage channel hosted numerous wetlands with variable water quality along its length. Localised distinctions in catchment condition and the extent of vegetated margins appeared to be responsible for contrasting water quality ranging from clear black water (above) to turbid (right).

Photo 18. Along this length of the channel erosion scalds cutting into sodic sub soils appeared responsible for generating increased turbidity levels in local run off.

Photo 19. Cattle pads running down the banks of wetlands provide a conduit for eroded soil and bank cutting flows.

Photo 20. The high water quality in this wetland contrasted significantly with that in nearby sites and may have been partially due to the exclusion of grazing that had occurred to create a rubber vine controlling fire. fuel load
Photo 21. This photo and the following three were all taken on the same drainage system and highlight the relationship of water quality to bank and catchment condition and cattle management practices. This severe erosion associated with a cattle access pad was in the lower part of the drainage.

Photo 22. Cattle disturbance of the edge habitat and a lack of macrophytes in the turbid water conditions were observed in the lower reaches.

Photo 23. Further upstream pre-existing riparian exclusion fencing had fallen into disrepair but site water quality condition and macrophyte growth was better than in the lower catchment.

Photo 24. The head of the drainage is used as a station water supply and cattle are excluded. Good water quality and fringing macrophyte diversity contrasts with the lower cattle impacted reaches.

Photo 25. Severe gully erosion cutting into sodic soil banks adjoining a coastal Gulf drainage. The extent to which this represents a natural process or one accelerated by cattle grazing and trampling impacts is a worthy research area. The suspension of relatively young tree root balls within the eroded surface suggests the processes has been accelerated.

Photo 26. The cutting and filling of drainage depressions by erosion processes following cattle pads highlights the potential vulnerability of shallow wetland basins to accelerated soil erosion in the coastal Gulf.
Feral Animals

Photo 27. Pig disturbance of native sedge edge habitat within coastal extended swale swamp on a ‘de-stocked’ coastal property.

Photo 28. Feral horse droppings and grazing impacts at inland ephemeral swamp on property ‘de-stocked’ of cattle.

Photo 29. Horse grazing on Bulkuru sedge within coastal extended swale swamp on a ‘de-stocked’ coastal property.

Photo 30. Pig destruction of bulkuru sedge stand established on margins of impounded wetland.
Photo 31. Cane toad abundances on many southern Gulf coastal wetlands remain high since their invasion ~22 years ago, the consequences of which remain largely undocumented.

Weeds

Photo 33. Rubber vine infestation of young palm in riparian zone of large open lagoon.

Photo 32. Cultural values on some properties de-stocked of cattle are impacted by large feral horse and pig populations.

Photo 34. Diverse community of emergent and aquatic bed macrophytes, good fish habitat on margins of large open lagoon. These types of communities are vulnerable to exotic ponded pasture infestation.
Photo 35. Exotic Yellow Oleander, Poinciana, and Custard apple horticulture escapees from station grounds invading wetland riparian community. Rajah shelduck were observed at this site.

Photo 36. Hyptis, Mint weed, aka Stinking Rodger is a weed often associated with sites with a history of disturbance by grazing pressure.

Photo 37. Part of ~50 ha Parkinsonia thicket on the edge of a seasonal freshwater swamp in the coastal southern Gulf.

Photo 38. Parkinsonia infestation on wetted margins of a seasonal freshwater swamp in the coastal southern Gulf. Reduction in openness in edge vegetation can significantly impact bird habitat values.


Photo 40. Rubber vine tower dominating riparian coolabahs on coastal floodplain ox-bow lagoon of the lower Flinders basin.
Built Infrastructure

Photo 41. Many dams create high value constructed wetland habitat. Values associated with these habitats would be degraded by widespread exotic pasture invasion.

Photo 42. The exposed banks and margins of this constructed dam site were host to large numbers of birds including a flock of several hundred speckled duck one of Australia’s rarest waterfowls.

Photo 43. The creation of perennial water points adjacent to natural ephemeral wetlands has implications for the grazing regime the wetland becomes exposed to.

Photo 44. Earthworks including bunds and excavation to extend the duration of seasonal wetlands are a common physical disturbance of pastoral property wetlands which can have positive and negative impacts.

Photo 45. The impacts of infrastructure including watering point density and location and fencing and its configuration on seasonal wetland biodiversity is a worthy area for research.

Photo 46. The excavated turkey nest dam (left) lies adjacent to boundary fence that transects Lake Marrrika (photographed in 2003/04 wet above). This site seasonally hosts large populations of shorebirds and waterfowl. Swans have nested on the mound (centre) created by the turkey nest dam excavation.
Photo 47. New riparian recruitment emerges behind a row of dead inundated trees behind a large private impoundment. This dead timber now provides roosting sites for many species of water bird and the overall site has high habitat values.

Photo 48. This weir on the Nicholson River has poor fish passage design and impacts the upstream fish community through a catchment area that extends to the NT boarder.

Photo 49. This private dam constructed initially in the 1940s was raised in the 1980s. A large high value artificial wetland has been created upstream but fish passage impacts remain.

Photo 50. Innocuous road crossing on the lower Flinders Basin (Bynoe) would present a fish passage barrier under a relatively significant proportion of time of flow events.

Fire Regime

Photo 51. Dead fire damaged (or possibly senesced) *Corypha* palm on bank of rubber vine infested large open lagoon. Poor levels of recruitment of this palm were observed at this rubber vine dominated and regularly burnt site.

Photo 52. On some Traditional Owned lands de-stocked of cattle, extensive use of fire (right) in areas with naturally high fuel loads provides effective control on recruiting trees and understorey wattles (left).
Other Issues

Photo 53. *Hymenachne amplexicaulis* a weed of national significance is used in high value ponded pasture developments in the coastal southern Gulf. Under a regime of sustained grazing pressure and seasonal hydrology attempts to establish naturalised populations of this grass have failed.

Photo 54. Dam and irrigation infrastructure associated with several hundred hectare ponded pasture development. Such sites provide a ready source of seed that can be transmitted by birds. This may pose risks to areas managed for conservation with reduced grazing pressure.

Photo 55. At the marine coastal margin of the Gulf dead salt affected terrestrial vegetation could herald creeping sea level rise.

Photo 56. In recent cyclonic events storm surges of seawater have purged previously freshwater swale swamps of the southern Gulf coastline.
Potential Management Proposal Sites

Photo 57. The land holder at this site has expressed interest in pursuing fish passage rectification works on his private weir and nature refuge designation for wetlands on the property including the wetland upstream of this impounded Mornington Inlet Basin drainage. (right).

Photo 58. Wetland upstream of impounded Mornington Inlet Basin drainage. The landholder has suggested nature refuge designation as a possible management option for the site.

Photo 59. Large open lagoon in the eastern margin of the southern Gulf. These wetlands have apparent affinity with Cape York systems and lie at the margin of the Mitchell Gilbert Fans Province. Traditional Owners manage this property as a commercial pastoral operation but have also expressed keen interest in improving management of wetland ‘country’ for cultural and biodiversity values.

Photo 60. Rubber vine tower dominating riparian community including Corypha palm on large open lagoon in the eastern margin of the southern Gulf.

Photo 61. Recruiting Corypha palm on large open lagoon in the eastern margin of the southern Gulf. This was the only observed recruit on the margin of this wetland that had numerous adult and senesced specimens.

Photo 62. Land managers of the property containing Rocky Lake (photographed in 2003/04 wet above) have indicated a willingness to consider extending wet season spelling by exclusion fencing.
Photo 63. Wild Horse Creek bordering the Marless Lagoon Wetland Aggregation was nominated by the landholder as a worthy riparian fencing project site. Several shorebirds were seen on the exposed margins of this system.

Photo 64. The upstream reaches of Wild Horse Creek held a large population of freshwater crocodiles and had high habitat value riparian vegetation communities.

Photo 65. Cockatoo Swamp an ephemeral swamp that lies within the Marless Wetland Aggregation was suggested as a potential site for fencing and grazing pressure management by the landholder.

Photo 66. Re-establishment of riparian fencing for cultural and biodiversity value management was identified as a management aspiration by the Traditionally Owners on this pastoral property.