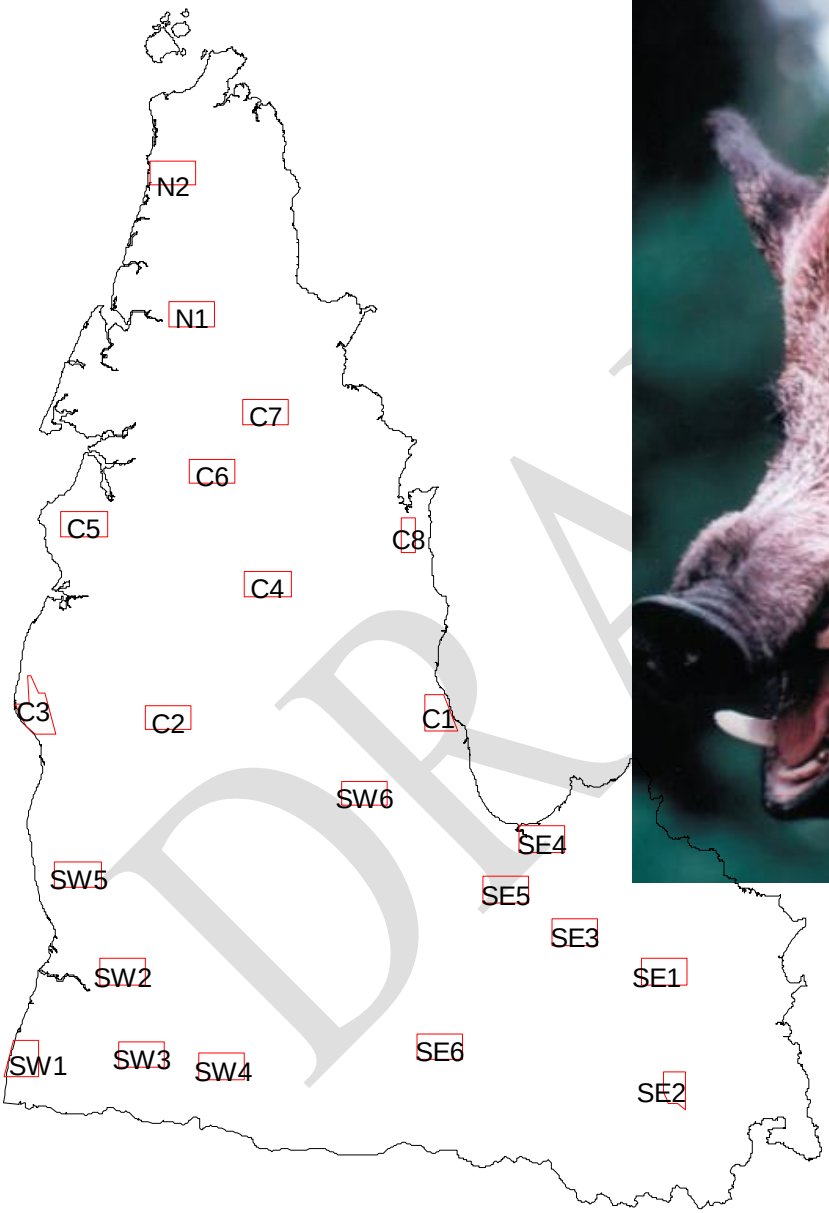
# Cape York Peninsula Feral Pig Management Plan 2006-2009






Cape York Weeds and Feral Animals Program

1919 Cookshire Endeavour

Natural Heritage Trust

*Helping Communities Helping Australia*

An Australian Government Initiative

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This publication will be made available online at
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Front cover picture: Feral pig (Photo from Rainforest CRC, 2003) and aerial feral pig survey sites on CYP (Map from CYWAFAP, 2005)

# ACRONYMS

| | |
|---|---|
| AQIS | Australian Quarantine and Inspection Service |
| BRS | Bureau of Rural Sciences |
| CRC's | Cooperative Research Centres |
| CSC | Cook Shire Council |
| CYP | Cape York Peninsula |
| CYWAFAP | Cape York Weeds and Feral Animals Program |
| DEH | Department of the Environment and Heritage |
| DNR | Department of Natural Resources |
| DNRM | Department of Natural Resources and Mines |
| DNRMW | Department of Natural Resources, Mines and Water |
| DPI | Department of Primary Industries |
| EPA | Environmental Protection Agency |
| EPBC | Environment Protection and Biodiversity Conservation Act |
| GIS | Geographical Information Systems |
| JCU | James Cook University |
| LG | Local Government |
| LGAQ | Local Government Association of Queensland |
| NAQS | Northern Australia Quarantine Strategy |
| NRME | Queensland Natural Resources Mines and Energy |
| NRMW | Natural Resources, Mines and Water |
| Pers. comm. | Personal Communication |
| PMP | Pest Management Plans |
| QPWS | Queensland Parks and Wildlife Service |
| RSPCA | Royal Society for the Prevention of Cruelty to Animals |
| RTO's | Registered Training Authorities |
| UQ | University of Queensland |

## FIGURES



## APPENDICES

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# EXECUTIVE SUMMARY

The Cape York Peninsula (CYP) Pest Management Strategy (CYWAFAP, 2004) provides a planning framework for coordinated pest management between research bodies, agencies, communities, industries, individuals and the government. From this plan stems the CYP Feral Pig Management Plan that focuses on one of the most prolific, widespread and damaging pest animals in Queensland – the feral pig.

This plan summarises the impacts, control methods, commercial harvesting prospects, research projects and management priorities for feral pigs on CYP.

The aim of the Cape York Weeds and Feral Animals Program (CYWAFAP) feral pig program is to:

> *Reduce the impacts of feral pigs, over all land tenures, on the environmental, health and economic values of Cape York Peninsula using sustainable best practice management methods*

The CYP Feral Pig Management Plan shares the vision of the Queensland Feral Pig Strategy (2004) of adopting the best practice management options to minimise the impact of feral pigs on the environment, economy and health of Queensland. The plan recognises the principles of pest management as stated in the *Land Protection (Pest and Stock Route Management) Act 2002* (Appendix A) and supports the objectives of the National Threat Abatement Plan for the Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (DEH, 2005).

This plan provides a focus on management and lists recommended actions for managing feral pigs on CYP over the next four years.

# INTRODUCTION

Cape York Peninsula has been described as feral pig (*Sus scrofa*) heaven. It has a total land area of 209 000 km$^2$, a diverse range of ecosystems, plenty of feed, high rainfall, sparse population and is inaccessible for some time of the year. CYP has two seasons: the Dry extending approximately from April to October, and the Wet from November to March. The coastal areas of CYP have some of the highest densities of feral pigs in Australia (Figure 1). The greatest densities of feral pig populations in Cape York have been identified by CYWAFAP aerial surveys to be on the marine plains south of Aurukun, Lakefield National Park (Mitchell, 2004) and Heathlands National Park.

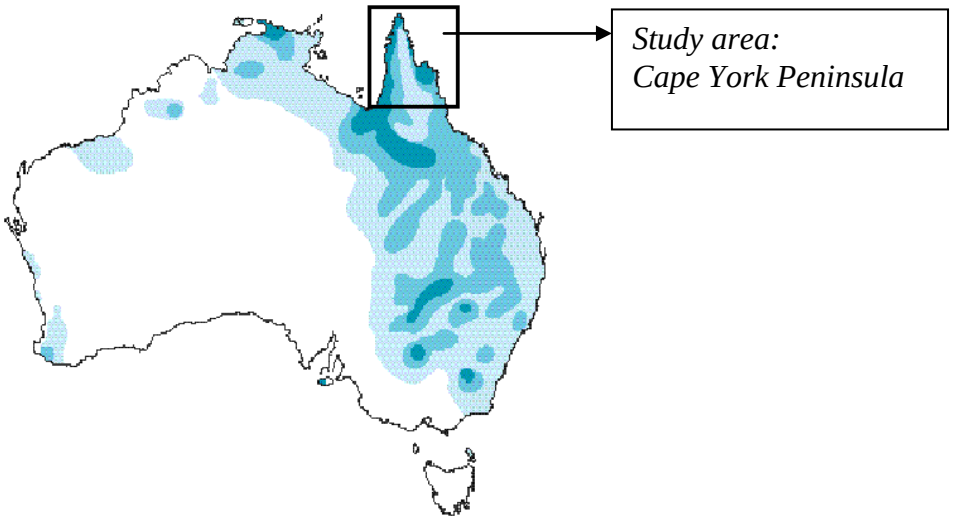


**Figure 1.** Distribution of feral pigs in Australia. The darkest areas = highest density, lightest areas = lowest density (Choquenot *et. al*., 1996). Reproduced with permission from the Bureau of Resource Sciences.

Feral pigs have an enormous, though largely unquantified, impact on the environmental, health, and economic values of CYP (CYWAFAP, 2002). They damage agricultural areas and habitat, and compete with stock and native animals for food. Feral pigs are omnivorous, opportunistic feeders that prey on native species such as turtles, birds and small ground dwelling mammals (Appendix B). Pigs are vectors for endemic diseases such as leptospirosis and are a real threat for spreading exotic diseases such as foot and mouth to livestock and Japanese encephalitis to humans (Jim Mitchell, pers.comm., 2006).

Feral pigs are prolific breeders. A 1996 CYPLUS report estimated CYP's feral pig population at 2.5 million. Herds of up to 400 have been recorded on CYP (NRMW, 2006). Is this referring to the Abrahams reference.

In a recent survey conducted for Marine & Coastal NRM Action Plan, the majority of responders on Cape York listed feral pigs as a very high concern for their communities (Howley *et al.*, 2006 unpublished). Feral pigs were considered to be the greatest threat to water quality, aquatic habitat, and turtle populations on CYP.

The Cook Shire Local Government Area Pest Management Plan prioritised feral pigs as the most strategic pest for protecting conservation, grazing and horticultural values in CYP (Cook Shire Council, 2002).

The management of feral pigs has led to controversy over the:

1. best methods for control;
2. humane methods of control;
3. waste of carcasses; and
4. feasibility of complete eradication.

Feral pigs are a food source for many indigenous communities and are an economic resource in the form of hunting from carcass sales and paying hunters. Despite the known impacts, some communities do not want to see this resource wasted.

***Legislative status***

Feral pigs are declared Class 2 pests under the *Land Protection (Pest and Stock Route Management) Act 2002*. Declared animals are targeted for control because they have, or could have, serious, economic, environmental or health impacts (NRMW, 2006). Declaration imposes legal responsibilities for control by landowners on land under their management, including all landowning state agencies. Large land owning state agencies are also required to develop and implement pest management strategies (NRM, 2004). A local government may serve a notice upon a landholder, requiring control of declared pests (DNRMW, 2006). Feral pigs are also listed as a Threatening process of Endangered Species and Ecological communities (DEH, 2005).

**Figure 2. Feral pig (*Sus scrofa*). Photo CYWAFAP, 2003.**

***Scope of this plan***

This plan forms part of the regional planning phase for managing a pest species (Figure 3). The National Threat Abatement Plan (DEH, 2005) encourages the use of best practice techniques particularly in priority areas for the protection of nationally listed threatened species and ecological communities. Pest Management Plans are required to adopt the recommendations made by the National Threat Abatement Plan.

In 2003 the Queensland Feral Pig Strategy recommended that guidelines should be developed for pest management plans for local government, catchment groups and properties to aid in consistency. These guidelines have since been prepared by the CYWAFAP and a template with guidelines for pest management plans is available on the CYWAFAP website (http://www.cyppests.com/home.html). CYWAFAP also assists in the preparation of pest management plans.

**Figure 3. The Context of the Cape York Feral Pig Management Plan to planning and research initiatives at other levels (*Adapted from the Cape York Pest Management Strategy 2004-2010*)**

| | SCOPE | | | |
|---|---|---|---|---|
| **SCALE** | **Resource Management** | **Research** | **Pest Management** | **Pest Species** |
| **National** | • National Strategy for the Conservation of Australia's Biodiversity<br>• National Guidelines and Principles for Rangeland Management;<br>• Northern Australia Quarantine Strategy (NAQS) | • Tropical Savannas CRC<br>• Pest Animal CRC<br>• Weed Management CRC<br>• CSIRO | • Model Code of Practice for the Welfare of Animals – Feral Livestock Animals Destruction or Capture, Handling and Marketing<br>• National Weeds Strategy<br>• Managing Vertebrate Pests – Principles and Strategies | • National Pest Species Threat Abatement Plans<br>• Strategies for Weeds of National Significance (WONS)<br>• Threat Abatement Plan – Feral Pigs |
| **State** | • Queensland Biodiversity and Natural Resource Management Strategy (proposed) | • Charters Towers Research Station | • Control of Exotic Pest Fishes Strategy<br>• State Agency Pest Management Plans Queensland Weeds Strategy<br>• Queensland Pest Animals Strategy | • Problem Crocodile Conservation Plan<br>• Queensland Parthenium Strategy<br>• Pest Status Review Series – Land Protection<br>• Queensland Strategy for wild dogs<br>• Queensland Strategy for feral pigs |
| **Regional/ Catchment** | • Regional Vegetation Management Plans<br>• CYP Natural Heritage Trust Plan<br>• Northern Australian Quarantine Strategy<br>• Catchment Management Plans: Annan-Endeavour; Laura-Normanby, Weipa / Albatross Bay; Bloomfield-Yalangi. | | • ***CYP PEST MANAGEMENT STRATEGY 2003-2010***<br>• ***CYP PEST MANAGEMENT PLAN 2006-2010*** | CYP Feral Pig Management Plan<br>• CYP Salvinia Management Plan (under development)<br>• Code of Practice for Gamba Grass |
| **Local Government** | • Local Government Planning Schemes | | • Aurukun Shire Pest Management Plan.<br>• Cook Shire Council Pest Management Plan<br>• Torres Shire Pest Management Plan<br>• Hope Vale Pest Management Plan<br>• Wujal Wujal Pest management Plan<br>• Seisia Pest Management Plan<br>• Lockhart River Pest management Plan<br>• Pormpuraaw Pest Management Plan<br>• Bamaga Pest Management Plan<br>• Draft Kowanyama Pest Management Plan<br>• Draft Mapoon Pest Management Plan<br>• Draft Napranum Pest Management Plan<br>• Draft New Mapoon Pest Management Plan<br>• Draft Umagico Pest Management Plan<br>• Draft Injinoo Pest Management Plan | • Codes of Practice for Leucaena, Vetiver Grass & Neem Trees (CSC)<br>• Hymenachne Management Plan for Cook Shire (proposed) |
| **Property** | • Property Management Plans | | • Property Pest Management Plans | |

# THE IMPACTS OF FERAL PIGS

Feral pigs impact on the environmental, economic and health values of CYP.
The underlying cause of these problems is the very nature of pigs - wallowing, rooting, digging, tusking trees, and switching food sources are typical of pig behaviour. This behaviour together with large pig herds can result in massive damage especially when resources are scarce. Pigs in large numbers also aid the transmission of disease.

***ENVIRONMENTAL***
CYP has some of the highest densities of feral pigs in Queensland (Figure 4). The greatest densities of feral pigs have been observed along water courses, swamps and marine plains in Lakefield National Park and on the west coast of CYP.

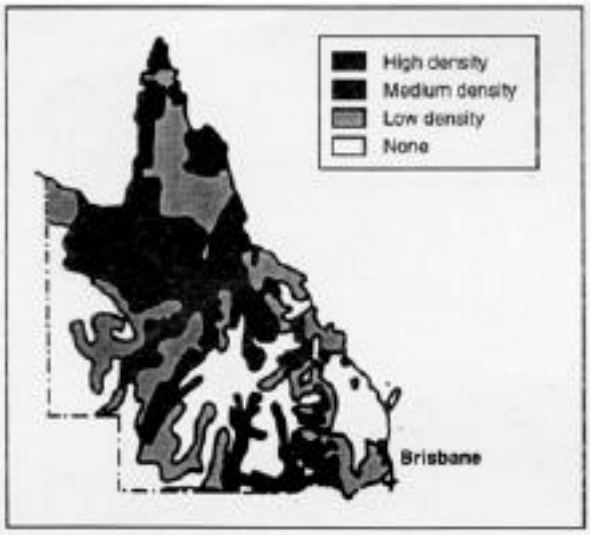


**Figure 4. The distribution of feral pigs in Queensland (DNRME, 2004)**

The main impacts of pigs on the natural environment of CYP are:
1. water quality reduction;
2. habitat destruction;
3. native animal predation;
4. spread of weeds.

***Water quality reduction***
The trampling, wallowing, rooting, digging, defecating and urinating habit of feral pigs in water directly affects water quality.

Pigs also have an indirect impact on water quality, fish populations & biodiversity from wetland destruction. Pig rooting mostly occurs in areas of high moisture such as drainage lines and swampy areas (Hone, 1995; Mitchell, 1993).

Acid sulfate soils underlie large areas of the CYP coastline. These soils are found under low-lying coastal areas like coastal plains, wetlands and mangroves (DEH, 2000) – *the preferred habitat of feral pigs*. After feral pig disturbance the soils are exposed to oxygen and they produce sulfuric acid in large quantities. After rain and particularly following prolonged dry periods, the built up sulfuric acid in these soils is released. This toxic

cocktail flows into surrounding waterways reducing water quality, killing fish and damaging sensitive ecosystems (DEH, 2000).

In riparian areas pigs can destabilise creek and river banks and contribute to erosion and sediment transfer to the Great Barrier Reef (Mitchell and Kanowski, 2003).

***Habitat destruction***

In 1993 Mitchell reported that pig diggings were more prevalent in lowland areas and coastal swamp habitat. Aerial surveys conducted over a three year period by CYWAFAP confirmed that pig density is greater on the marine plains than other vegetation types (Figure 5).

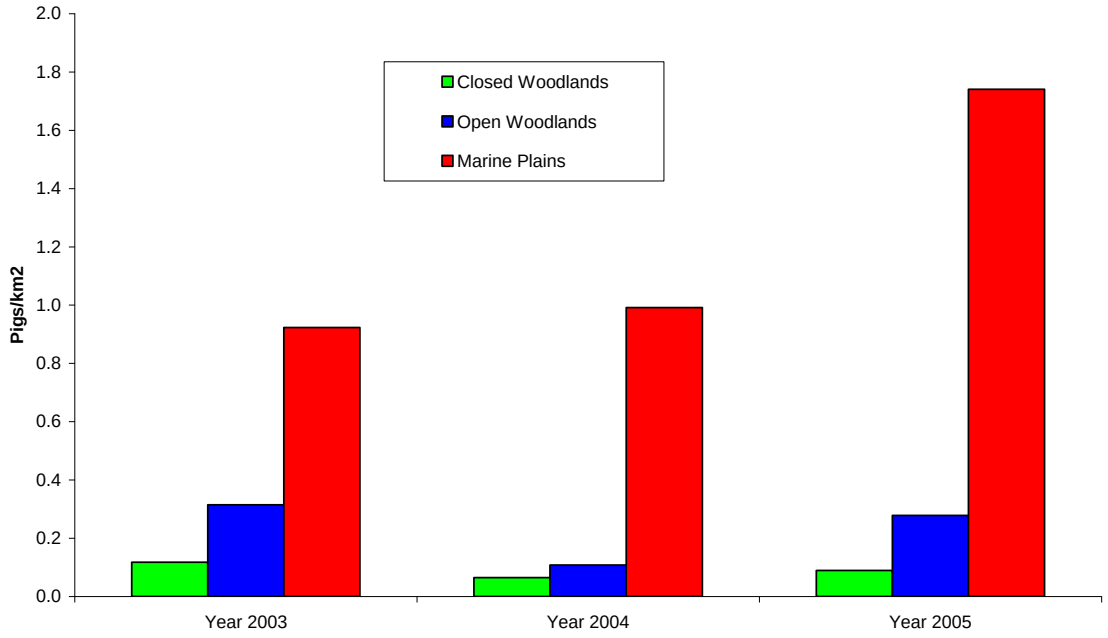


**Figure 5. Pig density in different vegetation types on CYP (Seymour and Molyneaux, 2001), CYWAFAP**

Marine Plains such as those in Lakefield National Park and western CYP are ecotones where fresh and salt water meet. Ecotones (or zones where two ecosystems merge) contain areas of increased diversity and creatures unique to the 'edge effect' that is created. Marine Plains on CYP regionally represent communities of *Eleocharis* sedgeland and tussock grassland communities (Abrahams *et al*, 1995). The salt marsh environment contains suitable habitat for migratory shorebirds and, threatened species such as the Cotton Pygmy Goose (*Nettapus coromandelianus*) and Golden Shouldered Parrot (*Psephotus chrysopyerygius*) (Stanton, 1994).

Pigs are believed to be responsible for the localised extinction of the Lotus Lily on the lower Mitchell floodplain (Herbert *et al.* 1994). They dig up and eat the rhizomatous plants after flood levels recede.


**Figure 6. Feral pig damage, Pormpuraaw. Photo CYWAFAP, 2001**

The northern and eastern shores of CYP form an area of international significance for the Beach Stone-Curlew (*Burhinus giganteus)*. It is the only area in Australia that is recognised as being significant for this species (Watkins 1993). Due to disturbance such as that created by feral pigs this species is now more common on offshore islands than the mainland coast (Driscoll 1994b in Abrahams *et al.*, 1995).

Feral pigs have removed much of the habitat (i.e., long perennial grass beside watercourses) used by the threatened northern or white-bellied subspecies of the Crimson Finch *(Neochmia phaeton evagelinae)* on the western coast of Cape York Peninsula (Abrahams *et al* ,1995).

Pig digging leads to a change in species composition. The expansion of mangroves into former grassy wetland areas is believed to have led to a reduction in fish populations, including Red Emperor (*Lutjanus sebae*) (Damian Langley, pers.comm. in: Howley *et al.*, 2006).

***Native animal predation***

As well as creating disturbance and competing with native species for food, pigs are active predators of many native birds, reptiles, mammals and invertebrates. Feral pigs are known to consume numerous native animals including earthworms, snails, centipedes, insects, frogs, lizards, snakes, freshwater crocodile eggs (*Crocodylus johnstoni*), turtles and their eggs, and small ground-nesting birds and their eggs (Pullar 1950, Tisdell 1984, McIlroy 1990, Mitchell 1993, Roberts *et al*. 1996 in McGaw and Mitchell, 1998).

**Figure 7. Pig predation on turtle nests, west coast of CYP Photo: Ian Bell (QPWS)**

Although feral pigs are know to consume a wide variety of native animals further research is required to determine what effect pig predation is having on an ecosystem or an individual species. In the absence of quantitative data Hart (2003) suggested using a ranking system as a means to evaluate environmental impact.

One of the single biggest concerns of feral pigs on CYP is their impact on marine turtles. Recent studies indicate that feral pigs may be responsible for declining turtle numbers on CYP due to their extensive predation on turtle nesting sites. These nesting sites occur on the West coast of CYP, Horn Island and the Jardine Swamps. The threatened Olive Ridley (*Lepidochelys olivacea*) and Flatback turtle (*Natator depressus*) (Figure 8) nests are susceptible to high levels of pig predation on CYP (Figure 7). Limpus *et al* (1993) estimate that loss of clutches from feral pigs south of the Jardine River is approaching 90%.

**Figure 8. Flatback turtle. Photo K. Howard, DEH, 2005**

In 2005 the QPWS surveyed approximately 150 kilometres of coastline north of Weipa in a turtle nesting area. Extensive feral pig activity was recorded along the entire coast and

pig interference and/or egg predation was recorded for 100% of the 14 turtle nests examined (Bell, 2003). Studies on the Pennyfather River found that between 75% to 95% of nests were destroyed by pigs within ten days of the eggs being laid (Doherty, 2005). QPWS is conducting a study on the impact of feral pig predation of turtle nests near the mouth of the Jardine River, with Crab Island nesting area to be used as the control site.

In 2004 the Nanum Wungthim Land and Sea Centre contracted the CYWAFAP to undertake an aerial shoot of feral pigs. Pig numbers are now well down on previous years (Jamie Molyneaux, pers.comm., 2006). Mapoon Indigenous rangers are monitoring Flatback and Olive Ridley turtle nests for continued signs of pig predation and aerial surveys are undertaken each year.

Two year shooting and baiting programs have been planned for turtle nesting beaches on the east coast around the Archer River, Jardine beaches and Orchid Point. Shooting of pigs will occur during the turtle nesting season (Jamie Molyneaux, pers. comm., 2006). Aerial shooting around the turtle nesting area should see that turtle numbers increase in the coming years (Jamie Molyneaux, 2003). QPWS conducted aerial baiting trials on turtle nesting beaches in Heathlands in 2005 (Howley *et al.*, 2006). Pig exclusion fencing has also been discussed, but, may be impractical on a beach environment.

Pig disturbance is listed as a threatening process under the EPBC Act on the Loggerhead turtle (*Caretta caretta*), Hawksbill turtle (*Eretmochelys imbricata*) and Flatback turtle (*Natator depressus*) (DEH, 2005). All of these species occur on CYP (Cogger, 1992).

***Spread of weeds***

Evidence suggests that feral pigs also play a significant role in the spread and propagation of native weeds such as Pond Apple (*Annona glabra*) (DEH, 2003) and Lion's Tail (*Leonotis nepetifolia*) in their droppings and fur (Andrew Hartwig, pers. comm., 2005). Feral pigs carry weed seed such as Parthenium (*Parthenium hysterophorus*) from the riverbanks to the open country and associated gullies (Mitchell and Kanowski, 2003). Quadrant sites placed around feral pig diggings by the CYWAFAP showed an increase of weed regeneration over native regeneration and in some cases monocultures of weeds were recorded (Seymour and Molyneaux, 2001).

Pigs have also been implicated in the spread of plant diseases such as root rot fungus (*Phytophera cinnamoni*). They transport contaminated soil in their hooves and fur and also damage plants leaving them open to infection (McGaw and Mitchell, 1998).

***HEALTH***

Feral pigs pose a health risk to humans and livestock on CYP. One of the biggest threats is zoonosis – diseases that can be transmitted from pigs to humans. Pigs are host to a wide variety of viruses, bacteria's and parasites including Roundworm, Sparganosis (Figure 9), Brucellosis (*Brucellosis*), Tuberculosis *(Mycobacterium spp),* Melioidosis (*Pseudomonas pseudomallei),* Murray Valley encephalitis, Ross River fever and *Leptospirosi*s (*Leptospira spp)* (McGaw and Mitchell, 1998). Feral pigs have the potential to carry Trichinella, Swine fever and Foot and Mouth disease (Figure 10). The first victim of Japanese encephalitis in Australia is thought to have caught the illness

while working on a fishing boat near Kowanyama. Health officials fear feral pigs could spread the virus to more populated areas on the east coast of Australia (Anderson, 1998).

Trichinella, Swine fever and Foot and Mouth disease could be introduced from Indonesia and West Papua into Australia (Jim Mitchell, pers.comm., 2006). Feral pigs or pig meat could be transported onto islands and eventually the mainland. Trichinosis is caused by eating raw or undercooked meat infected with the larvae of the Trichinella worm. Heavy infestation can cause heart and breathing problems and death (CDC, 2004).

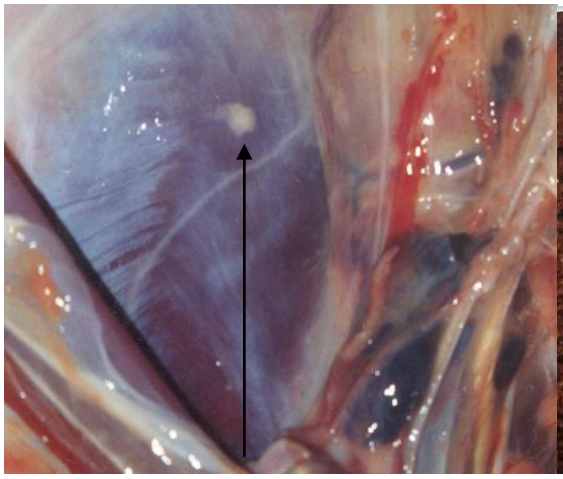

Figure 9. Sparganosis. Photo Seymour, 2001

Figure 10. Foot and mouth disease, note the blisters on the snout. Photo from Geering *et al*., 1995

Areas susceptible to the introduction of exotic disease are those where:

- large populations of feral pigs exist;
- wildlife predation is high; and
- where feral pigs have tested high for endemic diseases.

The introduction of exotic diseases can be hard to detect and control in areas inaccessible to vehicles.

Due to the high density of pigs and high numbers of tourists and fishermen to Princess Charlotte Bay, Lakefield National Park is considered a high risk zone for diseases such as foot and mouth (Jamie Molyneaux, pers. comm., 2005).

AQIS is actively monitoring the threat of exotic disease introduction onto CYP. Education programs are taking place to raise awareness about transporting pig meat between islands and onto the Australian mainland. Sentinel herds of pigs are kept in Bamaga and are frequently blood tested for the presence of exotic disease (Jim Mitchell, pers. comm., 2006).

***ECONOMIC***

The economic impacts of feral pigs in Cape York are evident in the Lakeland and Endeavour Valley agricultural areas. Economic impacts as a result of feral pig damage include the direct losses to agricultural production, the cost of continuing expenditure on pig control and damage to infrastructure such as fencing.

Pigs damage and consume pastures, reduce yields of crops (e.g., corn (Figure 11), bananas, mangoes and pawpaws), damage fences and pollute water sources.
There are no reliable estimates of the cost of feral pig damage in Cape York but based on two cropping properties in Lakeland Downs the figure is likely to be in excess of $200,000 annually (Seymour and Molyneaux, 2001). Studies have shown that pig activity also reduces pasture availability and can lead to the establishment of less desirable pasture species including weeds (Hone, 1980, in McGaw and Mitchell, 1998). A major concern of the beef industry in north Queensland is the risk of an exotic disease outbreak such as Foot and Mouth.


**Figure 11. Feral pig damage to corn crop, Lakeland. Photo CYWAFAP, 2000**

***CASE STUDY:***
***How reducing the feral pig population by 68% lead to an increase in productivity on Rutland Plain Station, 2002.***

One of the most successful aerial shooting programs on CYP took place on Rutland Plains Station in 2002. Rutland Plains Cattle Station is situated approximately 500km north-west of Cairns on the west coast of CYP. The station produces mainly Brahmin cattle crosses for live export to south-east Asia and the Middle East. Forty five percent of the station is coastal marine plain. Feral pigs competed with cattle for food, damaged fencing, and caused erosion around waterholes. The objectives of the shoot were to

1. undertake a survey of pig numbers before and after the shoot using a line-transect survey (Figure 12);
2. assess the best practice for control by reducing the population to an unsustainable level;
3. determine the cost-benefit ratio of helicopter-borne shooting as a control technique for feral pigs;
4. undertake disease sampling.

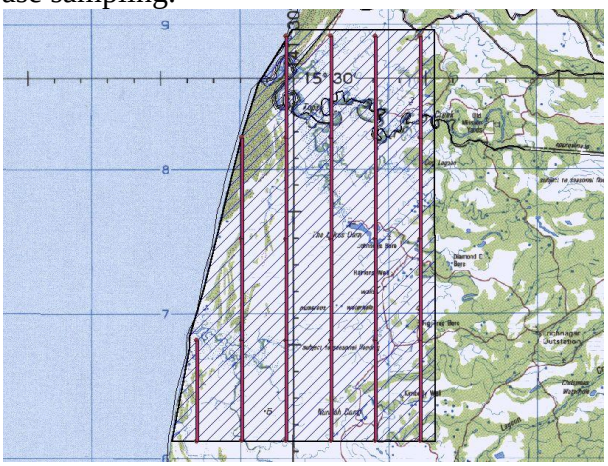


**Figure 12. The survey area for feral pig population counts, Rutland Plains, 2002**

CYWAFAP staff shot approximately 3700 pigs in the sample area in three days of shooting. NAQS scientists took blood samples to test for exotic and endemic diseases; over 50 stomach samples were recorded. After the post count the reduction rate was 68% at a cost $6.72 per pig. Pig density before the program was 3.74 pigs per $km^2$ and 1.2 $km^2$ after. The shoot was followed up with a 1080 baiting campaign.

Around one fifth of the pigs culled were examined by autopsy for Aujeszky's disease, Nipah virus, classical Swine fever and Porcine reproductive and respiratory syndrome. Serological testing was negative for all samples. Many pigs had high levels of endemic nematode, cestode and Acanthocephala parasites.

Since the control program commenced the station owner has observed greener lagoon areas, greater productivity and less stress in cattle. Magpie Geese (*Anseranas semipalmate*) have also been seen nesting in previously disturbed lagoon areas. This species is an indicator species for the healthy return of an ecosystem after disturbance. The reduction in pig numbers is maintained by the owner twice yearly with a baiting campaign and aerial shooting when necessary (Jamie Molyneaux, pers. comm., 2005).

## CONTROL TECHNIQUES

Pigs are difficult to control on a large scale for the long term. At the proceedings of the Feral Pig Action Agenda in 2003 the consensus was the eradication of feral pigs is the long-term goal for feral pig management (Lapidge *et al*, 2003). As part of this goal it was noted that eradication would require the development of more effective control techniques and technologies. Eradication means "the complete and permanent removal of the entire population by a time limited campaign" (Hart, 2003). Braysher and Moore (2003) noted that eradication, except on islands, is not possible with the current technology. Consequently, a more immediate goal was put forward to minimise the economic, agricultural, public health and environmental impacts of feral pigs through sustained control using currently available techniques.

***Best practice management***

There has been much discussion over what is the best practice method for controlling feral pigs. The best practice method must demonstrate that it is a superior or innovative practice that contributes to the improved performance of a process. Best practice methods should arise from agreement from multiple sources that the practice is superior and have a high number of repeated users (DNRME, 2004).

The main feral pig control techniques and their effectiveness have been summarised into a table by the DNRME (2004) (Figure 13).

| Control option | Features |
|---|---|
| **Trapping** | Can be made target specific<br>Allows commercial utilisation<br>Is labour- and skill-intensive<br>Requires access for trap and bait materials |
| **Shooting** | Is target specific<br>Allows commercial utilisation<br>Requires adherence to firearms legislation<br>Is costly for large numbers<br>Is not suitable for thick vegetation<br>Is labour- and skill-intensive |
| **Fencing** | Is low in impact on non-targets<br>Requires constant maintenance<br>Is costly and largely ineffective<br>Shifts problem<br>May impede movement of non-target species |
| **Dogging** | Involves animal welfare concerns<br>May displace pigs rather than capture them<br>Allows commercial utilisation<br>Controls only part of population |
| **Baiting** | Can control large numbers over large areas quickly and economically<br>Can be tailored to be target specific<br>Involves possible non-target issues if not conducted correctly<br>Raises public concern over humaneness and safety<br>Non-registered chemicals are used on occasions (illegal) |
| **Aversion** | (i.e. making the animal<br>wary, cautious or afraid)<br>Currently not commonly used<br>Longevity of this approach may be limited by pig intelligence<br>Raises potential animal welfare issues |
| **Biocontrol** | Not available<br>Potentially high cost and low chance of success<br>Public wariness of genetically modified organisms (GMOs)<br>Potential problems with domestic pig industry and native pigs in South-East Asia |

**Figure 13. Techniques for controlling feral pigs in Queensland, DNRME (2004)**

Aerial shooting and aerial mustering could also be added to Figure 13.

In 1998 McGaw and Mitchell recommended that the control method used will vary with the habitat, safety of people and animals, and the size and location of the area to be treated. Cultural concerns should also be considered.

The CYWAFAP have trialled a number of controlled techniques and have found that in open areas with large pig numbers that integrated pest management using aerial shooting and follow up 1080 baiting to be the most successful. Trapping has been successful for areas with a small numbers of pigs, urban areas and in dense vegetation such as rainforest. Control strategies such as aerial shooting and baiting can be specialised to target pig populations. Control is more effective when pigs are concentrated around water sources at the end of the dry season and where populations are localised within the riparian habitat.

***Aerial shooting***

Aerial shooting (Figure 14) allows large areas of land to be covered in a minimal amount of time with the ability to cover both dry country and swamp areas regardless of the time of year (Seymour and Molyneaux, 2001). The CYWAFAP report that when aerial shooting is conducted in a professional and competent manner, it is one of the most cost-effective and efficient means of feral animal control. The procedure of flying back after each shoot to double check that the pigs are dead ensures that humane destruction is carried out (Seymour and Molyneaux, 2001).

**Figure 14. Aerial shoot - the shooter will wait until the last pig comes into focus then shoot from the back to the front so as not to split the herd (Seymour and Molyneaux, 2001).**

Culling has occurred at Napranum (parallel to the coast from Duyfken Point to the Pennyfather River) in 2003 & 2005 and Mapoon (north of the Pennyfather River) in 2005. Follow up baiting to keep down pig numbers is encouraged where approved by the Traditional Owners.

A control program was carried out in Lakefield National Park and Princess Charlotte Bay during a survey for exotic diseases. Approximately 2500 feral pigs were shot in a total of 62 flying hours. (Jamie to clarify information)

The CYWAFAP undertakes aerial surveys before and after a shoot to determine the density of feral pigs and the success of the shoot. The CYWAFAP also conduct annual aerial surveys at 21 locations including Rutland Plains, Aurukun, Jardine Swamps, Port Stewart/Silver Plains, and Lakefield National Park to gather data on pig density and the seasonal variation of pig populations.

***Baiting***

Poison baiting is the most widely accepted pig control technique in rural communities as it is both fast and effective (Choquenot *et al.* 1996). Toxins such as 1080 (sodium fluoroacetate), Warfarin, CSSP, and Strychnine have all been widely used for the destruction of feral pigs. However, only 1080 and CSSP are registered for this purpose (McGaw & Mitchell, 1997). There is little justification for the use of CSSP over 1080 because of non-target poisoning risks and doubts about the humaneness of the toxin CSSP (Hart, 2003).

The use of 1080 in meat bait has attracted some opposition from environmental groups concerned about the non-target impacts on native carnivores. Landholders fear the loss of working dogs and animal welfare groups question if the poison is humane (Choquenot *et al* 1996). Parker *et al.* (2003) noted that when using 1080 on pigs large doses were required and the risk of secondary poisoning was high due to the incidence of vomiting and that 1080 has no antidote. Pigs are also known to develop bait shyness towards 1080 and can also survive apparent lethal doses.

Although 1080 remains the most commonly used bait many properties find it too controversial and prefer to use less well publicised poisons such as SAP (yellow phosphorous) or Luci-jet (organophosphate) (Lapidge *et. a*l., 2003).

The cost effectiveness of aerial baiting is superior to trapping, but inferior to aerial shooting. Choquenot *et al* (1996) claim that the success rate of ground baiting could be as high as 99.4%. Aerial baiting is considered the best technique to be used in the case of an exotic disease outbreak.

Although there is a need for improved pig-specific baits, control programs at least in the short term will continue to rely heavily on 1080 baiting programs (Twigg, 2003).

***Fencing***

Fencing is generally not regarded as the best control technique for feral pigs except for enclosing relatively small, highly valuable areas (McIlroy 1993 cited in Choquenot *et al.*1996 and Long and Robley, 2004). Since feral pigs are large, robust animals reaching up to 115 kg in size (Choquenot *et al.*1996); fences must be equally robust to exclude them. Where possible it is important to erect exclusion fences before pigs become accustomed to utilising the enclosed food source (Plant, 1985). Electrified wires can be used in conjunction with a fence to prevent it being breached.

Fences used to exclude pigs at Red Lily Lagoon in Lakefield National Park have met with some success.

***Biocontrol***
In 2002 Peacock, from the Pest Animal Control CRC in Canberra, observed that present methods of control were ineffective and the CRC was conducting preliminary research into a sterilisation virus that could be transmitted to pigs through bait. Peacock predicted that it would take years to develop a virus and there would be problems, such as protecting the domestic market and making sure the virus could not spread to other animals. By 2003 Peacock reported that it was now very unlikely that a virally-vectored immunocontraceptive was viable for pig control due to the potential problems with the domestic pig industry. Pigs are also poor candidates for immunocontraception as they have a high reproductive rate and highly fecund animals are very difficult to control through fertility disruption (Peacock, 2003).

***Community attitudes***
Total eradication may not be a preferred option for those who use pigs as a food source. Most aboriginal communities recognise that pigs are pests but still use them for food. Feral pigs can affect the availability of some very sought-after bush tucker including lotus lilies, yams, magpie geese, fresh water turtles and goannas (Thorburn, 2000). While feral pigs themselves could also be seen as a food resource, most people do not hunt pigs. Many Aboriginal people believe that the meat can make them sick, and in fact, just don't like the taste.

When preparing pest management plans the CYWAFAP seek the goals of Aboriginal people for feral animal management in their traditional country. Options are discussed on the best ways to achieve these aims and how management can best be implemented locally. Most workshops conducted by CYWAFAP in the communities of CYP receive very positive feedback (Seymour and Molyneaux, 2001).

Braysher and Saunders are developing a tool kit called PESTPLAN that will use practical methods to help groups prioritise the management of feral pigs across a region (Hart, 2003).

## COMMERCIAL HARVESTING

One action listed in the Queensland Feral Pig Strategy (2004) is to investigate the role of game meat harvesting in feral pig management. The National Threat Abatement Plan (2005) suggests land managers could use commercial harvesting as a component of an integrated program. Many indigenous communities see feral pigs as an important resource that is not to be wasted (Howley *et al*, 2006). Feral pig meat has been used as game meat in the export industry. In 2002 Australia exported 3462 tonnes of wild boar meat to overseas markets in Germany, France and the Netherlands (AEC Group, 2003). However, profitable harvesting of game meat is not a guaranteed venture on CYP. Factors that determine the profitability of a harvest include the:

- distance travelled to chillers (feral pig meat requires refrigeration within two hours during daylight time (Seymour and Molyneaux, 2001));
- distance travelled to abattoirs (Figure 15);
- ease of access for harvesters;
- density of pigs;
- disease and condition of the animals (six out of ten pigs must be thrown away due to Sparganosis (Seymour and Molyneaux, 2001)); and
- attitude of the landholders to use the carcass (DEH, 2005).

Harvesting operations for game meat may also not occur in areas where feral pigs are having the biggest impacts.

Other suggestions for the use of feral pigs include pet food, food for crocodile farms and the 'Blood and Bone' fertiliser industry.

**Figure 15. Feral pigs nearing the end of the processing line. Note the DPI meat inspector Ivan Spletter inspecting the feral pigs at the first trial (Photo Seymour and Molyneaux, 2001).**

## RESEARCH

Mitchell (2003) reported that feral pig research in North Queensland has basically been restricted to the last twelve years. Research has focused on ways to destroy pigs in a humane, cost effective way without harming non-target species or the surrounding environment. Current research topics include:

- improving the effectiveness of control methods;
- making control methods more target specific to feral pigs;
- making control methods more humane;
- quantifying the impacts feral pigs have on the values of CYP;
- prioritising areas for pig control in relation to conservation, threat of disease.

Specific projects the CYWAFAP is undertaking or assisting research into include:

- determining the most effective control techniques;
- improving existing control techniques;
- target specific baiting;
- determining the abundance and distribution of feral pigs on Cape York; and
- predicting priority areas for control using GIS.

This research include trials with the DNRMW to see how long 1080 poison lasts in the bait, pulse baiting trials and what type of pigs are eating the baits. Pulse baiting involves the repeat application of small numbers of 1080 bait using aerial application. This method reduces the chance of non-target animals eating the bait and pigs eating an excess amount of bait once they have received a lethal dose (CSIRO, 1993). This further reduces the risk of non-target baiting from the consumption of carcasses by native animals. This method is being trialled at Captain Billy's Landing by CYWAFAP, QPWS, DNRMW and EPA (Jim Mitchell, pers.comm., 2006).

CYWAFAP also record pig density (Figure 16), take stomach/blood samples (Figure 17), map impacts, map aerial surveys and keep photo points for determining changes over time. At the end of each month contractors and staff input data into the digital database.

Research topics undertaken by Dr Jim Mitchell, Zoologist from DNRMW include the:

- effectiveness of aerial baiting;
- ecology and management of feral pigs in rainforest habitat;
- identification of spatial and temporal feral pig diggings;
- impact of feral pigs on tree seedlings;
- seasonal migration of feral pigs;
- demographics of feral pigs (e.g., age, pregnancy, litter size, mortality);
- use of integrated baiting;
- use of alternative toxins for baiting;
- analysis of diet;
- best practice management (Lapidge *et al*, 2003).

Doherty (2005) and QPWS are currently researching feral pig impacts on turtle nests in north-eastern CYP.
A list of essential research suggested by the Feral Pig Action Agenda (2003) includes:

- genetic sampling to monitor feral pig movement/ translocations;
- monitoring and evaluating disease status;

- developing a test kit for disease sampling;
- biological control methods; and
- national monitoring surveys.

Other potential research projects could quantify feral pig impacts on water quality, aquatic habitat and turtle nests to help determine priority areas for control. The commercial utilisation of pigs could also be further investigated.

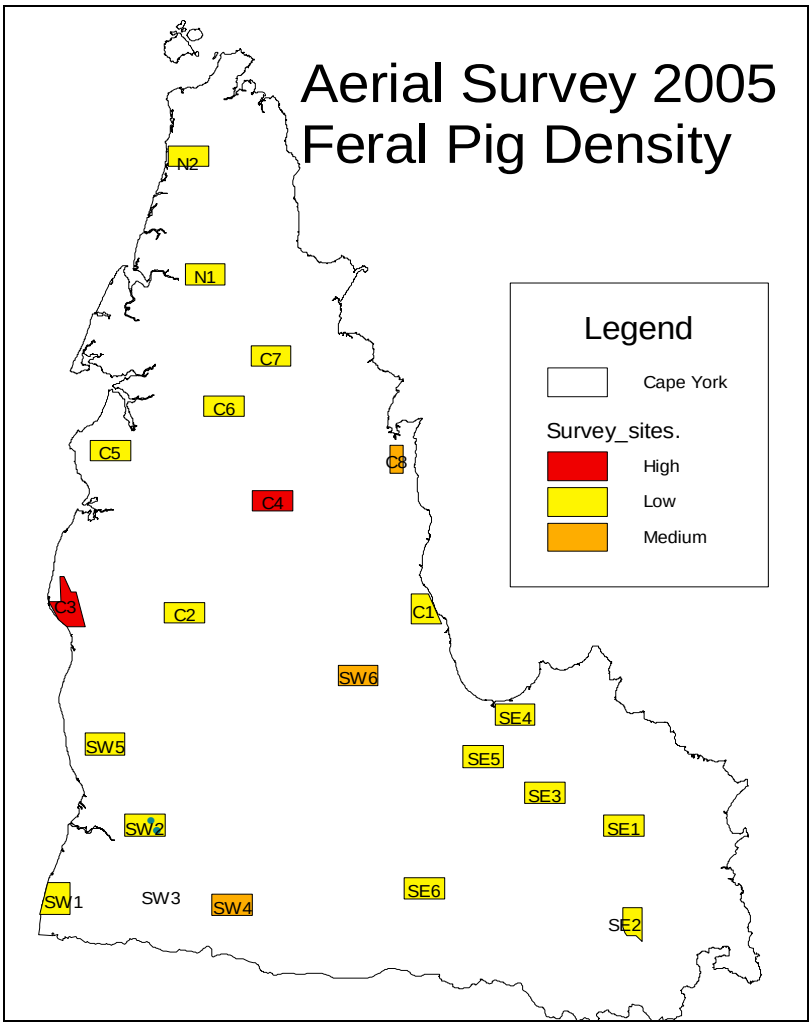


**Figure 16. Feral pig density on CYP. CYWAFAP, 2005**

**Figure 17. Taking blood from the heart chamber of a feral pig, Cape Melville, CYP. Photo: J. Molyneaux, 2000.**

## RECOMMENDED MANAGEMENT ACTIONS

The current emphasis of feral pig management is to:

- develop awareness in the community of the feral pig problem;
- manage feral pigs effectively;
- ensure there are adequate resources for research and control programs in the long term;
- gain commitment from stakeholders to contribute to control programs; and
- determine priorities for control in high-value environmental, economic and disease risk areas.

High-value areas could include conservation zones, turtle nesting sites, wetlands, crops and areas where the risk of introduction and spread of disease is high. In Pest Property Management Plans land managers may identify localised areas such as rubbish dumps or towns as priorities for pig control.

The following actions are largely derived from the strategies set out in the QLD Feral Pig Strategy (2004). Some actions have been omitted, modified or updated to specifically address the current needs of feral pig management on CYP.

Some actions from the QLD Feral Pig Strategy (2004) have been achieved and are therefore omitted from the recommended actions table. These achievements include the:

- development of guidelines for the preparation of property pest management plans (CYWAFAP);
- financial and equipment loan incentives for landholders to undertake feral pig control on their property;
- commencement of population assessment of feral pig numbers and impacts across Queensland (the CYP part)
- preparation of pest property management plans;
- research into the ecology and biology of pigs;
- refinement of tools to measure the impacts of feral pigs, and improve the effectiveness of control technologies; and
- formation of a Pest Management Committee for CYP. The Cape York Peninsula Pest Advisory Committee (CYPPAC) commenced in 1998 and in 2005 became the Cape York Peninsula Pest Management Advisory Group (CYPPMAG).

The management recommendations are listed under twelve actions in the following tables:

### Action 1: Develop and implement awareness programs throughout CYP to promote effective feral pig management

| No. | Action | By Whom | By When |
|---|---|---|---|
| **1.1** | Develop landholder, industry and local government awareness programs on the costs and impacts of feral pigs and options for control | NRMW, CYP Landcare Program all stakeholders including industry and community groups | June 2008 |
| **1.2** | Establish partnerships between government, supportive community and industry groups in order to harness their collective communication channels and support for feral pig control | NRMW, CYP Landcare Program industry and community groups | December 2007 and ongoing |
| **1.3** | Develop an awareness program relating to the disease risk of feral pigs and how to manage risk from human consumption | DPI, QHealth, AHA | June 2007 |
| **1.4** | Coordinate education, research and community knowledge when developing awareness programs | NRMW, CYP Landcare Program all stakeholders, CYWAFAP. | Ongoing |

### Action 2: Reduce the impacts of feral pigs in priority areas in the long-term

| No. | Action | By Whom | By When |
|---|---|---|---|
| **2.1** | Identify priority areas for sustained control programs based on cultural, economic, health and environmental values and research | NRMW, LG | December 2006 |
| **2.2** | Conduct sustained control programs | All stakeholders | Ongoing |
| **2.3** | Ensure control continues beyond the initial knockdown phase | All stakeholders | Ongoing |
| **2.4** | Trial fencing off areas of high production and conservation value and maintain fencing | All landholders including government agencies | Ongoing |
| **2.5** | Undertake research into exotic disease prevention and control | AQIS, Q Health, NRMW | June 2009 |

## Action 3: Train and accredit feral pig control operators in best practice management techniques

| No. | Action | By Whom | By When |
|---|---|---|---|
| **3.1** | Develop best practice procedures and related templates | NRMW | December 2007 |
| **3.2** | Encourage registered training organisations to provide accredited training on feral pig management | NRMW, RTO's | December 2007 |

## Action 4: Manage feral pigs with regard to local circumstances and conditions

| No. | Action | By Whom | By When |
|---|---|---|---|
| **4.1** | Identify effective control techniques for each bioregion and produce a best practice manual by bioregion | All stakeholders | December 2006 |
| **4.2** | Apply appropriate control techniques for the bioregion | All stakeholders | December 2006 |
| **4.3** | Coordinate control programs across and adjoining areas of high production and conservation value | All relevant landholders including government agencies | Ongoing |
| **4.4** | Conduct coordinated broad-scale population knockdowns across all tenures | All stakeholders | Ongoing years |
| **4.5** | Ensure local governments have the competency and capacity to undertake compliance provisions | NRMW, LG | Ongoing |
| **4.6** | Ensure CYWAFAP and QPWS have the capacity to undertake compliance provisions | NRMW, LG, CYWAFAP, QPWS | Ongoing |
| **4.7** | Continue aerial surveys of feral pig populations on CYP | CYWAFAP | Annually |

## Action 5: Integrate future harvesting programs with monitoring and control programs

| No. | Action | By Whom | By When |
|---|---|---|---|
| **5.1** | Investigate the feasibility of harvesting programs | NRMW, harvesting groups | June 2007 |

| | | | |
|---|---|---|---|
| **5.2** | Conduct a cost–benefit analysis of harvesting contribution to feral pig control | NRMW, harvesting groups | December 2007 |

## Action 6: Incorporate feral pig management into broader natural resource management, being mindful of the implications of such natural resource management

| No. | Action | By Whom | By When |
|---|---|---|---|
| **6.1** | Provide feral pig management information to catchment and regional NRM groups | NRMW | June 2007 |
| **6.2** | Include feral pig components (either specifically or as 'pest animals') within regional and catchment NRM planning | LG, regional and catchment groups | Ongoing |
| **6.3** | Conduct feral pig management activities so as not to adversely impact upon natural resources | All stakeholders | Ongoing |

## Action 7: Ensure that agencies, land managers, and indigenous shires with legislated responsibilities are empowered and resourced

| No. | Action | By Whom | By When |
|---|---|---|---|
| **7.1** | Include feral pig management in all planning and budgeting activities for all tenures | All stakeholders | June 2007 |
| **7.2** | Implement the QLD Feral Pig Strategy and this plan on all tenures | All stakeholders | Ongoing |
| **7.3** | Ensure that cultural values are honoured where control is being conducted | All stakeholders | Ongoing |
| **7.4** | Ensure long-term funding for CYWAFAP and QPWS feral pig control | EPA, NRMW | Ongoing |
| **7.5** | Ensure funding for the development of pest management plans | NRMW | Ongoing |
| **7.6** | Provide financial incentives for landholders and land managers to take action | NRMW | June 2009 |

**Action 8: Encourage, prepare and implement feral pig planning at local levels (local government area, catchment and property) that is compatible with state and national plans**

| No. | Action | By Whom | By When |
|---|---|---|---|
| **8.1** | Develop assistance for local feral pig management planning (all levels) | NRMW, LG,CYWAFAP | December 2007 |
| **8.2** | Develop incentive options to produce feral pig management planning | NRMW, LG, CYWAFAP | December 2006 |
| **8.3** | Provide funding for and develop local pest management plans | NRMW, CYWAFAP, LG, regional and catchment groups and landholders | December 2007 |
| **8.4** | Implement local management plans | All stakeholders | Ongoing |
| **8.5** | Build capacity of community to manage their own feral pig problems | NRMW, LG, Indigenous Shires | June 2008 |

**Action 9: Continuously improve the effectiveness, efficiency and humanness of best management practices for the monitoring and control of feral pigs**

| No. | Action | By Whom | By When |
|---|---|---|---|
| **9.1** | Evaluate and document best practice procedures using an adaptive management approach | All stakeholders | Every two years |
| **9.2** | Coordinate research at science level | NRMW, CRC's JCU, UQ | December 2007 |
| **9.3** | Where possible improve existing control techniques and, where necessary, develop and adopt new techniques | NRMW, CYWAFAP, industry, CRC's, JCU, UQ | Ongoing |
| **9.4** | Develop accurate and consistent monitoring techniques for population and impact monitoring | NRMW, CYWAFAP, industry, CRCs, JCU, UQ | December 2007 |
| **9.5** | Ensure long term funding for research on the economic, environmental and health impacts of feral pigs | DEH, NRMW, CRC's | Ongoing |
| **9.6** | Conduct quantitative research on the impacts of feral pigs on water quality, aquatic habitat and turtle nests | NRMW, industry, CRC's, JCU, UQ | December 2009 |
| **9.7** | Conduct targeted research into the ecology and biology of feral pigs in all | NRMW, CRCs JCU, UQ | December 2007 |

| | | | |
|---|---|---|---|
| | habitats | | |
| **9.8** | Amend management plans/strategies in light of review outcomes | All stakeholders | Annually |

## Action 10: Ensure all stakeholders are committed and contributing to feral pig control in CYP

| No. | Action | By Whom | By When |
|---|---|---|---|
| 10.1 | Establish network of stakeholders and inventory of resources | NRMW | December 2006 |
| 10.2 | Establish stakeholder meetings | NRMW, LG, CYWAFAP and industry groups | Six monthly |
| 10.3 | Demonstrate control techniques to all relevant stakeholders | NRMW, LG, CYWAFAP and game harvesters | Ongoing |
| 10.4 | Support development, encourage adoption, and cooperate in implementing latest technologies in controlling feral pigs | All stakeholders | Ongoing |

## Action 11: Gain public and political support for the effective and humane management of feral pigs

| No. | Action | By Whom | By When |
|---|---|---|---|
| 11.1 | Liaise with ministers, directors general, Land Protection Council, catchment groups, LGAQ and conservation groups | All | December 2008 |
| 11.2 | Develop and agree on a consistent message for feral pig management | Feral Pig Management Committee | December 2008 |
| 11.3 | Link actions within this plan to Queensland Feral Pig Strategy (2004) and Threat Abatement Plan (*EPBC Act*) | DEH, EPA | December 2006 |

## Action 12: Obtain cooperation and support from all stakeholders in resourcing their components of this plan

| No. | Action | By Whom | By When |
|---|---|---|---|
| 12.1 | Promote this plan | NRMW, CYWAFAP | December 2006 |
| 12.2 | Seek high-level endorsement of this plan | NRMW, CYWAFAP | December 2006 |
| 12.3 | Review this plan | All stakeholders | Annually |

## OTHER RELEVANT MANAGEMENT PLANS

This plan should be read in conjunction with other pest management plans including the:

- Queensland Feral Pig Management Plan 2004
- Queensland Pest Animal Strategy 2002-2006
- Cape York Peninsula Pest Management Plan 2006-2010
- Cook Shire Pest Management Plan 2004, 2006-2010
- National Threat Abatement Plan for the Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (DEH, 2005)
- CYP Pest Management Strategy 2004-2010

## ACKNOWLEDGEMENTS

Many thanks to Jamie Molyneaux, Cathy Waldron, Nerida Holznagel, Christina Howley,

Michael Stephan and Jim Mitchell for assistance in writing and editing this plan.

# REFERENCES


Abrahams, H., Mulvaney, M., Glasco, D., & Bugg, A. (1995). *Areas of Conservation Significance on Cape York Peninsula. **A** Cape York Peninsula Land Use Strategy.* Office of the Co-ordinator General of Queensland
Australian Heritage Commission, DEH.

AEC (2003). *Game meat processing facility- feasibility study* Cook Shire Council.

Anderson, I. (1998). *A real headache*. New Scientist Magazine, April, 1998). http://www.newscientist.com/article/mg15821282.000.html

Bell, I. (2003). *Turtle Monitoring Project: collaborative project by the Mapoon Aboriginal Council,* Queensland Parks and Wildlife Service and Department of Primary Industry.

Braysher, M and Moore, R (2003). *Draft Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs.* University of Canberra and Environment Australia. In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

Cape York Peninsula Land Use Strategy (1995).

Cape York Weeds and Feral Animals Program (2002). *Summary of Achievements January 1999 – August 2002.* Cook Shire Council, Cooktown.

Cape York Weeds and Feral Animals Program (2004). *Cape York Peninsula Pest Management Strategy 2004-2010.* Cook Shire Council, Cooktown.

(CDC) Centre for Disease Control and prevention (2004). *Trichinellosis* Atlanta, USA. http://www.cdc.gov/ncidod/dpd/parasites/trichinosis/factsht_trichinosis.htm

Choquenot, D., McIlroy, J. and Korn, T. (1996). *Managing Vertebrate Pests: Feral Pigs*. Bureau of Resource Sciences. Australian Government Publishing Service, Canberra.

Cogger, H.G., (1992). *Reptiles and amphibians of Australia* .Rev. ed, Reed Books, Sydney.

Cook Shire Council (2002). *Pest Management Plan 2003-2006.* Cook Shire Council, Cooktown.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) (1993). *Rodent control in piggeries. CSIRO Wildlife and Ecology Unit.*

Department of the Environment and Heritage (DEH) (2000). *National Strategy for the Management of Coastal Acid Sulfate Soils.* http://www.deh.gov.au/coasts/cass/index.html

Department of the Environment and Heritage (DEH) (2003). *Weeds of National Significance Weed Management Guide Pond Apple* (Annona glabra). CRC Weed Management.

Department of the Environment and Heritage (2005). *Threat Abatement Plan – for predation, habitat degradation, competition and disease transmission by feral pigs.* Commonwealth of Australia, Canberra, ACT.

Department of Natural Resources Mines and Energy (DNRME) (2004) *Feral Pig Management Strategy*. Web Publishing Services and the State of Queensland.

Department of Natural Resources Mines (DNRM) (2004). *Declared animals of Queensland – Fact Sheet,* Queensland Government.

Department of Natural Resources Mines and Water (DNRMW) (2006). *Feral pigs in Queensland – distribution, ecology and impact.* Pest Series Fact Sheet. The State of Queensland.

Doherty, J. (2005). Ecological Impact Assessment of Feral Pig Predation in Marine Turtle Breeding Habitat on the West Coast of Cape York. Report submitted to Augumathimaree Paynaranama Traditional Owners.

Geering, W. A, Forman, A. J and Nunn, M. J (1995*) Exotic Diseases of Animals a field guide for Australian veterinarians*. Published by Australian Government Publishing Service Canberra.

Hart, Q. (2003). *The feasibility of eradicating feral pigs from mainland Australia* Bureau of Rural Sciences, Canberra. In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

Herbert, B., Peeters, J., Graham, P. & Hogan, A. (1994) *Natural Resources Assessment Program, Fish Fauna Survey Project.* Queensland Department of Primary Industries.

Hone, J. (1980). *Effect of feral pig rooting on introduced and native pasture in north-eastern New South Wales.* Journal of the Australian Institute of Agricultural Science **46**:130-132.

Hone, J. (1988). *Feral pig rooting in a mountain forest and woodland distribution, abundance and relationships with environmental variables.* Australian Journal of Ecology **13**: 393-400.

Howley, C., McCollum, I., O'Connell, K., and Stephan, K. (2006). *Draft Cape York Peninsula Natural Resource Management Action Plan Marine and Coastal.* Unpublished. Department of Community Services. Cape York Community Engagement Group.

Lapidge, S., Derrick, M., and Conroy, J. (2003). *Adaptive management and demography of feral pigs in southern Queensland.* DNRM and Pest animal control

CRC In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

Long, K. and Robely, A. (2004). *Cost effective feral animal exclusion fencing for areas of high conservation value in Australia.* Arthur Rylah Institute for Environmental Research. Department of the Environment and Heritage.

McGaw, C.C, and Mitchell, J. (1998). *Feral pigs in Queensland-Pest status review series- land protection.* Queensland Department of Natural Resources and Mines, Queensland.

Mitchell, J. (1993). *Systematic assessment of feral pig damage and recommended pig control methods in the wet tropics World Heritage Area.* Final Report to the Wet tropics Management agency, Department of Lands, Charters Towers, Queensland.

Mitchell, J. (1997). *Diggings by feral pigs within the Wet Tropics World Heritage Area, North Queensland.* Wildlife Research **24** (5) 591.

Mitchell, Dr. J. (2004). *Aerial Surveys of Feral Pigs*, Interim Report. Queensland Department of Natural Resources and Mines, Natural Heritage Trust Cape York Weeds and Feral Animals Program. Sep 2004.

Mitchell, J. and Kanowski, A. (2003). *Best Practice feral pig management in the Burdekin River Catchment.* Technical Report to the Dalrymple Land Care Committee and Bureau of Rural Sciences, National Feral Animal program

Molyneaux, J. (2003).*Cape York Peninsula Feral Animal Survey (feral pigs and brumbies).* Feral Animals Officer, CYWAFAP, Cook Shire Council. In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

Molyneaux, J. (2003). *Nanum Wungthim Land and Sea Centre. Feral pig control program* Unpublished. CYWAFAP, Cook Shire Council.

Parker, R., Scanlan, J., Mitchell, J., Saunders, G., Twigg, L. and Lapidge, S., (2003). *Target-specific delivery systems.* From NSW Department of Agriculture, WA Department of Agriculture. In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

Peacock, T (2002). *Virologists focus on Australia's feral pigs.* BioMed Net http://www.vetscite.org/publish/items/000445/index.html

Peacock, T. (2003). *Virally vectored immunocontraception not a viable option for feral pig control.* From Pest Animal Control CRC. In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

Personal Communication, Andrew Hartwig, (2005). Queensland Parks and Wildlife Service, Lakefield Ranger.

Personal Communication Jamie Molyneaux, (2003). Cape York Weeds and Feral Animals Program, Feral Animals Officer.

Personal Communication Dr Jim Mitchell (2006). Department of Natural Resources Mines and Water. Zoologist.

Personal Communication Jamie Molyneaux, 2005. Cape York Weeds and Feral Animals Program, Feral Animals Officer.

Rainforest CRC (2003). *Feral pig impacts and control – issues in tropical forest landscapes.* Issue 1, June, 2003
http://www.rainforest-crc.jcu.edu.au/publications/issueSeries/ITFLpigs.pdf

Seymour, S. and Molyneaux, J. (2001). *Feral pig management in Cape York Peninsula: A handbook for practitioner's* .Internal document. CYWAFAP, Cooktown.

Stanton, P. (1994). Country in Flames: Proceedings of the 1994 symposium on biodiversity and fire in North Australia**. :** Ed. Deborah Bird Rose. Published jointly by the Biodiversity Unit, Department of the Environment, Sport and Territories and the North Australia Research Unit, The Australian National University.

Thorburn, K. (2000). *Feral Challenge for Arnhem community.* Savanna Links Issue 16 October - December 2000, Tropical Savannas CRC.
http://savanna.ntu.edu.au/publications/savanna_links16/feral_challenge.html

Twigg, L. (2003). *Feral pig control and research activities in Western Australia.* From W.A. Department of Agriculture. In: Proceedings of the Feral Pig Action Agenda, Ed. Lapidge, S.J., James Cook University, Cairns.

# APPENDIX A

## THE PRINCIPLES OF PEST MANAGEMENT

The *Land Protection (Pest and Stock Route Management) Act 2002* states that the principles of pest management for land are as follows:

Integration
Pest management is an integral part of managing natural resources and agricultural systems.

Public Awareness
Public awareness and knowledge of pests must be raised to increase the capacity and willingness of individuals to manage pests.

Commitment
Effective pest control requires a long-term commitment to pest management by the community, industry groups and government entities.

Consultation and partnership
Consultation and partnership arrangements between local communities, industry groups, State government agencies and local governments must be established to achieve a collaborative approach to pest management.

Planning
Pest management planning must be consistent at local, regional, State and national levels to ensure resources target priorities for pest management identified at each level.

Prevention
Effective pest management is achieved by:

a) preventing the spread of pests, and viable parts of pests, especially by human activity; and
b) early detection and intervention to control pests.

Best Practice
Pest management must be based on ecologically and healthy responsible pest management practices that protect the environment and the productive capacity of natural resources.

Improvement
Research about pests, and regular monitoring and evaluation of pest control activities, is necessary to improve pest management practices.

**Current techniques for controlling feral pigs in Queensland**

**Trapping**

- Can be made target specific
- Allows commercial utilisation
- Is labour- and skill-intensive
- Requires access for trap and bait materials

**Shooting**

- Is target specific
- Allows commercial utilisation
- Requires adherence to firearms legislation
- Is costly for large numbers
- Is not suitable for thick vegetation
- Is labour- and skill-intensive

**Fencing**

- Is low in impact on non-targets
- Requires constant maintenance
- Is costly and largely ineffective
- Shifts problem
- May impede movement of non-target species

**Use of Dogs**

- Involves animal welfare concerns
- May displace pigs rather than capture them
- Allows commercial utilisation
- Controls only part of population

**Baiting**

- Can control large numbers over large areas quickly and economically
- Can be tailored to be target specific
- Involves possible non-target issues if not conducted correctly
- Raises public concern over humaneness and safety
- Non-registered chemicals are used on occasions (illegal)

# APPENDIX B:

## Summary of the biology and ecology of the feral pig

Scientific name: *Sus scrofa*
Common name: feral pig
Length: 105–55cm (male) and 100–30cm (female)
Weight: up to 115 kg (male) and 75 kg (female); habitat and conditions may increase or decrease these averages

**Reproductive characteristics**
Breeding season: limited by food availability (requires ~15% protein)
Oestrus cycle: 21 days
Mean litter size: average 4.9–6.3 (up to 10)
Gestation: 112–14 days
Juvenile mortality: 10–15% (good conditions) and 90–100% (drought)
Age at first breeding: weight dependent (25–30kg)

**Diet**
The feral pig is considered to be an opportunistic omnivore (Choquenot *et al*. 1996), and it has been known to consume the following groups of foods:
• fruits and seeds: grains, fruits, rainforest fruits
• foliage and stems: grasses, sugar cane, banana trees
• rhizomes, bulbs and tubers: including tuberous crops such as potatoes
• fungi
• animal material: carrion, earthworms, lambs, arthropods.
The foods consumed vary from region to region and through the year, and the potential food sources are limited by availability rather than preference for any single food type.
Pigs have a relatively high-energy requirement, particularly during lactation and the growth of young pigs (Choquenot *et al*. 1996). Sows require about 15% of their diet to be crude protein in order to successfully suckle their young. This protein requirement can be met from plant material but more commonly is met from animal matter such as earthworms, carrion, arthropods, frogs and reptiles. Animal matter rarely exceeds 5–18% of a pigs diet (Giles 1980; Pavlov 1980).
Feral pigs will relocate in response to food availability and, in particular, seasonal requirements for higher protein and energy associated with reproduction and growth.

**Social structure and behaviour**
The most common grouping of feral pigs are either a few sows and their young, bachelor groups (individuals less than 18 months of age) or individual boars (usually older than 18 months). After weaning, pigs will remain with their mother until the next litter or, in the case of sows, until they mate (Masters 1979; Giles 1980; Pavlov 1980).
Group size varies with age, sex, food and water availability and disturbances (such as hunting or other control measures). Group size can range from solitary boars to groups of 100 or more sharing a locally scarce resource such as a single waterhole during droughts.
Feral pigs habitually make use of trails, shelter areas, feeding and watering areas (subject to availability), rubbing and tusking trees and wallows. There is no evidence that feral pigs, of either sex, actively defend territories.