Species Management Plan for FERAL PIGS

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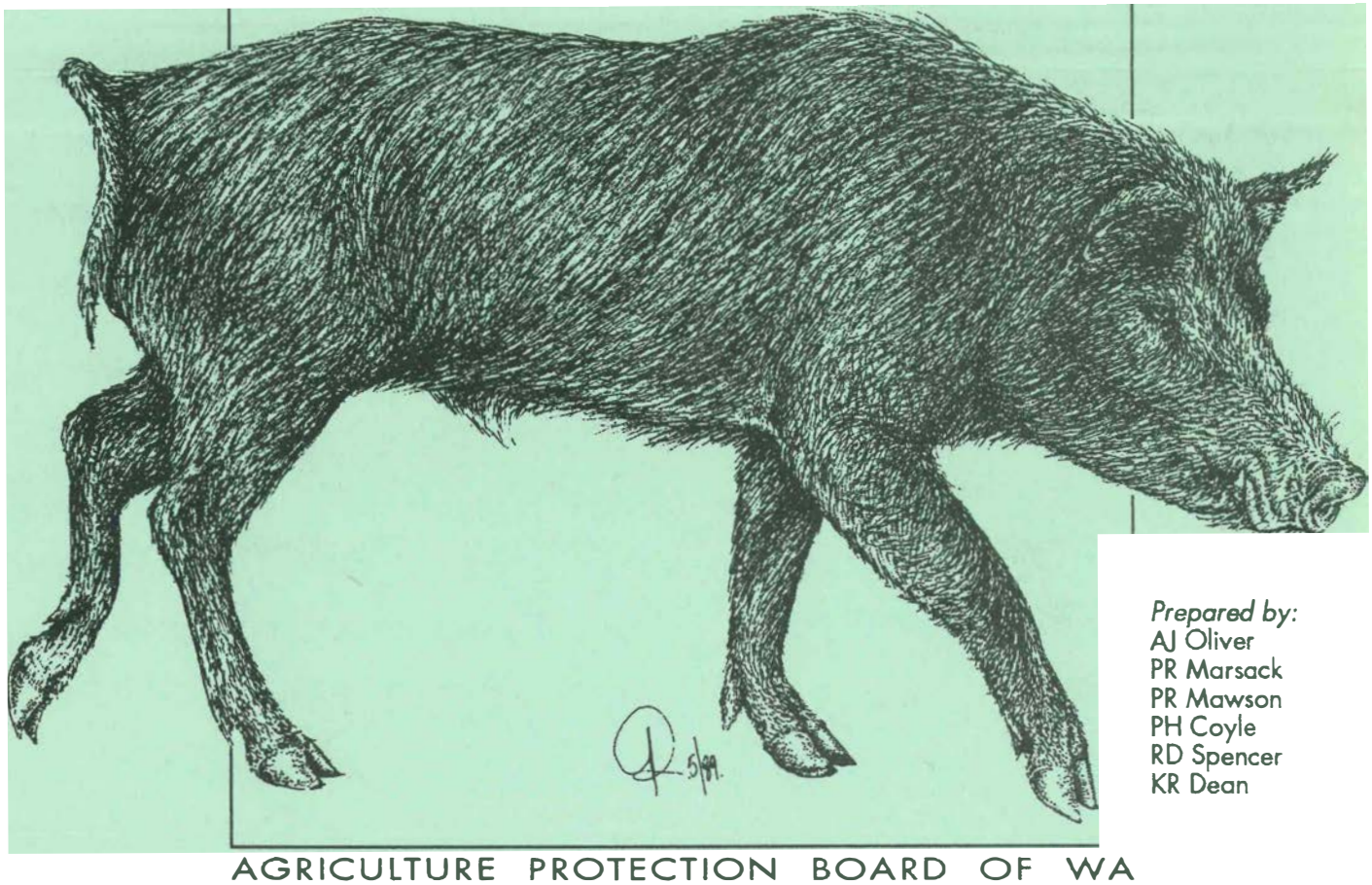

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PREFACE

Western Australia is free from many of the world's worst pests. Elsewhere in the world introduced pests cost agriculture industry millions of dollars. They may also threaten the natural environment and kill or compete with native plants and animals.

The Agriculture Protection Board (APB) provides a service to safeguard the state's rural productivity and natural and community resources from the impact of weed and animal pests. The Agriculture and Related Resources Protection Act (ARRPA) (1976) places the responsibility for managing pests on land owners and occupiers. As such the APB's role is in planning, co-ordinating and monitoring control efforts by landholders. Thus many pests are kept out of the state, the spread of other pests within the state is minimised and the eradication, control or management of other pests is conducted efficiently. The APB, in consultation with landholder committees, decides whether the cost of continuing control is justifiable when set against the potential costs of agricultural and environmental damage in the absence of control.

A dual system of committees advises the APB on local and statewide policies. Regional Advisory Committees include representatives of producer organisations and local shire councils. They in turn nominate members to one of eleven Zone Control Authorities throughout the state.

The detrimental effects of pests include increased production costs, reduced income, and possible exclusion from overseas markets. The APB also tries to minimise other adverse effects, so that the environment is relatively unaffected by pests and people's welfare is maintained.

Activities intended to achieve the protection objectives concerned with pest and environmental management are supported by research and service programmes. The APB also maintains a close liaison with the Department of Agriculture and the Department of Conservation and Land Management, at both the administrative and field level. The APB is responsive to the points of view of community groups concerned about issues such as conservation, pesticide usage and animal welfare.

Protection objectives are best achieved by gaining public support and participation and by explaining, demonstrating and promoting appropriate protection measures rather than relying on regulation. The protection programme is primarily implemented by means of educational and advisory strategies.

Declared species (those which landholders are obliged to control) have been grouped according to priority, on a regional basis, under the following guidelines.

Priority 1 - species not established - exclusion

Priority 2 - species very limited in distribution -eradication

Priority 3 - species established - high priority for control

Priority 4 - species widely established - lesser priority for control, suppression of economic effects, eradication of small infestations with serious potential.

Operational plans are drawn up for each region, setting out objectives and planned activities and describing how progress towards the objective is to be measured.

These regional operational plans are linked together by species management plans for each of the most significant declared species, or in some cases groups of species which are managed in a similar way.

The species management plans describe the strategies for managing the pest and the rationale behind these strategies. The plans aim to provide a statewide framework as a basis for planning at regional levels.

The Board's staff of some 260 is organised into two functional groups. The head of each group is a member of the executive management team and reports to the Chief Executive Officer. These groups correspond to the two programmes of protection (field activities) and research.

1. INTRODUCTION

Feral pigs are considered a pest species in Western Australia because of the damage they cause to agriculture and the environment. Although they have been recognised as a problem for at least 20 years, they are generally seen by most primary producers as a minor threat to production. However, there is an unknown potential for numbers of feral pigs to increase, with a consequent increase in damage.

Feral pigs are reported to be present in 8 of the 11 agricultural and pastoral zones of Western Australia however, there is very limited information on their abundance. The main populations are established in three separate areas of Western Australia, and feral pigs are probably most abundant in agricultural areas around Geraldton, with smaller numbers in the south-west and some river systems of the Kimberley region. Reports indicate that feral pigs are still extending their range, particularly in the south-west.

The Agriculture Protection Board (APB) has gazetted feral pigs as declared animals. The declaration restricts introduction and movement, places the responsibility for control on landholders and restricts their keeping by the public.

Eradication of feral pigs over a large area is probably impractical. However, local control in the event of an exotic disease outbreak might become necessary. In Western Australia poisoning with 1080, trapping and shooting are the control techniques generally used. Hunting is occasionally used for control but is more commonly a recreational activity. Barrier fencing is used on a very limited scale to exclude pigs. The timing of control and choice of techniques is best based on a knowledge of pig biology and behaviour.

This document is intended tp provide a general outline of the APB's policy on feral pigs and to briefly describe the management processes which are currently in use. The Species Management Plan is not intended to provide specific details on how to control feral pigs. Information on control techniques, in the form of Infonotes, is available from any APB office.

1.1 STATUS & PRIORITY

Feral pigs are a declared species of animal under the ARRP Act. They may only be kept under permit and their numbers are to be reduced by landholders to minimise the potential damage that could occur if the animals were left uncontrolled. Feral pigs are a priority 3 species (see Preface) for the whole of the state.

The objectives adopted by the APB to protect agriculture and the environment from the harmful effects of feral pigs are:

i) restrict the introduction and spread into new areas;

ii) control of infestations where possible; and

iii) the implementation of control programmes to minimise the effect on agricultural production and the environment.

1.2 MANAGEMENT POLICY

Feral pigs are declared to be pests because they cause damage to agriculture and the environment, and because they have the potential to carry and spread exotic diseases of livestock and humans. The activities of feral pigs are clearly detrimental to the natural environment in Western Australia, but this is difficult to quantify in economic terms. Damage to agriculture is economically significant at a local but not at the State level. The serious economic consequences of an exotic disease of livestock remain a potential threat. In the absence of exotic diseases, feral pigs have a relatively minor economic impact in Western Australia.

The original policy of the APB was to eradicate feral pigs throughout the State. However, experience elsewhere in Australia indicates that eradication over a large area is virtually impossible, and is extremely expensive over a smaller area. A policy of maintaining the population at a low level is considered achievable and is appropriate to the present economic significance of the pest.

Damage and Economic Significance

Although feral pigs are reported to be widespread, reports of damage are not common, suggesting that they are a minor problem overall in spite of causing serious losses to individual producers. Only three districts in WA reported that pigs caused damage on 10% or more of

properties. In most districts damage occurred on 2% of properties or fewer (APB Questionnaire Survey, 1990 unpublished). There is no estimate available of the total value of damage currently caused by feral pigs in Western Australia.

Damage to Agriculture

Feral pigs affect agriculture directly by feeding on crops and livestock, causing damage by rooting and trampling crops and pasture, and by harbouring and spreading diseases and parasites (Tisdell 1982). Damage tends to be local but the overall costs to the Australian agricultural industry were conservatively estimated at $50-80 million per year in 1982 (Tisdell 1982). Crops damaged by feral pigs include cereals, grain legumes, sugar cane, orchard and forestry plantings, and pasture (Tisdell 1982). Physical damage to fencing and water supplies occurs, as well as increased soil erosion and reduced water quality resulting from rooting and wallowing (Tisdell 1982). In Western Australia damage to crops and pasture was reported by 32% of districts where feral pigs were present. Direct losses to grain crops were probably most significant, with losses to some lupin crops amounting to tens of thousands of dollars per year (APB Questionnaire Survey, 1990, unpublished).

Livestock production can be affected indirectly through the destruction of pasture by rooting and grazing, or directly by predation, mainly on lambs. Direct predation on livestock has only rarely been reported in Western Australia.

Damage to the Environment

Damage to native ecosystems has rarely been quantified but some effects are clear. Rooting of soil causes physical damage, erosion, increased water turbidity, nutrient enrichment of naturally low nutrient waters, and affects soil fauna. Rooting reduces the ground cover, sometimes changes the composition of plant communities and can facilitate invasion by weeds (Alexiou 1983; Hone 1980). Feeding on native plants and animals is directly destructive, and presumably results in competition with native animals dependent on the same food resources. Some 30% of reports of damage by feral pigs in Western Australia referred to damage to the environment (APB Questionnaire, 1990 unpublished).

Feral pigs cause another environmental problem which is difficult to quantify: by their presence they attract hunters, who often operate illegally. Some hunters may disturb or kill other animals, use firearms illegally, trespass in quarantine areas, contribute to the spread of declared plants (noxious weeds), and occasionally put the public and government employees at risk. To an unknown extent, hunters are responsible for maintaining and even spreading populations of feral pigs. Hunters' dogs are thought to have introduced hydatid disease into populations of feral pigs and western grey kangaroos near Perth (Thompson 1988).

Parasites and Diseases

There is circumstantial evidence that pigs spread the fungal pathogen *Phytophthora cinnamomi* which causes jarrah dieback disease in Western Australia (Masters 1979). Pigs can harbour a number of pathogens affecting livestock and man, including tuberculosis, brucellosis, salmonellosis, toxoplasmosis, anthrax and leptospirosis, and the tapeworm parasites *Echinococcus granulosus* (which causes hydatid disease) and *Spirometra erinacei* (Tisdell 1982). Hydatids have been recorded in feral pigs and kangaroos from the Canning and Mundaring water catchments since 1990 (Thompson 1988).

Arguably the greatest threat posed by feral pigs is a potential one: they could act as hosts or vectors for several important diseases of livestock not yet present in Australia, such as foot and mouth disease, African swine fever, rinderpest and rabies. Should any of these diseases be introduced and become established in feral pig populations in Australia, eradication would be extremely difficult and costly. The presence of such diseases would have dramatic adverse effects on Australian livestock industries, with immediate losses of export markets worth billions of dollars (Beckmann and Davidson 1990) until eradication of the disease could be proved.

Computer models to predict the likelihood of foot and mouth disease establishing and spreading in feral pig populations have indicated that the disease can readily be sustained in populations with densities of 1.4 pigs km-2, and spread when densities are 0.53 pigs km^{-2}. Populations of this level almost certainly exist in some areas of the south-west of Western Australia.

Unless infected populations are reduced to very low (>95% reduction) levels, foot and mouth disease would be expected to spread unchecked. Because of the low probability of signs of infection being observed and reported to health authorities, the disease is likely to go undetected for 29 days or more in high density populations and much longer in low density populations (Pech and McIlroy 1990).

1.3 COMMUNITY ATTITUDES

The community's attitudes to feral pigs varies with each community group's interests. Hunters regard feral pigs as an asset and some have allegedly contributed to their spread within the south-west of Western Australia. Unlike the situation in the eastern states hunters in Western Australia do not generally pay for pig hunting rights. As well as hunting rights, feral pig meat has not been commercialised in WA. The presence of hydatids in feral pigs in a few locations has reduced the potential commercial value of feral pork.

Farmers regard feral pigs as a pest needing control. Due to feral pig mobility, farmers experiencing damage often have to undertake control programmes for pig populations that reside on adjacent land. This can lead to disputes about the responsibility that various landholders have over itinerant feral pigs. Managers of public land including state forests and national parks also need to take into account the presence of feral pigs in their overall management plans.

Conservationists consider feral pigs should not only be prevented from expanding their range in WA but populations should also be reduced (if eradication is not possible) in areas where they cause damage to native flora and fauna. Damage to newly planted trees also causes concern to foresters and others involved in tree planting.

2. MANAGEMENT ACTIVITIES

2.1 MANAGEMENT OBJECTIVES

To minimise the effects feral pigs have on:

- the viability of primary production in agricultural areas
- the likelihood of spreading an exotic disease
- the quality of the natural environment
- the quality of water in catchment areas

2.2 MANAGEMENT PROGRAMME

Strategy

To control feral pigs on private and public land so as to reduce their adverse effects on primary production and the environment.

Actions

APB staff will investigate any reported feral pig activity or attacks. If activity is confirmed a control programme may be instigated either by the landholder or the APB (see 2.3 below), using any of the following techniques:

- grain bait or processed feeder pellets dosed with 1080 (ONLY to be carried out by officers trained and certified to use 1080 for this purpose)
- trapping, using panel, funnel or figure 6 trap designs
- shooting using .243 or .308 calibre rifle, or 12 G shotgun with SG or SSG ammunition. Hunting is being investigated as a control technique by CALM.

2.3 LEGISLATION AND ENFORCEMENT

Enforcement options under the Agriculture and Related Resources Protection Act (ARRPA) have very limited application within the management plan.

Feral pigs are very mobile animals, their range may extend over a number of properties which exacerbates the requirement to place the responsibility for control on landholders. While the provisions of the Act provide ample power to the APB to direct private and local authority landholders to undertake control work, no such provisions exist to direct government departments to undertake control on land under their control. Teh APB relies on other government departments to discharge their responsibilities to control feral opigs and to co-operate with the APB and adjacent private landholders in this regard. Control of feral pigs is designed to protect the environment and water quality just as much as agriculture. In the south-west at least, most pigs reside on government land.

This being the case, a co-operative approach with the APB co-ordinating the effort of various landholders seems appropriate.

The APB has categorised feral pigs as A4, A5 and A6 which means -

A4 - (movement) that feral pigs may not be brought into the state or moved within the state without a permit issued under the Agriculture and Related Resources Protection (Declared Animals) Regulations 1985.

A5 - (control) places the onus of control on landholders. Control under A5 means to either destroy, prevent and eradicate or in its more literal meaning to reduce and restrict the numbers of animals.

A6 - (keeping) provides a mechanism whereby people may keep feral pigs under permit subject to the ARRP (Declared Animals) Regulations 1985.

Under the ARRPA a number of enforcement actions are possible, which include -

- Negotiation of a mutually agreeable control programme.
- Service of a notice on a landholder directing certain action be undertaken.
- Prosecution of a landholder for failing to comply with a direction notice.
- The power to carry out the requirements of a direction notice where the landholder fails to comply and to recover the cost of the work.

- Power to demand a person deliver a declared animal into custody.
- Power to order destruction or to seize and destroy or dispose of a declared animal where it is being held contrary to the Act.
- Power to prosecute a person who wilfully liberates or abandons declared animals.

2.4 IMPLEMENTATION

It is the responsibility of the landholder (private and public) to undertake full control of feral pigs. In conjunction with local APB district staff, landholders may call on the APB to carry out specialised poisoning operation, or provide advice in relation to control.

2.5 OPERATIONAL

The APB provides technical advice, assistance and a service for the control of feral pigs by poisoning. Landholders are responsible for carrying out all other types of control, but in some instances control may be completed by the APB under a contract.

Private Land

In the northern agricultural areas and the south-west, 1080 bait preparations (pig pellets, lupins and oats) and trapping are the most commonly used control methods. In the Kimberley region feral pigs are shot opportunistically by pastoralists and APB officers when they are encountered during routine inspections and operations. The large area and remoteness of the region makes poisoning or trapping impractical.

Public Land

Feral pigs on Crown land are controlled by the agency with which the land is vested using poisoning, trapping and shooting. These methods are also used in government reserves, subject to the agreement of the department or agency involved. In these situations the APB often provides assistance or advice..

Timing of Control

In northern agricultural areas control is generally carried out between June and October while growing cereal crops are vulnerable. Additional control is carried out when necessary.

Seasonal factors determine the timing of control in the Kimberley and south-west regions. Access is often only possible outside the wet seasons (i.e. May-September in the Kimberleys, September- March in the south-west).

In all cases, care is taken to avoid baiting in sensitive areas including the vicinity of towns, communities, public roads and recognised recreational areas. If necessary, alternative control techniques are considered.

2.6 EXTENSION AND PUBLIC EDUCATION

All APB regional staff regard personal contact with landholders as the most effective extension method. However, APB officers in the south-west consider that excessive extension and public education may actually be counter productive: awareness of the presence of pigs may lead to increased illegal hunting activity. There is however, a need for increased public awareness of the links between hydatid disease and illegal hunting.

In the northern agricultural areas public education and extension is carried out through departmental memos (mailed to landholders), newspaper articles and local radio and television programmes.

Extension is considered unnecessary in the Kimberley region, which has low numbers of feral pigs distributed over very large areas.

2.7 PROTECTION OF HUMAN HEALTH

Section 68 of the ARRP Act confers power on the APB to prohibit people taking declared animals. This section is used in the outer metropolitan area where feral pigs are present and are much sought after by recreational hunters.

The legislation aims to prevent people taking feral pigs for human consumption from specified areas where poisons such as 1080 may be used for control or where diseases such as

hydatids may exist. It may also be used to prevent people interfering with control methods such as trapping. The legislation requires the APB to advertise the prohibitions in the Government Gazette and local newspapers.

Where poisoned bait is laid, warning notices must be displayed at entry points and in the immediate vicinity of the control work.

2.8 TRAINING

APB staff are given training in the field in the preparation of 1080 bait material, trapping techniques and the use of firearms. They are also trained to recognise signs of feral pig activity. They advise landholders on appropriate control techniques and if necessary instruct them in the safe and effective use of such techniques. Landholders are not permitted to carry out their own 1080 poisoning programmes.

2.9 RESEARCH

There has been considerable research into aspects of the biology and control of feral pigs, particularly in areas of eastern Australia where numbers of pigs are very high.

During the last six years (1985-91) the APB has carried out research into the biology of feral pigs in the agricultural area, and a variety of control methods which can be used to mitigate damage caused by feral pigs have been developed. The results of this research have led to the recommendation of specific trapping and 1080 poisoning techniques for the control of feral pigs. This information is available to landholders through their local APB officer and in the form of written Infonotes.

3. FUNDING

There are no specific allocations for feral pig control by government authorities such as the APB, Department of Conservation and Land Management (CALM) and the Water Authority of Western Australian (WAWA).

The APB is not a landholder and as such is not obliged to control feral pigs. It may carry out control programmes on behalf of landholders, with the landholder paying a fee for the service. The APB has allocated funds towards research into the biology and control of feral pigs, in particular the use of 1080. In addition the APB has received of funds provided by the Commonwealth Department of Primary Industry and Energy (from 1987-1991) to further this research work.

The Department of CALM does not have a specific fund for feral pig control. Rather, District Managers submit an annual budget which may include an item which could be used for the control of feral pigs in their district.

Similarly the WAWA does not have a specific fund for feral pig control in catchment areas. In the event of control being required, money is obtained from a general fund which services catchment management in that area or region. Control programmes are initiated only when water quality is directly affected or if neighbouring landholders are being affected by pigs which reside on WAWA managed land. In general funding allocation for feral pig control is low and on a needs-must basis.

4. EVALUATION AND REVIEW OF PROGRAMME

The current declaration status of feral pigs (category A4, A5, A6) provides sufficient legislative power to cope with any changes in the numbers of feral pigs existing in the wild, their distribution, or the level of damage they are causing to be adequately dealt with by means of existing control methods.

The Species Management Plan will be reviewed as the need arises (eg when the APB's corporate, strategic and operational plans are revised).

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6. APPENDICES

6.1 GENERAL BIOLOGY

Identification

Feral pigs are the wild, free-living descendants of domestic pig stock derived from the Eurasian wild boar, *Sus scrofa*. Most Australian feral pigs originated from domestic stock imported by European settlers, but some may be of south-east Asian origin (Pavlov 1983). They vary considerably in size, colour and conformation. Pigs of recent domestic origin tend to be large and heavy and are often white or piebald rather than black (Masters 1979). Feral pigs from long-established populations tend to be small, with longer snouts, heavier forequarters and shorter backs than domestic breeds (Pullar 1953).

Adult feral pigs vary in size and weight in different habitats and under different conditions. Weights of adults generally range from 30 to 115 kg, with sows lighter than boars (Pavlov 1983). In a sample of adult feral pigs from the south-west of Western Australia, average live weights were 40 kg and 60 kg for sows and boars respectively (Masters 1979).

Distribution and Abundance

Feral pigs are widespread in Australia, surviving in a range of habitats from tropical to semi-arid and sub-alpine (Pech and Hone 1988). In Western Australia they are most numerous in the forest country of the south-west (Masters 1979), in agricultural areas north of Geraldton, and in the Kimberley region. Numbers are probably highest in the agricultural areas. Recent sightings of a few feral pigs as far south as Pemberton and eastwards to the Stirling Range suggest that feral pig populations are spreading, possibly as a result of deliberate releases.

It has proved extremely difficult to estimate numbers of feral pigs, particularly in densely vegetated habitats. Estimates of the total feral pig population in Australia range from 4 million to 20 million (Beckmann and Davidson 1990), but there are probably fewer than 35 000 in Western Australia. Of 19 agricultural and pastoral districts surveyed, 6 could give no estimate of feral pig numbers, 11 had estimated populations of 1000 or less, and only 2 had estimated populations of over 1000 (Geraldton/Chapman Valley and Northampton with approximately 10 000, and West Kimberley with about 3000). Estimates were based on sightings, signs of activity, numbers killed, and reports from landholders.

Distribution and numbers have increased over the past 50 years but population densities generally remain low, suggesting that there is little likelihood of numbers reaching the very high levels seen in parts of eastern Australia. Densities of feral pig populations vary considerably from habitat to habitat, depending on the available resources. In eastern Australia densities of 5 to 10 pigs/km2 are common in productive habitats such as agricultural areas (Mitchell *et al* 1982) and numbers may reach 50 pigs/km^2 (Giles 1980). In Western Australia numbers may locally reach 4 pigs/km^2 in jarrah forest, but the overall density is probably less than 1/km^2 (Masters 1979).

Feral pigs are vulnerable to high temperatures, and in areas where temperatures regularly reach 30°C or more they need shelter and daily access to water (Allen 1984; Hone et al 1980). Over most of their range they are restricted to the immediate vicinity of watercourses or swamps, where water is available and vegetation is thickest. In Western Australia feral pigs tend to be found along watercourses, even in the forests of the south-west (Masters 1979). No pigs were reported from districts with annual rainfall below 300 mm.

Social Biology

The social biology of the feral pig is similar to that of the wild boar (Mauget 1981). The basic social unit comprises the adult sow and her litter, sometimes with sub-adults from previous litters. Two or more females and litters may make up a group (Masters 1979; Mauget 1981). Females and juveniles are gregarious, while males become increasingly solitary with age; adult boars tend to associate with groups only when sows are in oestrus (Masters 1979; Mitchell et al 1982). Group size varies with habitat and availability of food. In the jarrah forest of Western Australia, groups of more than 12 pigs are rare (Masters 1979), but larger groups are found in more productive country (e.g. swamps and agricultural country) and groups of over 50 pigs are reported in parts of north-eastern Australia (Mitchell et al 1982).

Feral pigs occupy distinct home ranges but do not appear to exclude other pigs or defend large areas; there may be considerable overlap of home ranges (Pech and Hone 1988). The size of a home range varies with the habitat and the resources available, with larger ranges found in less

productive areas. Adult sows tend to move less than adult boars (Hone et al 1980), particularly when their litters are young. In western New South Wales adult boars ranged over total areas of 10 to 50 km², compared with 5 to 20 km² for sows (Hone et al 1980; Hone 1984).

Limited radiotracking studies in Western Australia have measured home ranges of between 1.0 and 2.0 km² over periods of up to 6 months; sows and boars had ranges of similar size. Home ranges in agricultural areas tended to be smaller than those in jarrah forest. Feral pigs are capable of considerable short-term movements under conditions of stress, and individual pigs are known to have moved up to 55 km in response to disturbance (Saunders and Bryant 1988). Daily movements of 8 km or more may be made between feeding and refuge areas (Giles 1973).

Feral pigs have poor eyesight and rely on their acute senses of smell and hearing to find food and avoid danger (Tisdell 1982). They tend to be most active after dusk and around dawn (Giles 1980; Tisdell 1982). This crepuscular activity avoids exposure to high diurnal temperatures and minimises contact with humans (Tisdell 1982).

Reproduction

Feral pigs have a high reproductive capability and may breed at any time of year, but environmental factors and food availability tend to impose some seasonality.

The gestation period is about 114 days (Henry 1968). The time between birth and the next fertile mating can be as short as 2 months (Hone 1984), making 2 litters per year possible in good conditions. In Western Australia one litter per year is typical, with a breeding interval of about one year (Masters 1979).

Sows can bear their first litter at around 8 months of age, if their body condition is good. A minimum body weight of 25-30 kg is typical (Allen 1984; Hone 1984), but lighter sows sometimes bear litters. In the south-west of Western Australia the number of pregnancies peaks in winter, when more food is available and the sows are in good condition (Masters 1979).

The feral sow bears her litter in a sheltered area, often building a farrowing nest using vegetation (Giles 1980; Pavlov 1983). Feral sows generally have smaller litters than domestic pigs, with an average of 6 young (Hone 1984). Litter size in both domestic and feral sows tends to increase with age over the first four years of life (Giles 1980). In south-west Western Australia, 72 litters ranged in size from 1 to 10 young, with an average of 5.3. Litters were larger from sows which had access to additional food sources on agricultural land (Masters 1979). In the south-west of Western Australia mortality of feral pigs between birth and weaning has been estimated at about 27% (Masters 1979). In spite of such losses, feral pig populations can double in size in a year in good conditions (Allen 1984).

Diet

Feral pigs are true omnivores but they generally rely on plant material for the bulk of their diet (Giles 1980; Masters 1979; Pavlov 1983). In the south-west of Western Australia the diet of feral pigs includes the fruit and roots of the cycad palm *Macrozamia*, berries of *Persoonia* (snottygobble), grasses, forbs and clover, roots and bulbs, fungi, invertebrates, frogs, lizards, birds, and mammals, the last mainly as carrion (Masters 1979).

Marked changes in diet reflect changes in the availability of particular food items (Giles 1980; Masters 1979). Agricultural crops, especially cereal grains, may be seasonally important to feral pigs in Western Australia, and lupins, oats and wheat are all eaten. Where such high-protein grains are part of the diet, feral pigs are reported to show increases in litter size and body weight, and improved survival (Mitchell et al 1982).

6.2 CONTROL METHODS

Poisoning

Since 1985, sodium monofluoroacetate (1080) has been widely used to poison feral pigs in W.A. This toxin is preferred because many native mammals have a degree of tolerance to 1080 (King 1982; McIlroy 1986). However, feral pigs have a large body size and are not particularly sensitive to 1080, which means that large quantities of bait and a relatively high concentration of 1080 must be used. Risks to non-target species can be minimised by choice of bait type, burying the bait or placing it in areas where only pigs are likely to find it, and by presenting poisoned bait for the minimum period.

In Western Australia a fixed dose of 1080 is used with a fixed volume of bait material (4 000mg 1080 to the contents of one standard bait mixing drum). This results in a 1080 concentration of 0.057% by weight in wheat bait, 0.05% in feeder pellets, and 0.04% in lupins. These dose rates are similar to recommended rates which have proved effective in eastern Australia: 0.033% in wheat bait and 0.05% in pellet bait (O'Brien 1988).

Anticoagulant poisons such as Warfarin have been used to control pigs in eastern Australia, but not in Western Australia. Most anticoagulants are chronic poisons and must be presented over a long period (7-14 days) to be effective, increasing the risk to non-target animals. The effects of anticoagulant poisoning can be reversed by medical treatment, unlike those of 1080 poisoning.

Both 1080 and Warfarin have been shown to be highly effective in some circumstances, killing 80-90% of a target pig population (Saunders and Bryant 1988; McIlroy 1989; Choquenot 1990). However, the effectiveness varies considerably, even using the same bait and toxin at the same site at different times, and kills of only 30% are also recorded. Variations in the success of poisoning can be caused by seasonal changes in behaviour or food preferences, changes in availability of food, or disturbance by hunters or farmers.

Free-feeding with unpoisoned bait material is necessary to encourage regular feeding by pigs before poisoned bait is used, particularly in the case of 1080. Only grain bait and processed feeder pellets are recommended for use with 1080 in W.A. Other foods such as apples and meat may be used to attract pigs initially but are also attractive to many non-target species and should not be used in poisoning.

Costs of poisoning are relatively low. Overall costs per pig killed are probably below $10.00 in many cases, but real costs are difficult to estimate since carcasses are often not found. Costs of poisoning small numbers of pigs are disproportionately high, because a lengthy free-feeding must take place whatever number of pigs is involved.

Trapping

Several trap designs have been used successfully and trapping is used frequently by the APB. Growers who regularly experience damage often maintain traps to remove at least part of the feral pig population. Trapping can be effective (Saunders 1988), but depends on seasonal factors, good trap design, careful free-feeding, and minimal disturbance of the target pig population. Sows and young pigs are generally more easily trapped than boars. The technique is costly, particularly in terms of time, and is unlikely to be useful for quickly reducing a large population (Saunders 1988). It can be used where poisoning may not be acceptable (e.g. water catchments, national parks), or as a follow-up to other methods. In one trial in jarrah forest in 1988, pigs were trapped at a cost of about $50.00 per animal.

Hunting (using dogs)

Trained dogs can be used to locate and catch pigs which are then killed by the hunter. Recreational hunting is common, but there have been few quantitative trials of the method (McIlroy and Saillard 1989). Most pig-hunting in Western Australia takes place in jarrah forest or other thick vegetation, and most of the dogs used here hunt by scent. In open habitats in eastern Australia sight-hunting dogs are used. Hunters generally operate for sport and do not aim to eradicate pigs or seriously reduce their numbers. Illegal hunting can be a considerable nuisance.

A trial of hunting in jarrah forest in south-western Western Australia showed that at least one third of all the pigs encountered escaped from the dog. When groups of pigs were encountered usually only one was caught. In the trial, pigs did not disperse over long distances in response to occasional hunting, but in eastern Australia a few pigs are known to have moved 20 km or more in response to disturbance by humans (Saunders and Bryant 1988). It is possible that more intensive hunting would disperse some pigs that escaped from dogs. This might be effective in reducing short-term damage but would not be acceptable in the event of an outbreak of an exotic disease.

The effectiveness of hunting depends largely on the skill and experience of the hunter and dogs. There are no professional pig hunters in Western Australia.

In the hunting trial the cost per pig killed was approximately $25.00.

Aerial Survey and Shooting from Helicopters

In open habitats with large numbers of pigs in northern and eastern Australia, helicopters have been used sucessfully in locating and counting pigs. In these areas large numbers of pigs are shot from the air, and in some cases populations have been reduced by over 80%. The relative costs of shooting increase greatly as numbers decrease and surviving pigs learn to hide from the

helicopter (Saunders and Bryant 1988).

In Western Australia pigs are present at low densities in heavily vegetated habitats, and survey from helicopters has proved impractical. During attempts to eradicate feral pigs from a small island in the northern Kimberley region, 17 pigs were shot from a helicopter during 25 hours of searching. The cost per pig killed was over $380.00, clearly excessive for a routine control method. Comparative costs in shooting exercises in northern and eastern Australia ranged from under $4.00 to over $40.00 per pig, depending on the initial population size, area covered, and degree of control required.

Shooting feral pigs from helicopters does not appear to be a useful option in Western Australia, but helicopters are valuable for locating pigs in remote or inaccessible areas.

Fencing

Barrier fences can be built to exclude or contain feral pigs. Successful designs include a 5-wire electric fence or hinge-joint or ringlock netting with barbed wire (Hone and Atkinson 1983). Purpose-built fencing would cost $1500-$2000 per kilometre, and would only be justified to protect high value crops or in the event of an exotic disease outbreak. A cheaper alternative is to place one or more electrified outrigger wires on an existing fence - this can be effective if pigs have not already become accustomed to crossing the fence (Allen 1984).

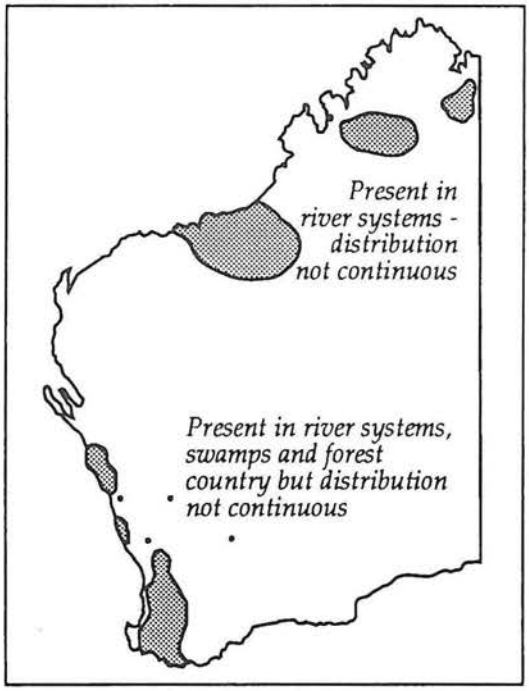
Captive feral pigs were used in tests of various designs of fencing in eastern Australia (Hone and Atkinson 1983). No research trials of electric fencing to exclude feral pigs have been carried out in Western Australia and the sporadic nature of damage caused by pigs would make fences difficult to test in the field.

Prevention of the most serious agricultural damage reported in Western Australia (losses to lupin crops) by using fencing would be expensive and difficult, because of the size of the paddocks involved.

Other Control Options

A number of other methods have been suggested for the control of feral pigs, including the use of chemosterilants, the use of a specific disease pathogen, and modification of habitats to exclude feral pigs. None of these methods has been applied successfully elsewhere, and they offer no obvious advantages for the control of feral pigs in Western Australia. The economic significance of feral pigs is not sufficient to justify the use of such expensive and unproven techniques.

6.3 CURRENT DISTRIBUTION OF FERAL PIGS IN WESTERN AUSTRALIA



6.4. RESPONSES TO DRAFT FERAL PIG SPECIES MANAGEMENT PLAN

The following points were raised by the various respondents to a draft copy of the APB's Feral Pig Species Management Plan. Each point raised is listed, whether it was included in the ammended draft and the reason for including/excluding it.

Organization	Comment	Included (Y/N)	Reason
Department of Conservation and Land Management	Management of public land	N	General comment
	Confirm sightings of f/p in east Stirlings	N/A	Confirmed with APB staff, CALM advised
	Q. word 'appropriate', p7 para 4	Y	deleted from text
	kangaroos spread dieback	N	anecdotal, noted
	include hunting as a control method	Y	relevant, added to text
Murdoch University	Include additional zoonotics	Y	added to text
Water Authority of W.A.	Plan is a position statement	Y	More precise prescription, added to text
	Need to review Kim Master's 1979 work	N	Not high priority, no funds, pop'n dynamics of pigs unchanged
	review use of 1080 in catchments	N	Current guidelines appear satisfactory
	change wording in 'Trapping' p15	N	adequate as is
	refer to organization as Water Authority	Y	valid request
Environmental Protection Authority	Damage to the environment	Y	relevant
Bureau of Rural Resources	Purpose and target audience not clear	Y	relevant
	Eliminating pop'n is unrealistic	N	covered in section 1
	No strategy for assessing impact of pigs. Need to monitor and evaluate control programmes	N	not APB role. CALM monitors environmental damage
	No details on control techniques	N	policy paper, not an Infonote
	Need to specify how APB/land-holder co-ordination is achieved	N	covered in preface

APB (Three Springs)	Responsiblity of government depts. No APB authority	Y	expand section 2.3
	Restriction of movement of f/p , enforcement	Y	local policies should apply
APB (Zone 1B)	Exacerbate spread of Noogoora burr by attracting hunters/dogs	Y	relevant
	f/p management should be preventative not responsive	N	nature of the beast
	significance to agriculture	N	covered in section1, p3
APB (Executive)	who initiates control?	Y	text amended
	include a distribution map for the state	Y	included in text
	Section 2 to be more prescriptive	N	plan is only a brief outline of policy