Economic assessment of the impact of dingoes/wild dogs in Queensland

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This report was commissioned by the Department of Natural Resources and Mines and completed by Rural Management Partners, an independent consultant. The information in the report may not represent the views of the department.

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- The Department of Natural Resources and Mines (NR&M) formed a steering committee for the purpose of providing data and feedback on the progress of the work. Departmental members of the steering committee included Elton Miller and Scott O'Keeffe from the Pest Management Strategy, while external members included Robert Pietsch and Will Banks from AgForce. During the course of the study several meetings were convened, where useful comment and feedback was provided.
- Paul Paping from the Pest Management Mapping section provided major assistance with information on the usage of 1080 throughout the state, and the distribution of the wild dog population.
- More than 30 graziers affected by wild dog predation were interviewed by telephone for their assessment of production losses and control costs. All of the technical comment made in this report is based on either 'expert opinion' gleaned from respondents, or background material taken from the literature.
- Mr Lee Allen, the department's principal dingo researcher provided detailed comments on an early draft.
- Mr Mark Goulett from FERALS OUT was primarily responsible for the semi-urban case studies, while Scott O'Keeffe assisted with background on the management issues.

List of acronyms

ABS	Australian Bureau of Statistics
AMH	Australian Meat Holdings
AQIS	Australian Quarantine and Inspection Service
BRS	Bureau of Rural Sciences
DPI	Department of Primary Industries
DPI&F	Department of Primary Industries and Fisheries (formerly DPI)
EPA	Environmental Protection Agency
LPO	Land Protection Officer (NR&M)
MCC	Mackay City Council
MLA	Meat and Livestock Australia
MSC	Maroochy Shire Council
NR&M	Department of Natural Resources and Mines
QPWS	Queensland Parks and Wildlife Service
R&D	research and development
TCC	Townsville City Council
WDBF	Wild Dog Barrier Fence
1080	sodium fluoroacetate

Executive summary

- The Department of Natural Resources and Mines (NR&M) commissioned Rural Management Partners to estimate the cost of dingoes and wild dogs to Queensland's rural industries, particularly the grazing industry. The associated study also examined, in less detail, the impacts of dingoes and wild dogs on rural fringes/semi-urban communities. The study then evaluated the merits of different control methods.
- The study collected primary data by interviewing 32 graziers by phone, and gathered supplementary cost data for 2000–01 from local government officers and NR&M Land Protection Officers (LPOs). Case studies in several shires demonstrated the likely impacts of dingoes and wild dogs in semi-urban areas in Queensland.
- The costs incurred from the presence of dingoes and wild dogs include livestock losses due to predation and spread of disease, control costs, and loss of flexibility in the choice of enterprise mix. Local and state governments, and the Commonwealth Government make substantial contributions to dingo and wild dog control programs, and industry bodies such as Meat and Livestock Australia (MLA) occasionally fund research on the impacts of dingoes and wild dogs.
- The major costs of dingoes and wild dogs (in 2002–03 prices) include:
  - livestock losses of approximately $18.3 million due to predation on sheep and cattle. However, the accuracy of estimates on direct stock losses is affected by the difficulty of establishing statewide loss rates, seasonal fluctuations and livestock numbers and values.
  - losses in the cattle industry of around $9 million per year due to spread of disease. Dingoes and wild dogs are almost solely responsible for the spread of hydatidosis, and are partly responsible for the spread of *Neospora caninum* in cattle.
  - control costs of approximately $5.4 million. The Queensland State Government funded about 30% of total control costs with the rest borne by producers and ratepayers.
  - reduced enterprise mix flexibility. The presence of dingoes and wild dogs contribute to the loss of productive potential when they force sheep to be replaced by cattle, regardless of normal market dictates. Sheep are highly sustainable in semi-desert environments, whereas cattle only perform well in the 'good' years, which occur infrequently.
  - secondary costs to the rural economy when sheep are replaced by cattle as a result of the presence of dingoes and wild dogs. There could be a significant shift in expenditures in outback townships and reduced employment.
- The case studies do not provide an accurate estimate of costs inflicted on semi-urban areas, but they demonstrate that dingoes and wild dogs can reduce the quality of life in many semi-urban areas throughout Queensland. Possible impacts include perceptions of reduced personal and pet safety, health risks, and reduced property values in the presence of dingoes and wild dogs.

Conclusions

- Queensland loses about $33 million (2002–03 prices) annually in terms of control costs, livestock losses due to predation by dingoes and wild dogs, and diseases spread by these pest animals.
- $33 million is a conservative estimate considering there are also opportunity costs resulting from reduced enterprise mix flexibility, and secondary impacts on rural communities due to substitutions of sheep for cattle. The magnitude of this cost can be expected to vary through time depending on interactions between dingo and wild dog populations, seasonal conditions, livestock numbers and values, and the efficacy of control measures.
- Due to the losses incurred by the grazing industry, an awareness campaign is considered appropriate to elicit greater participation from cattle producers in coordinated baiting programs. Baiting is the most effective method of control, but should be used in conjunction with other techniques.
- Future research and development (R&D) should be aimed at gaining a better understanding of how dingoes and wild dogs spread disease throughout the cattle population, and the role that dingo and wild dog control measures play in reducing hydatid infection.
- In addition to agricultural costs, there can be serious impacts from dingoes and wild dogs on semi-urban communities as demonstrated in several case studies in Queensland. A more comprehensive study is required to thoroughly assess such impacts. The case studies demonstrate the difficulty of managing dingo and wild dog problems in semi-urban areas due to complex interactions between social and environmental systems. Little is known about the ecology and habits of dingoes and wild dogs in these areas.
- Determining the most appropriate control measures to employ in urban and semi-urban areas would mean assessing the problems and level of risks faced by the community, and consulting with the community. This work would determine the most appropriate form of animal control to mitigate such risk and the collaborative work required of local and state governments.
- Finally, there are many social dimensions to the dingo/wild dog problem that infer a major role for government. Currently, the market economy is ill equipped to assign all the costs and benefits of dingoes and wild dogs to responsible parties. It was not possible to quantify the cash cost inflicted by dingoes and wild dogs on semi-urban communities, due to the complex nature of such costs relative to resource and time constraints applied to the study. Under these circumstances, the current involvement of local and state governments should be retained while fostering greater community understanding of the dingo/wild dog problem and issues.

1 Introduction

1.1 Identifying the cost of dingoes and wild dogs to the Queensland economy

The dingo is defined as both 'wildlife' and 'native wildlife' under the *Nature Conservation Act 1992* (Qld). This makes the dingo a natural resource within protected areas such as national parks. Outside of protected areas, however, dingoes are a declared pest and can be controlled by landholders according to economic dictates.

Therefore, the relevance of moderating impacts is geographically dependent. The economic impacts of dingoes would be minimal if they could be confined to protected areas, but their high mobility, combined with few material barriers to movement, allows them to enter new areas and give rise to economic and social costs.

Further complicating the issue is the fact that dingoes have bred extensively with particular domestic dogs that have flourished in the wild. If this continues, the dingo as we know it is likely to disappear (see Brown 2002). In any event, there is no practical distinction between the behaviour and consequences of predation by dingoes and wild dogs. The result has become the so-called 'wild dog problem', which is widespread outside parks and reserves. As such, the reference throughout this report will be to 'wild dog' impacts.

In this report, the focus is on cost impacts in areas throughout Queensland that have a dependence on some form of mainstream economic activity—principally grazing, but also rural residential. The cost due to wild dogs refers to one 12-month period. The 12-month period used by this study was nominally 2002–03, but the cost estimate developed can be taken to refer generally to the early part of the current decade.

The cost of wild dogs[1] to the Queensland economy can be broken into the following categories:

- livestock deaths in rural and semi-urban areas
- reduced livestock performance and wellbeing due to harassment and non-fatal bites
- spread of disease that either affects production directly, or leads to reduced carcass value[2]
- cost of control (fencing, baiting, trapping etc.), including the time involved
- in areas with a comparative advantage in sheep, opportunity losses from not being able to run sheep once wild dog predation exceeds threshold levels

[1] Other predators that compete against wild dogs, and thereby cause livestock losses, are feral pigs, eagles and foxes. The extent to which these predators compete against each other within an area remains a matter for further investigation and analysis.

[2] Most of the disease risk associated with wild dogs is confined, at this stage, to diseases affecting livestock. However, there are exotic diseases linked to dogs that can affect human health. Rabies, for example, is presently exotic to Australia, but if it were to find its way into the country and become established, wild dogs would pose the greatest risk to its maintenance and spread. As rabies is mainly a problem for human health, most of its impact would occur in rural residential areas.

- direct costs and loss of amenity in affected semi-urban areas.

Offsetting the above, to some small extent, are impacts that can act to assist the grazing industry. Firstly, wild dogs may displace foxes from a region. This means that an area with a resident wild dog population might not suffer fox problems. Secondly, wild dogs prey on macropods and, to this extent, reduce the competition for scarce pasture resources. In practice, wild dogs prey on a range of native fauna, and many people, including graziers, consider this a negative impact. In the total scheme of things, the economic 'positives' sometimes ascribed to wild dogs appear to be overwhelmed by the 'negatives' they inflict. The primary purpose of this study is to estimate the actual costs imposed by wild dogs throughout Queensland.

In the past, the threat of wild dog predation has influenced the distribution of sheep and cattle throughout Australia along with many other factors, including climate, native pastures, relative profitability, proximity to transport and markets, and potential to exercise control according to terrain and vegetation. Indeed the geographic distribution of agricultural enterprises is dynamic and cannot be linked to any single factor. Broadly speaking, the distribution of livestock enterprises is tied to a complex combination of economic and environmental influences.

Over the past five to six years, there has been an enormous reduction in Queensland's sheep population, with wild dogs widely regarded as one of the factors that have contributed to the decline. Indeed for some Queenslanders who have left the woolgrowing industry, wild dog predation has been the determining factor. The most recent official (ABS) statistics for the state's sheep population are for 2000–01, but forecasts of subsequent movements in numbers are available from various sources. In any event, sheep numbers throughout Queensland have fallen since 2000–01, and there is a general perception that wild dog impacts have become more widespread and/or more intense. As such, the cost of impacts could be sensitive to the year selected.

It is surmised that increased knowledge of the size and nature of the costs being inflicted by wild dogs will put decision makers in a better position to develop strategies to serve the best interests of the whole state.

1.2 Objectives of this study

The issues supporting the central objective of the study, which is to estimate the actual costs imposed by wild dogs throughout Queensland, include:

- the impact of wild dogs on the grazing industry
- the impact of wild dogs in semi-urban areas
- the relative merits of various control measures.

1.3 Methods and data

In livestock areas, it is assumed that the economic impact of wild dogs will approximate the sum of the costs that they inflict on grazing activity. To estimate this impact on a statewide basis, it is necessary to consider the following issues:

- how wild dogs create a cost (valuation approach versus economic opportunity foregone)
- isolation of the costs inflicted by wild dogs from the costs inflicted by other predators that operate in a similar way

- cash cost of controlling wild dogs, e.g. fencing, baiting, labour for patrolling
- local government areas where the cost applies throughout the state
- aggregation of all cost impacts over a 12-month period
- opportunity cost of not being able to run sheep[3].

The methodology employed by this study was very simple, as it relied on gathering, evaluating and compiling primary data relating to the above cost items. These data were collected by interviewing people with first-hand knowledge of wild dog impacts, namely graziers, LPOs, shire CEOs and Land Protection Services staff. The contact details for the graziers were provided to the author by AgForce on the basis of their locations, and their likely ability and preparedness to provide useful information.

1.3.1 Placing a figure on losses

For the purposes of developing loss estimates, a small number of graziers (32) located in Queensland's pastoral belt were interviewed by telephone (see tables 1 and 2)[4]. Data were also sought from shires and LPOs in affected areas using questionnaires.

The economic target of wild dog predation in rural Queensland is the progeny of livestock breeding units, thus the major impact is loss of lambs, calves and goats. This reduces breeding efficiency (expressed in terms of weaning rate) and productivity generally. A reduced weaning rate has many flow-on consequences including:

- **loss of opportunity to achieve the full production potential of the breeding unit.** For example, a lamb that might cost $20 to replace at birth could be worth two to three times this amount within 12 months, with negligible additional cost. Or a cow that fails to raise a calf will impose a fixed cost on the business (for 12 months' feed and husbandry) without making any contribution to the sustainability of the business. A value might also be placed on the interest foregone on the income foregone.
- **reduced self-sufficiency and economic sustainability in terms of replacing adult livestock as they are culled for age and productivity.** This is particularly important to remote area woolgrowers who have limited scope for purchasing replacements. The competitive advantage of remote area wool production lies in self-reliance, low inputs and turn-off of a high unit value product (i.e. wool). But if the isolated grazier's capacity to breed replacements is denied by wild dog predation, the underlying strength of the business is eroded and viability threatened.
- **reduced supply and higher prices for store cattle at a time of greater specialisation.** If the larger and more remote cattle properties lose the ability to breed stores cheaply, the efficiency of the whole supply chain will be adversely affected. This is a general concern given the huge investment by Queensland in feedlots and green crop fattening that relies

[3] This is a complex issue with economic, ecological and social dimensions. Some of these are discussed later in the report.

[4] The purpose of the telephone survey was to gain a robust 'impression' of the nature and scale of livestock losses due to wild dog predation in the pastoral regions of Queensland. Due to the limited resources available to the study, it was not possible to undertake a more statistically valid survey. Despite this, we are reasonably confident that the data from which the predation rates were derived are 'reasonable' and generally reflective of the broader situation.

on sourcing replacement stock from the more remote breeding areas. It needs to be appreciated that, as land development has proceeded in Queensland with significant improvements in liveweight gain per unit area, breeding operations have retreated to more extensive areas where control of wild dog predation is often most difficult.

This analysis, however, does not attempt to estimate all of the opportunity losses associated with wild dog predation leading to mortalities. In the case of livestock losses, a valuation approach is used whereby stock killed by wild dogs are valued at their replacement cost. The principle supporting this approach is that at any point in time, we can never be certain of realising opportunities, and it is not entirely clear where a given opportunity terminates. While the formal valuation approach to losses can be stated with certainty, and it applies precisely at the time of the mortality, it is a minimum figure and is definitely conservative given that a probability exists of all opportunities being realised in practice.

The graziers interviewed were asked to put a dollar figure on the cost of replacing lambs or calves lost to wild dogs. There was a significant range in the figures given depending on each grazier's assessment of replacement costs. These costs were determined by factors such as the location of the business, and the age and quality of the stock. It seems logical that there will be variations in replacement costs over time, and location and according to the 'quality' of the livestock[5], so acceptance of the graziers' own estimates is not seen as inappropriate. Grown sheep were valued at about $80 per head, with this comprising a fleece worth $38 (5.5 kg at $7/kg) and the sheep itself worth about $42.

An estimate of wild dog costs suffered by Queensland's rural industries in 1968[6] included interest on capital invested in livestock lost and in capital tied up in the Wild Dog Barrier Fence (WDBF). The current analysis does not include 'interest foregone', as this would require adoption of an assumption regarding the appropriate rate to apply, and some presumption about the opportunity itself. Thus the current analysis attempts to focus on actual cash costs for a defined period.

The opportunity principle is, however, most relevant to placing a value on particular losses. In the case of calves that have suffered dog bites, for example, the opportunity principle is the most appropriate methodology. Non-fatal bites on calves can ultimately result in a loss of value when the animals are sold, as scarred muscle might be condemned on the kill floor. Whether this leads to a price discount on the balance of the carcass or simply loss of the affected muscle, the carcass will have suffered an opportunity loss that can be estimated with accuracy, and directly attributed to an earlier wild dog attack. Some other losses are determined in a similar fashion.

[5] For example, the death of a lamb will represent a larger loss for a stud breeding operation than for a standard breeding operation, where replacement rams are always purchased. In either case, the study has relied on the graziers' own estimates of the loss entailed.

[6] The actual estimate was derived by the Stock Routes and Rural Lands Protection Board. The figure they came up with was $40–$50 million per year. This is a rather large figure considering it applied some 35 years ago, prior to the inflation of the 1970s and 80s. However, it clearly did apply to a much larger sheep population than exists today. Drawing comparisons of the loss estimates derived by different studies is fraught with problems and will not be attempted on this occasion.

1.3.2 Control costs

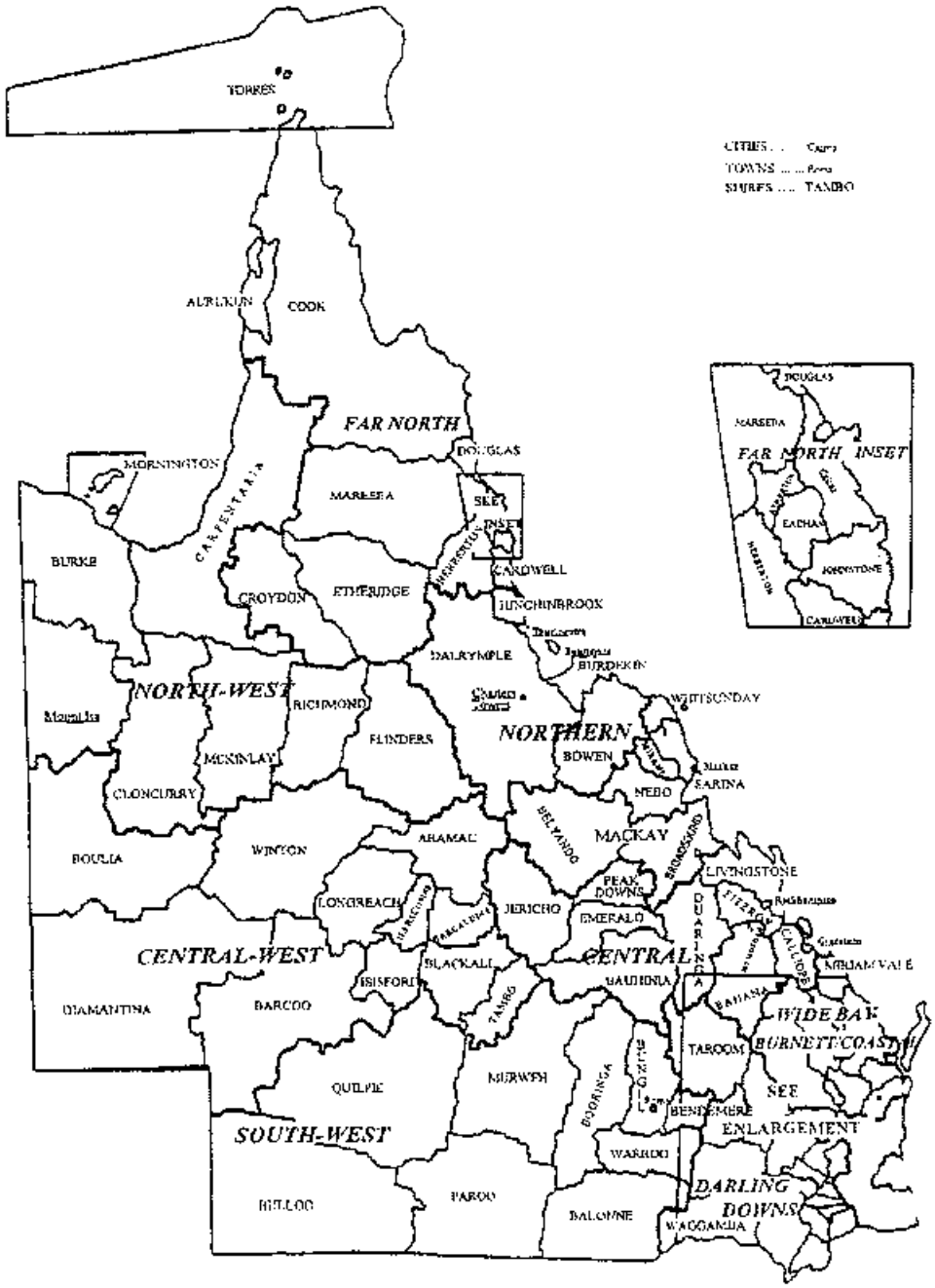
It might be surmised that where outlays on wild dog control are high, the losses due to wild dog predation will be low. Some of the graziers interviewed spent an enormous amount of time monitoring wild dog movements and attempting to achieve control through trapping and baiting. In this study, all farm-level control measures were treated as cash costs to the farm business.

A record of the interviews conducted for this study is shown in Table 1. Many of the people interviewed had great difficulty quantifying the rate of loss they had suffered due to wild dog predation. As explained later, there can be considerable technical difficulties associated with assigning lamb and calf losses to particular causes.

Table 1: Interviews conducted, or questionnaires issued, for gathering data

Group	Number	Data sought
Graziers	32	Livestock losses and the costs of controlling predation rates.
Land Protection Officers	6	Time involved in coordinating baiting campaigns for the region, training of local government officers, planning and media management.
Shire Chief Executive Officers	10	The cost of making and distributing baits, bounties, wages for trappers, fencing, etc.
Land Protection Services	7	State level costs including staff, the cost of 1080, developing baits and maintaining the WDBF.

Figure 1: Queensland local government areas



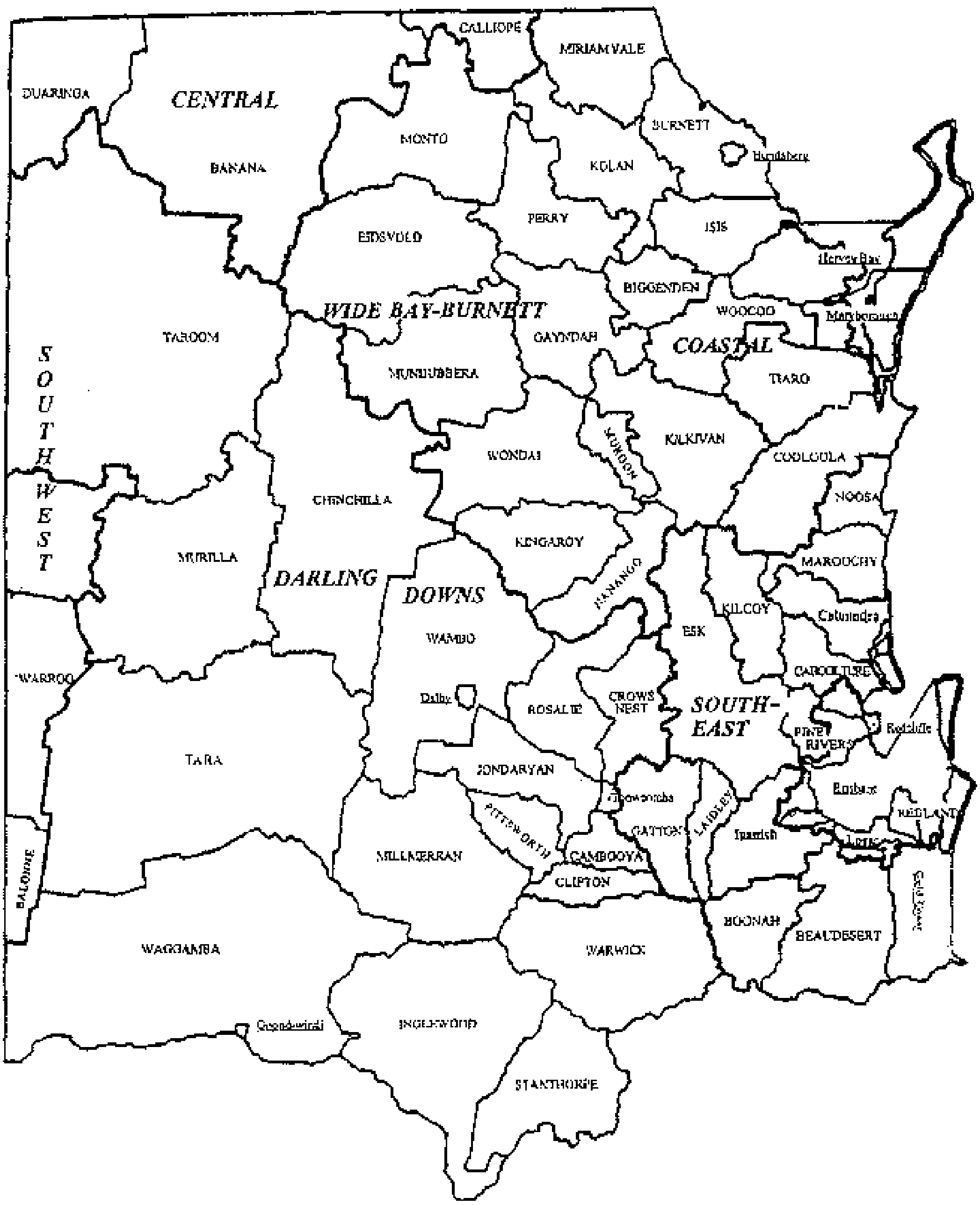
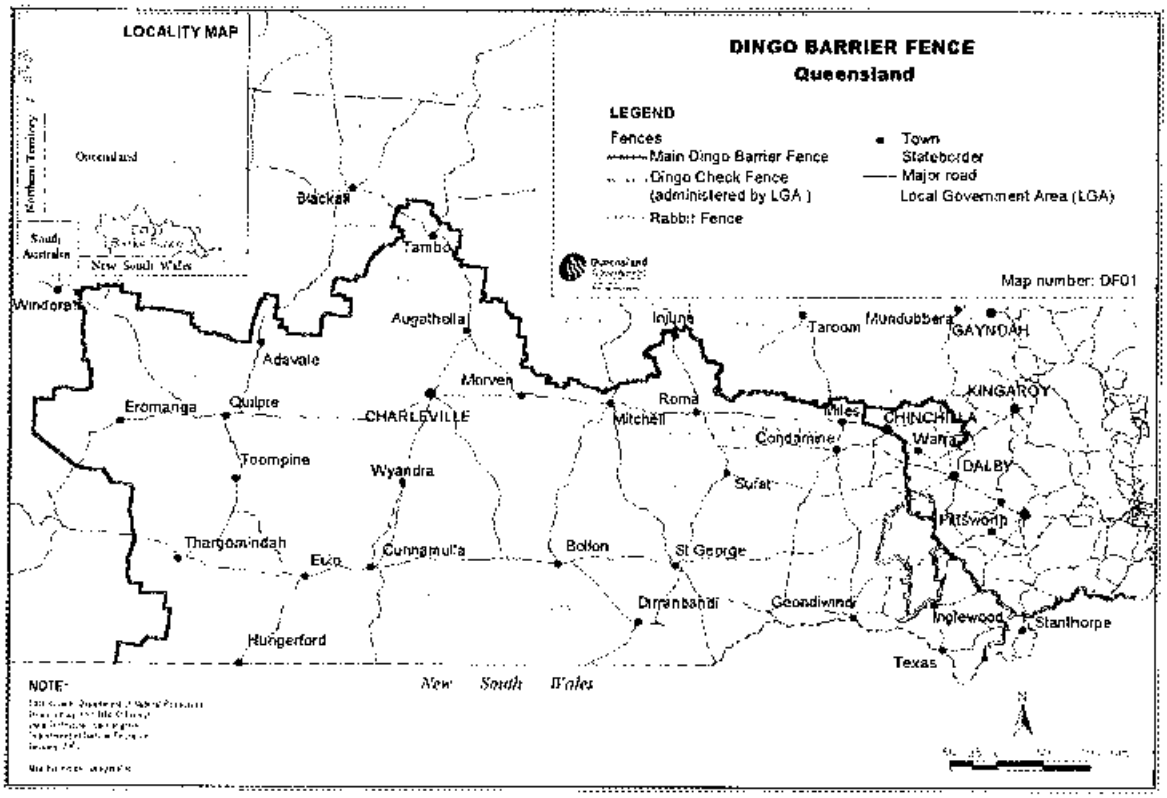

CALLIOPE
MIRIAM VALE
DUARINGA
CENTRAL
MONTO
BURNETT
BANANA
KOLAN
Bundaberg
PERRY
ISIS
EIDSVOLD
Hervey Bay
BIGGENDEN
WIDE BAY-BURNETT
WOOCOO
Maryborough
TAROOM
GAYNDAH
COASTAL
SOUTH WEST
MUNDUBBERA
TIARO
KILKIVAN
WONDAI
COOLOOLA
NOOSA
CHINCHILLA
KINGAROY
MURILLA
MAROOCHY
DARLING
DOWNS
KILCOY
Caloundra
ESK
WAMBO
CABOOLTURE
WARROO
Dalby
ROSALIE
CROWS NEST
SOUTH-EAST
Redcliffe
PINE RIVERS
TARA
JONDARYAN
Brisbane
REDLAND
GATTON
LAIDLEY
Ipswich
MILLMERRAN
CAMBOOYA
CLIFTON
BALONNE
BOONAH
BEAUDESERT
WAGGAMBA
WARWICK
INGLEWOOD
STANTHORPE

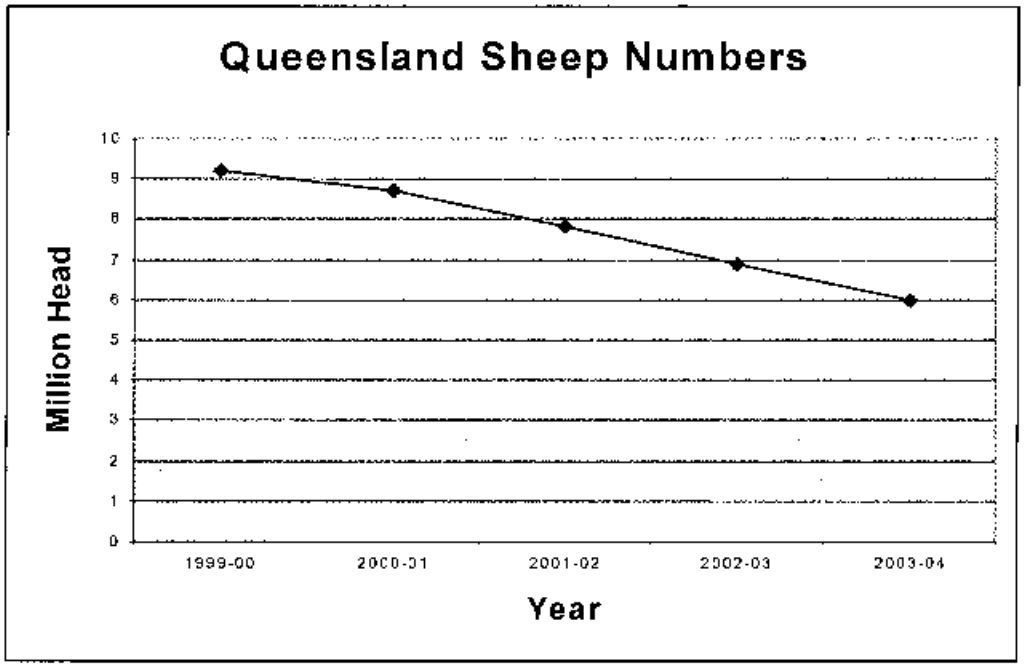
Figure 2: Pest animal fences in Queensland



2 Impact of wild dogs on the grazing industry

2.1 Livestock losses

Between June 1998 and June 2001, the sheep flock in Queensland fell from 11 million to 8.7 million head, a drop of more than 20%. All the indications suggest that falls of a similar magnitude have occurred in subsequent years. A recent Wool Innovations Australia forecast has indicated that Queensland's sheep population in 2003–04 is heading towards 6 million head. The implied trend in sheep numbers over the past five years is illustrated in the chart below.



This decline has been ascribed to several factors including:

- a long period of poor wool prices prior to the last one or two seasons
- severe drought from 2000 to 2003
- pest predation (mainly from wild dogs)
- difficulty in getting shearers, and the overhead costs of employing staff[7]
- an advancing age profile among wool producers
- many property sales where cattle producers have outbid wool growers
- the coincidence of a relatively strong cattle market.

[7] The relatively labour-intensive nature of woolgrowing is often advanced as a strength of the sheep industry because of the flow-on benefit for local townships. But, given the difficulty of attracting workers to outback regions, the industry's need for labour is also a weakness.

However, all decisions are made at the margin, and several of the graziers interviewed nominated 'wild dogs' as the influence that tipped their decision to finally get out of sheep. Where wild dog predation was viewed by woolgrowers as 'the problem' rather than the economics of woolgrowing *per se*, the high sheep prices of recent years may have given added impetus to the decision to exit in some cases[8].

The additional costs being inflicted by wild dogs were found to vary enormously between years and among graziers, depending on several factors:

- **Queensland's sheep population:** As wild dogs find sheep attractive prey, it is reasonable to surmise that statewide predation losses will be directly related to the sheep population. On this basis, it might be concluded that a fall in the sheep population will mean a fall in statewide losses to wild dogs. While this outcome may apply in general, it is in fact an over-simplification. In practice, a fall in sheep numbers could be accompanied by an increase in the rate of predation on remaining flocks— especially where neighbouring cattle properties choose not to become involved in coordinated baiting campaigns. Conceivably, therefore, statewide and individual property losses could be moving in opposite directions at the present time. Also, with the disappearance of sheep, there could be some transference of pressure onto cattle herds and native animals[9]. This will apply most particularly at the last gasp of severe drought, when native prey might be scarce.

- **Queensland's cattle population:** Queensland has twice as many cattle as sheep (the beef cattle herd is approximately 11 million). So while the rate of wild dog predation on cattle is much lower than for sheep, the aggregate impact might be large since it will be proportional to the herd size.

- **Losses versus control:** The potential for wild dog losses applies throughout most livestock regions. However, the incidence of attacks and losses varies enormously depending on the nature of the country and the efficacy of control measures. Some baiting campaigns, for example, can be so effective that they virtually eliminate mortality losses. But in the absence of effective control, sheep and goat breeding can be rendered non-viable in some areas.

- **Degree of coordination and cooperation among neighbours:** 1080 baiting relies, in the first instance, on availability of baits. Only NR&M officers and local government officers who have been approved by the Queensland Department of Health are licensed to prepare 1080 baits. After this, effective control appears to depend in large part on the degree of coordination and cooperation among neighbours. In some regions, baiting syndicates have been established for the purpose of eradicating existing dogs and closing off the passages that wild dogs might use to gain entry. Over the past five years, however, many properties that traditionally ran sheep have been converted to cattle properties. It was reported by several longer-term owners that, where new owners fail to maintain involvement in coordinated baiting campaigns intended to form a barrier to entry by wild

[8] Sheep prices have risen somewhat independently of wool prices, due to the strong live export market. This market has, in turn, forced up prices for local slaughter sheep, putting abattoirs in competition with re-stockers.

[9] While domestic livestock tend not to constitute a significant proportion of the wild dog's diet, loss of sheep from an area recently invaded by wild dogs could lead to additional predation pressure on native animals. This pressure could seriously impact on wallaby and small reptile numbers.

dogs, gaps can open up and 'dog problems' can suddenly erupt in 'virgin' country.

- **Geography and climate:** A recent study of *Neospora caninum* in cattle found that the prevalence rate was highest in areas with more than 500 mm of annual rainfall, and with evidence of a permanent wild dog population. This distribution pattern leaves a large proportion of Queensland's cattle herd vulnerable to the disease.
- **Ecological dynamics:** The observed increase in wild dog numbers in settled Queensland has been ascribed to many factors. Persistent drought over the past two to three years, combined with the introduction of the calicivirus, has probably reduced the supply of native prey and rabbits and thereby promoted the dispersion of subordinate dogs into more settled areas as they search for new food sources. As these 'new food sources' clearly exist in the domestic livestock population, wild dog populations are able to survive, and thrive, unless there is effective intervention. East of the Dividing Range, clearing for rural residential and intrusion of human population has probably lured wild dogs into such areas. This is especially the case where settlement is accompanied by increased food supplies, whether in the form of domestic animals, pets, or food scraps and open compost.
- **Livestock type:** Wild dog attacks have traditionally been associated with goats, sheep and especially lambs. However, some of the highest dollar losses reported to this study were from a single cattle breeding operation where there was a close source of wild dogs, and it was not possible to exercise effective control of wild dog predation (see box below).

Millmerran cattle breeder

The situation faced by an isolated cattle producer with limited means of controlling wild dog predation highlights the sporadic distribution of impacts. This producer borders a large area of state forest which harbours a significant dingo population. Because it is not possible for the producer to take out public liability insurance applicable to baiting and trapping in the state forest, traditional control programs are not possible at this time. This has resulted in massive calf losses caused by dingoes dispersing out of the forest. The rate of loss is threatening the viability of the total business.

Table 2 shows the livestock losses and prevention costs for 2000–01 reported by each of the 32 graziers interviewed. The 'rate of loss' relates to the total cost and the number of sheep or cattle normally run on the property.

Table 2: Livestock losses and prevention costs reported by 32 Queensland graziers for 2000–01

Shire & (enterprise)	Livestock losses ($)	Prevention costs ($)	Total cost ($)	Rate of loss
Barcaldine (mainly sheep)	154 000	6000	160 000	$12.30/sheep
Barcaldine (sheep)	–	1500	1500	37c/sheep
Barcoo (cattle breeding)	–	4000	4000	$1/cow
Barcoo (sheep)	de-stocked	5000	5000	$1/sheep

Blackall (cattle & goats)	18 400	7600	26 000	$13/goat
Boulia (sheep & cattle)	9000	6000	15 000	$1.67/sheep
Broadsound (cattle)	14 400	2000	16 400	$5.30/cow
Broadsound (cattle)	1000	4000	5000	77c/cow
Isisford (sheep & cattle)	–	1200	1200	24c/sheep
Livingstone (cattle)	–	500	500	–
Longreach (sheep & cattle)	1500	1500	3000	26c/sheep
Longreach (sheep & cattle)	600	800	1400	31c/sheep
Longreach (sheep)	2300	2200	4500	43c/sheep
McKinlay (cattle breeding)	22 500	1000	23 500	$13/cow
McKinlay (sheep & cattle)	60 000	10 000	70 000	$8.25/sheep
McKinlay (sheep)	3000	2200	5200	26c/sheep
Millmerran (cattle breeding)	70 500	7200	77 700	$64/cow
Murweh (cattle breeding)	–	1000	1000	67c/cow
Murweh (cattle)	..	2000	2000	$2.50/cow
Murweh (sheep)	2000	2840	4840	$1.94/sheep
Murweh (sheep)	20 000	7000	27 000	$3.37/sheep
Murweh (sheep)	16 000	2000	18 000	$6.43/sheep
Murweh (sheep)	10 000	2000	12 000	$2.26/sheep
Quilpie (sheep & cattle)	90 000	2000	92 000	$18.40/sheep
Quilpie (sheep & cattle)	18 000	6000	24 000	$1.33/sheep
Quilpie (sheep)	500	3000	3500	$1/sheep
Richmond (cattle)	5000	500	5500	75c/cow
Tambo (sheep & cattle)	19 500	1000	20 500	$4.10/sheep
Tambo (sheep)	45 000	5000	50 000	$1/sheep
Warroo (mainly sheep)	45 000	16 000	61 000	$8.13/sheep
Warroo (mainly sheep)	50 000	5600	55 600	$5.56/sheep
Winton (sheep)	3000	1100	4100	$2.73/sheep
Total	**527 200**	**113 740**	**640 940**	

Several points should be noted regarding the data in Table 2.

- There was considerable variation in the rate of loss suffered by the graziers interviewed;

therefore, it is difficult to draw statewide conclusions about the rate of loss being suffered by individual graziers. This is due to differences in scale, knowledge and response to the wild dog problem, and the severity of attacks in an area over time. The survey confirmed that 'variability' is a defining aspect of the wild dog problem, and one which applied between regions, and among graziers within regions.

- It is possible that the estimate of losses given by some graziers understates actual losses, because some graziers have a poor knowledge of their lamb and/or calf losses (Lee Allen, pers. comm.). This 'poor' knowledge stems not from ignorance, but from lack of tangible evidence that a given loss was caused by wild dogs. On remote cattle stations, for example, calves taken at birth by wild dogs will 'disappear without trace' and the cause will ultimately be ascribed to infertility. It is possible that variations between graziers in their knowledge of predation losses could explain some of the large range in reported losses.
- All of the graziers surveyed participated in some form of wild dog control and incurred costs accordingly. Indeed several among the 32 graziers interviewed participate in programs that have been effective in preventing losses. These programs were characterised by a high level of coordination and cooperation among neighbours. On the other hand, isolated woolgrowers (e.g. surrounded by cattle producers) often suffered high predation losses, as well as high control costs.
- As a generalisation, control costs are low compared to the stock losses. In the case of the 32 graziers interviewed, the livestock losses were almost five times greater than the outlays and costs associated with prevention. As noted in section 4, all forms of control are still labour intensive, and in extensive areas where labour resources are scarce, it will be difficult to achieve optimal control effort.
- Several of the sheep graziers shown above with heavy losses in 2000–01 have since got out of sheep, while others had negligible predation losses for the simple reason that they were de-stocked due to drought. It is apparent that beyond some threshold, wild dog predation will force graziers out of sheep and wool production. It is conceivable, therefore, that the reduction in Queensland's sheep population over the past four to five years could have led to a reduction in the total cost of wild dog predation, depending on how and where the wild dog 'pressure' and associated losses are transferred to other species.

Table 3 shows how the severity of the predation impact was distributed among the 32 graziers surveyed. It should be noted that predation losses do not include control costs. These results suggest that about half of all woolgrowers are suffering relatively low losses. Indeed most of the growers in the 'negligible' category are only incurring control costs. On the other hand, those woolgrowers reporting losses in excess of $5/sheep in 2000–01 have either exited the industry or remain vulnerable.

Table 3: Distribution of predation losses among the 32 graziers surveyed

Rate of predation loss		
Negligible	Moderate	Severe
<$1 per head	$1–$5 per head	>$5 per head
16 = 52%	12 = 35%	4 = 13%

The predation losses for the cattle industry shown in Table 2 do not include losses due to disease spread by wild dogs. These losses are less apparent than predation, and it is possible that not all cattle producers are fully conscious of the dollar amounts at stake. Wild dogs are a host of the parasites *Neospora caninum* and hydatidosis (causal agent *Echinococus granulosus*). An estimate of the losses associated with these diseases is provided in Table 4. *Neospora caninum* has been shown to be a cause of bovine abortion and, hence, reduced herd fertility. In a recent study (Landmann & Taylor 2003), *Neospora caninum* was found to be prevalent throughout Queensland beef herds, with the rate approaching 15%. Assuming that one-quarter of the infections can be attributed to wild dogs (Lee Taylor, pers. comm.), the cost to the Queensland herd would be $3.4 million annually (see Table 4). Implicitly, the costing analysis assumes that the size of this loss is directly proportional to the wild dog population. Further R&D would be needed to determine the veracity of this assumption.

Another hidden cost for the cattle industry is loss of by-products value due to hydatidosis. In Queensland, wild dogs are the main vector of hydatidosis (Lee Taylor, pers. comm.). Today the disease is widespread in the cattle population, resulting in about half of all livers being condemned—particularly in older cattle (AQIS vet AMH abattoir Dinmore, pers. comm.). Where a liver is condemned, its value drops from about $1.20/kg (for human consumption) to 20c/kg (for pet food), implying an opportunity loss of $1/kg[10]. Assuming one million livers each weighing 6 kg are condemned in Queensland annually, the cost to the state's economy would be $6 million. These estimates are possibly conservative, as no value is placed on the threat posed to our exports should importing countries cite objections to these diseases and impose restrictions on future trade.

Even though wild dogs are responsible for spreading hydatidosis to the cattle population, it is not yet clear how the relationship works in practice. Thus R&D including statistical and economic analysis is needed to quantify the relationship between wild dog control and the rate of reduction in hydatid infection throughout Queensland's cattle herd (Lee Allen, pers. comm.).

[10] The market outlook for cattle offal is strong as reported by ABC Rural (25 July 2003): 'China has lifted trade restrictions on importing meat and Austrade's branch office in Beijing says it's been hit with a barrage of requests from meat importers looking for more offal.' However, Australia's ability to capitalise on the prospects in China will be seriously impaired by the high rate of (offal) condemnations that presently occur.

Table 4: Estimate of cash losses in the Queensland cattle industry due to wild dog-related diseases

Consequence	Details	Annual loss ($ million)
	Neospora caninum	
Abortions	3.75% of Queensland's 6 million breeding cows infected, with 10% of these aborting at $150 per calf = $13.5 million. Assume one-quarter of abortion cost due to wild dogs.	3.4
	Hydatidosis	
Offal condemns	One million livers each weighing 6 kg condemned on the slaughter floor, resulting in opportunity loss of $1/kg.	6.0
Total annual loss		9.4

Predation losses to wild dogs for the entire state can be estimated by applying average mortality rates to the livestock population. It can be expected that the rate of mortality will be influenced by wild dog incidence and the efficacy of prevention measures. In Tables 5 and 6, an attempt has been made to combine the shire livestock statistics with presumptions about likely mortality rates. These rates have been based on sheep and cattle incidence, and the influence on predation due to protection from either the Wild Dog Barrier Fence (WDBF) or usage of 1080 baiting.

Details on how the tables were developed are provided below.

- **Selection of shires:** The worst affected shires will have significant numbers of both sheep and cattle (Lee Allen, pers. comm.). This is because sheep are highly prone to wild dog predation, while many cattle producers are not particularly vigilant when it comes to exercising control. Each of the 28 shires shown in

Table 6 had no less than 20 000 sheep and 20 000 cattle in 2000–01[11]. Together, these shires accounted for about 98% of the state's sheep population and more than one-third of the cattle population. The analysis assumes that it is reasonable to directly link sheep losses for the whole state to the sheep population in these 28 shires.

- **Usage of 1080 in sheep and cattle shires:** These 28 sheep and cattle shires are also the heaviest users of 1080 dog baits (59% of the state total), although the volume has varied considerably[12]. For the three-year period 2000–03, 1080 usage in the 28 shires was as follows: one shire used more than 2 kg/yr; five shires used 1–2 kg/yr; eight used 0.5–1 kg/yr; and 14 used less than 0.5 kg/yr.
- **1080 usage elsewhere:** Outside the 28 sheep and cattle shires, six shires were relatively heavy users as follows: Bowen 0.7248 kg/yr; Calliope 0.5584 kg/yr; Carpentaria 0.7566 kg/yr; Dalrymple 1.0710 kg/yr; Etheridge 0.4916 kg/yr; and Livingstone 0.5490 kg/yr. All these shires have significant cattle populations, and it might be presumed that they also have serious wild dog problems.
- **Efficacy of 1080 usage:** While it is possible to relate 1080 usage directly to control costs, it is not possible to assume an inverse relationship between 1080 usage and livestock mortality rates due to wild dogs. In practice, the efficacy of 1080 usage will vary depending on several factors including how well the baiting campaigns have been planned and executed.
- **Predation rate for sheep:** For estimation purposes it is necessary to apply common factors to the livestock population. For those shires with more than three-quarters of their area inside the WDBF, a cost of 80 cents per sheep was applied to the entire sheep population. This figure was based on the survey results, where costs ranging from nil to $18.40 per head were reported. As the range merely indicates the 'reality' of the situation, it is preferable to consider the distribution of cost impacts as shown in Table 3.
- Based on the revealed distribution and discussions with woolgrowers and wild dog experts, it is apparent that average losses of between $1 and $5 per head apply to about one-third of the Queensland flock. Thus a figure of 80 cents per head for all sheep inside the WDBF is considered realistic, especially in light of the current volatility in sheep numbers. Outside the fence, a rate of $1.20 per head was applied. The differential of 40 cents per head is objectively based, and has been taken from the report by EconSeach (2000 p.10) which assessed the economics of the WDBF.
- **Cattle losses:** Numerous studies of foetal and calf wastage in tropical areas of northern Australia (where wild dog populations are described as 'abundant') have demonstrated loss rates ranging from 4% to over 20%. The problem is worst where young dogs are operating in packs, and during dry times when native prey might be scarce. After removing 'background' losses, it is estimated that 'wild dogs losses' in six northern

[11] This population combination was chosen because it effectively isolated all those shires with significant sheep numbers, but also some cattle. This combination predisposes an area to wild dog problems.

[12] Ninety-three of Queensland's 122 local government areas used more than 0.01 kg/yr of 1080 for dog baits over the past three years. Thus usage of 1080 on wild dogs is practically statewide, with total annual usage being more than 30 kg/yr. However, the rate of usage is heaviest in the shires known to have wild dog problems. For example, six of the seven shires that use more than 1 kg/yr of 1080 have more than 20 000 sheep and more than 20 000 cattle in 2000–01.

shires where dogs are abundant[13] average about 4% per annum of breeder numbers (Lee Allen, pers. comm.). In mixed sheep and cattle shires, calf losses to wild dogs are typically low and, for the purposes of this analysis, have been put at 0.05% of breeder numbers. In all other shires throughout the state (72 in total), the loss rate was put at 1% of breeder numbers. For all areas, a calf was valued at $150.

- Non-fatal attacks on calves usually leave bites that lead to price discounts at the point of sale—either in the saleyard or in the abattoir. In Australian abattoirs, carcasses that are presented with any defect (in this case scar tissue) are downgraded, and the grazier (or owner at the point of slaughter) will suffer an opportunity loss. Wild dogs are also known to attack the genitals of adult cattle, rendering them infertile. While it is clearly difficult to estimate the size of all these costs[14], they will be proportional to the herd size and will apply throughout most of the state.
- Calf predation rate: The method of estimating cattle industry losses is illustrated in Table 5 for the 28 sheep and cattle shires. The calf loss rate of 0.05% was applied to the 2000–01 breeder population in the 28 shires and then multiplied by $150 per head, resulting in a total cost of over $1.3 million. The same method was applied to high and medium predation areas of the state.

Table 5: Calf losses in Queensland due to wild dog predation 2000–01

Calf predation rate	Shires (no.)	Breeders*	Total loss ($ million)
Low (0.05% of breeders)	28	1 751 854	1.3
Medium (1% of breeders)	72	2 671 534	4.0
High (4% of breeders)	6	702 000	4.2

* Taken from the 2000–01 ABS reports. Note that the medium and high losses by shire were estimated outside the table.

[13] Wild dog density is defined in terms of pack sizes. Abundance occurs where packs of 10–15 dogs can be sighted.

[14] Under-reporting of calf losses caused by wild dogs is likely in the cattle industry, due to the extensive nature of the industry, leading to little scrutiny of the various causes of low branding rates. Unless graziers undertake pregnancy testing and closely monitor calving rates, it is possible that some/many predation losses could be ascribed to 'other' causes.

Table 6: Estimated dollar losses by shire due to wild dog kills 2000–01

Shire	Sheep	Loss per sheep	Estimated sheep loss	Breeders	Calf losses 0.05% of breeders	Loss at $150 per calf
Aramac	458 823	$1.20	$550 588	43 302	216	$32 400
Balonne	696 806	$0.80	$557 445	84 789	423	$63 450
Barcaldine	354 514	$1.20	$425 417	31 002	155	$23 250
Barcoo	187 989	$1.20	$225 587	49 729	248	$37 200
Blackall	441 780	$1.20	$530 136	51 127	255	$38 250
Booringa	295 770	$0.80	$236 600	89 089	445	$66 750
Boulia	61 498	$1.20	$73 798	103 069	515	$77 250
Bulloo	156 742	$0.80	$125 394	47 044	235	$35 250
Bungil	48 118	$1.20	$57 742	103 675	518	$77 700
Chinchilla	31 479	$1.20	$37 775	42 693	213	$31 950
Duaringa	28 213	$1.20	$33 856	131 674	658	$98 700
Flinders	304 422	$1.20	$365 306	155 075	775	$11 6250
Ilfracombe	366 136	$1.20	$439 363	6357	32	$4800
Inglewood	262 002	$1.20	$314 402	16 843	84	$12 632
Isisford	340 965	$1.20	$409 158	17 672	88	$13 200
Longreach	758 264	$1.20	$909 917	56 371	282	$42 300
McKinlay	176 482	$1.20	$211 778	163 117	815	$122 250
Millmerran	33 428	$1.20	$40 114	18 234	91	$13 650
Murweh	456 815	$0.80	$365 452	99 469	497	$74 550
Paroo	815 616	$0.80	$652 493	38 207	191	$28 650
Quilpie	658 616	$0.80	$526 893	38 112	190	$28 500
Richmond	119 494	$1.20	$143 393	77 345	386	$57 900
Stanthorpe	147 165	$1.20	$176 598	9162	42	$6 300
Tambo	169 154	$1.20	$202 985	54 207	270	$40 500
Tara	185 971	$0.80	$148 777	53 330	267	$40 050
Waggamba	226 003	$0.80	$180 802	72 878	364	$54 600
Warroo	101 399	$1.20	$121 679	34 227	171	$25 650
Winton	589 823	$1.20	$707 788	64 055	320	$48 000
Totals	8 473 487		**$8 771 236**	1 751 854		**$1 311 932**

If it could be presumed that sheep losses due to wild dog predation in Queensland were directly proportional to the sheep population, then the figure of $8.77 million shown in Table 6 would be high by a factor of about 30% due to the decline in sheep numbers since 2000–01. Based on Wool Innovation projections, the sheep flock in Queensland has fallen from 8.7 million head in 2000–01 to about 6 million in 2003–04. Assuming the same rate of predation, this would reduce the 'estimated sheep loss' figure in Table 6 to about $6 million. But as pointed out already, the rate of predation might have gone up as flock size has gone down, and there may have been some movement in predation impacts among species. Moreover, sheep numbers might increase on those properties that still have sheep, if predation rates can be brought down at some point in the future, or if cattle profitability reduces relative to sheep. In any event, the estimated sheep loss of $8.77 million is carried forward to Table 9, where an estimate of aggregate costs is provided.

For those graziers left the sheep industry over the last few years, the costs due to wild dogs were very high in the period leading up to their exit. The figures provided by a Morven district grazier (see box below) further demonstrate how the quantum of costs can be severe where the grazier finds himself in a vulnerable situation. The estimated loss of $40 per sheep given by the Morven grazier is considered to be conservative in view of current sheep and wool prices.

A detailed record of losses: Costs incurred over a one-year period from 1 July 2000

Number of days that traps were set and checked

July 2000	28 days
August 2000	7 days, and a 1080 baiting program on 22 August
April 2001	9 days, and a baiting program on 23 April
May 2001	12 days
June 2001	11 days

Cost summary

Sheep losses	50 head at $20 each	$1000
Loss of wool	50 fleeces at $20 each	$1000
1080 baiting	Two applications	$440
Trapping	98 hours at $15/hr	$1425
Travel	1950 km at 50c/km	$975
Total for year		**$4840**

The total number of sheep shorn was 2500, implying an average loss of $1.94 per head. Over 12 years, the grazier's cash losses were $24 000. The cost of catching a dog during the period was estimated at between $600 and $800. This grazier exited the sheep industry in 2003.

2.2 Prevention costs

2.2.1 Background to 1080 usage in Queensland

Following successful trials in 1967, 1080 completely replaced the use of strychnine for dingo control by the Stock Routes and Rural Lands Protection Board in 1968 (Sheehan 1984). Under Queensland's poison regulations, 1080 is listed as a Schedule 7 poison, which means landholders cannot purchase it directly. Thus landholders participating in baiting campaigns must take meat products to nominated bait preparation centres, where Land Protection Officers and local government officers (licensed under the Health (Drugs and Poisons) Regulation 1996) prepare the baits at concentrations applicable to the target species.

Some graziers wanting to be independent to carry out their own baiting activities still use strychnine, as no special supervision is required for preparation of the baits.

The major problem with 1080 is the threat, if consumed, to non-target animals. Shortly after the introduction of 1080, a number of working dogs and domestic pets were lost to baits, and this turned many graziers against its usage. Indeed this 'problem' remains today, as dogs are widely used for getting cattle out of rough country[15]. The reluctance of some cattle producers to lay baits is a major obstacle for coordinated baiting programs. This reluctance, in turn, presents a problem for control generally, since coordinated baiting has been found by rigorous investigation to be the most effective measure for curtailing the wild dog population (see *Evaluation of the effectiveness and efficiency of the wild dog control program in Western Australia*).

While 1080 baiting is undoubtedly the major weapon for combating wild dogs at the moment, it is by no means the only method. Comments on the relative merits of different control measures are made in section 4.

2.2.2 Control by graziers

The telephone survey revealed that Queensland graziers are making large dollar outlays attempting to control the wild dog situation through one or a combination of measures. 1080 baiting is the major control method used on a statewide basis.

Fortunately, detailed data have been collected for the volume of 1080 used and the number of baits distributed in Queensland (see Figure 3). Regardless of the efficacy of the baiting, it is possible to derive a cost for the baiting itself. This has been done in Table 7 based on data provided by NR&M head office staff, shire councils involved in coordinated baiting campaigns and individual graziers.

In 2002 there were about 3.2 million dog baits, injected with about 31 kg of 1080, distributed in Queensland. The total weight of meat needed to make the dog baits is estimated at about 458 000 kg. In Table 7, this meat has been valued at $1.40/kg. The cost of distribution was derived from detailed baiting costs provided by the Blackall Shire. Based on actual outlays, this shire calculated a total cost for meat, labour and contract distribution services of about

[15] Some sheep producers with a similar dependency on working dogs have developed strategies that combine 1080 usage and working dog safety. The strategy involves not baiting those areas where the dogs might be working alone to bring out stock. Where baits have been laid, only one or two dogs are used so that close supervision is maintained and the dogs keep moving. Another strategy is the use of wire muzzles that prevent dogs from picking up baits while working.

$2/kg. Given a cost for meat of $1.40/kg, it would appear distribution costs amount to 60 cents.

Table 7: The estimated annual cost of 1080 baiting in Queensland

Cost component	Details	Amount ($ per year)
1080 poison	31 kg at $420/kg (delivered)	13 000
Meat (more than 3 million baits)	458 000 kg at $1.40/kg	641 200
Manufacture of the baits and coordination of landholders*	27 NR&M Land Protection Officers at $15 000 each (on average)	405 000
Land and air distribution of baits	458 000 kg at 60c/kg	274 800
Total		1 334 000

* Excludes involvement by shire officers (this information is included in Table 9).

Some graziers reported investing a high proportion of their total work time into wild dog control, as outlined in the following case study.

Case study: Wild dog control in Warroo Shire

Over the past decade, woolgrowers in the Warroo Shire have become particularly isolated as sheep have been replaced by cattle. A Warroo woolgrower with close to 8000 sheep and 300 breeders reported that half his working year is devoted to fighting the wild dog menace. Due to the futility of coordinated baiting, he is placing high reliance on electric fencing (to keep wild dogs out) and trapping (to capture those that get through). Warroo Shire offers a $100 bounty for dingo scalps, and local doggers want $500 for known problem dogs. This grazier is currently suffering sheep losses valued at about $45 000 per annum, and control costs of about $16 000 per annum.

2.2.3 Shire councils

Most shires throughout Queensland's pastoral belt are heavily involved in pest control programs. For those shires contributing to the WDBF, the biggest single cost is the annual payment (formerly known as a precept[16]) which they make to the state government for maintenance of the fence. For example, in 2002–03 Paroo Shire made a precept payment of $119 700 to the Department of Natural Resources and Mines (NR&M) for maintenance of the WDBF. In the same period, the shire made additional payments of $20 000 for rabbit control and $20 000 for pest R&D, bringing the amount they outlaid on precept payments to about $150 000—or about 12% of the shire's total budget.

[16] The dictionary meaning of 'precept' is 'order for collection or payment of money under a rate' (Concise Oxford Dictionary).

Table 8 shows figures for seven rural shires that were approached directly regarding their outlays on wild dog control. These seven shires are thought to have the heaviest involvement in wild dog control but, based on those shires previously identified, the analysis has assumed that there are 28 rural shires throughout Queensland that make significant outlays on wild dog control. In practice, many other rural shires will make outlays on wild dog control, including precept payments for the WDBF. However, it is assumed that the outlays in Table 8, extrapolated to 28 shires, will be a reasonable representation for the whole of rural Queensland.

Table 8: Outlays on control of wild dogs as reported by seven selected rural shires, 2000–2001

Shire	Cost category ($)*				Total ($)
	Baiting	WDBF	Bounties	Other	
Aramac	104 257	–	3140	872	108 269
Blackall	24 567	1400	15 700	10 173	51 840
McKinlay	10 000	..	20 100	11 500	41 600
Murweh	10 000	135 600	6987	10 000	162 587
Paroo	4583	119 700	.	7117	131 400
Quilpie	13 852	87 900	70	4000	105 822
Waggamba	9087	–	2400	37 872	49 359
Sub-total	176 346	344 600	48 397	81 534	650 877

*Due to reporting difficulties, the allocation of costs between categories should not be interpreted as entirely accurate. Note that some shires (e.g. Waggamba) contribute to the so-called 'check fence' but not the WDBF. Waggamba's contribution to the check fence has not been included in Table 8.

When the average cost of $92 982 per shire derived from Table 8 is applied to 28 shires, the inferred cost for all rural shires is $2.6 million. All of this amount except for shire expenditure on the WDBF has been transferred to Table 9 (where all the rural cost impacts are aggregated). Expenditure on the barrier fence by 15 shires[17] in 2001–02 was about $700 000 based on state government expenditure in that year of the same amount. This figure has tended to rise every year (it rose to $775 000 in 2002–03) due to the combined effects of wear and tear on an ageing structure, and the temporal inflation of material and labour costs.

Rural shire outlays on wild dog baiting, trapping and bounties is put at $1.8 million. This amount is nominally allocated between activities in Table 9.

Table 9 shows the aggregate costs for the whole state. Care has been taken to avoid double counting, thus none of the WDBF costs shown in Table 8 are entered directly into Table 9. The cost of the 1080 program was divided between graziers (meat and bait distribution) and the state (1080 and mixing) and Local Government (mixing), while an additional amount has

[17] The amount contributed to the Barrier Fence in recent years by individual shire has ranged from over $140 000 to less than $2000. The distribution of the cost burden among the 15 shires that are either fully, or partially, protected by the fence is determined by the Barrier Fence Panel. This is based on several factors, including domestic stock numbers protected, the condition of the fence itself and preparedness to pay.

been assigned to shires (this information was not shown in Table 7).

Table 9: Summary of direct costs inflicted on Queensland's rural economy by wild dogs

Participant	Details of cost	Amount ($)
Graziers		
Predation losses—sheep	See Table 6	8 771 000
Prevention costs	Baiting (meat, labour, fuel, etc.)	616 000
Other control costs	Trapping, shooting, fencing, surveillance	357 000
Sub-total		**28 675 000**
Shires (based on 28 sheep and cattle shires)		
WDBF in 2001–02	$ for $ matching of state contribution to WDBF	700 000
Check fence	Tara, Waggamba, Stanthorpe and Inglewood shires	200 000
Bounties and trapping etc.	Bounties range from $10 to $100 per scalp	50 000
Baiting (this information was excluded from Table 7))	Meat, mixing and distribution	1 500 000
Sub-total		**2 450 000**
State		
WDBF	Staff, materials and vehicles etc.	700 000
1080	30 kg at $400/kg plus freight	13 000
Coordination and bait making	27 NR&M officers directly involved	405 000
NR&M head office and R&D	Planning, coordination and extension $265 000 R&D $400 000	665 000
Other government departments	Queensland Parks and Wildlife Service (QPWS) Environmental Protection Agency (EPA)	200 000 (estimate only)
Sub-total		**1 983 000**
State total		**33 108 000**

Several interesting observations stem from the figures in Table 9.

- The total cost of production losses, plus control and all government outlays related to assistance, is calculated at $33.1 million for a recent 12-month period. Due to the difficulties with estimating the sheep and cattle predation rates, the figure should be cited as a range, i.e. $15–$20 million. This figure is lower than some previous estimates (see footnote 6), but the total in Table 9 refers to a relatively low sheep population and is on a mostly cash basis. Some previous estimates have included imputed costs such as interest

on funds spent on WDBF) or lost (due to predation of livestock).

- The high loss suffered by the cattle industry reflects the dominance of this industry in Queensland relative to sheep. This loss situation is compounded when disease impacts due to wild dogs are taken into account, thus annual production losses from the cattle industry are put at $19 million, as compared with $8.8 million for the sheep industry. However, some of the cattle industry losses from disease would not immediately convert to producers' gains if the disease were to be eradicated. Because an increase in the value of livers (due to removal of hydatid infection) would rely on the responsiveness of processors to derived carcass value, a commensurate lift in cattle prices would probably lag behind the investment by producers in wild dog control.
- Statewide, the ratio of losses to control costs is estimated at about 5:1. This apparent imbalance is analysed in detail in
- Table 10.
- Shires in Queensland are making a significant contribution in the battle to control wild dog predation. Those shires protected by the WDBF are required to meet half the cost of the fence's maintenance. All other shire expenditure on wild dog control comes originally from rate payers within the affected shire.
- The aggregate costs shown in Table 9 do not take into account costs inflicted by wild dogs on semi-urban areas. Unfortunately, at this time there is no simple way of aggregating the wild dog impacts on semi-urban areas, but some coastal shires have started to keep detailed records. Pine Rivers Shire, which is located on the northern reaches of Brisbane, receives in excess of 750 wild dog-related complaints per year, and now employs a full-time pest management officer[18]. Over a recent 12-month period, the following losses to wild dog predation were recorded: 38 chickens; 29 calves; 29 goats; 17 sheep; and 14 pet dogs and cats The value of these losses was estimated at over $26 000. A distinguishing aspect of non-rural costs is the direct threat to human life, as demonstrated by the tragic death of a boy following a dingo attack on Fraser Island in 2001.

2.3 Secondary impacts

There are two starting points from which flow-on impacts can be analysed:

1. invasion by wild dogs
2. substitution of sheep by cattle.

2.3.1 Impact of wild dogs on the local ecology

Ecological: Several of the graziers interviewed reported correlations between wild dog numbers and native fauna. They had observed, for example, that lizards, small birds and rat kangaroos were much more numerous when dog numbers were low, as might be the case after successful baiting campaigns. It is apparent that wild dogs, as dominant predators, have the ability to impact on a wide range of native and introduced prey. Cattle herds are most vulnerable during severe drought when native fauna populations can be very low (Lee Allen, pers. comm.).

[18] Data provided courtesy of Darren Sheil, Pest Management Officer for Pine Rivers Shire.

2.3.2 Economic impact of sheep substitution

Cattle cannot be substituted for sheep as if the 'net feed value' of all country was, and is, the same. In marginal country there is not the bulk of grass to sustain cattle in all but the very best of seasons. Sheep, however, due to their superior foraging ability, can do quite well on country that is marginal for cattle. In some areas, therefore, if it is not possible to run sheep or goats, it will not be possible to use the country for any traditional form of grazing. Only in very big seasons will some classes of 'desert' sheep country be suitable for running cattle. Several of the graziers interviewed also commented that their properties were too small to run cattle.

With the reduction in sheep numbers, there is some prospect that greater pressure will come to bear on cattle[19], especially during calving and dry times, and where wild dog populations are unstable. Due to their slower flight response and greater size, cattle are not as vulnerable to wild dog predation as sheep, but with the decline in the sheep population throughout the state, the predation costs in the cattle herd are starting to exceed those suffered by sheep. It is already known that wild dogs can inflict huge losses on individual cattle breeding operations in the absence of effective controls. In any event, the cost to the cattle industry through disease spread by wild dogs already exceeds the cost of predation on sheep in Queensland, and disease losses are likely to escalate further if cattle continue to replace sheep. While the processing sector would be the first to benefit from a reduction in hydatid infection in cattle, higher returning prices would eventually flow to producers.

Social: In the absence of wild dogs, it is certain that Queensland would have a larger sheep population than it has today[20]. To this extent, the wild dog problem has imposed a social cost on the state by reducing the demand for labour, as woolgrowing is a much more labour-intensive business than beef cattle production. This loss of jobs and the loss of associated flow-on benefits is borne disproportionately by townships that have traditionally had a heavy reliance on woolgrowing e.g. Longreach, Blackall, Tambo, Bollon, Charleville, Surat and Winton.

The labour cost associated with shearing sheep is currently about $3.50 per head. Thus a property running 10 000 sheep would outlay $35 000 annually on wool harvesting, and would employ at least one full-time employee (in addition to the owner). Compared to a cattle operation on the same property, the difference in direct outlays on labour would be in the order of $60 000 per annum. Where this money is spent locally, there might be an additional one or two jobs created in providing services through neighbouring townships.

Given that the human population in western Queensland is low in any event, the loss of contiguous demand is significant from the perspective of maintaining essential services and delivering socially acceptable standards in health care and primary education.

Environmental: Predation by wild dogs can have an impact on survival of populations of endangered fauna such as small macropods (Fleming et al 2001, p.49). In some instances wild dogs do not lessen their attacks on sheep and goats, even when they rely on native fauna for

[19] This prospect will depend on many factors including the stability of the local wild dog population (see Allen and Gonzalez).

[20] Several graziers explained that wild dogs have been a dominating influence in accelerating the decline in Queensland's sheep population. They explained that fluctuations in wool prices and drought are not powerful enough forces on their own to explain the quantum exit from sheep.

sustenance (Fleming et al 2001). Several of the graziers surveyed tendered the observation that wild dogs 'kill for sport'.

Economic: In those parts of the pastoral belt where it is possible to run both sheep and cattle, the loss of the woolgrowing option constitutes a significant impact. In the past, fluctuations in relative prices[21] and seasonal conditions changed the economics of sheep and cattle, and led to profitable adjustments in the flock/herd ratio. This consideration applies particularly during dry times when cattle lose condition rapidly and may become unsaleable, while sheep continue to survive and produce a useful wool clip. Thus running sheep is good insurance against drought in regions that are drought prone.

Once sheep disappear completely from a property, however, this sort of adjustment is no longer possible, and sheep are unlikely to be reintroduced even if their economics are demonstratively superior to those for cattle. To the extent that wild dog predation is currently forcing out sheep, graziers are losing future choices that could have been economically valuable.

The situation explained by several of the graziers interviewed highlights the possibility of multiple losses. In some remote western areas, however, woolgrowing has the following strengths:

- The high unit value of wool makes it economical to employ shearers and transport the sale product to remote markets.
- Providing it is possible to breed, the expensive option of buying in replacements is avoided.
- With the strengthening of the live export trade, there is now an attractive market for any surplus sheep that can be bred on the property.

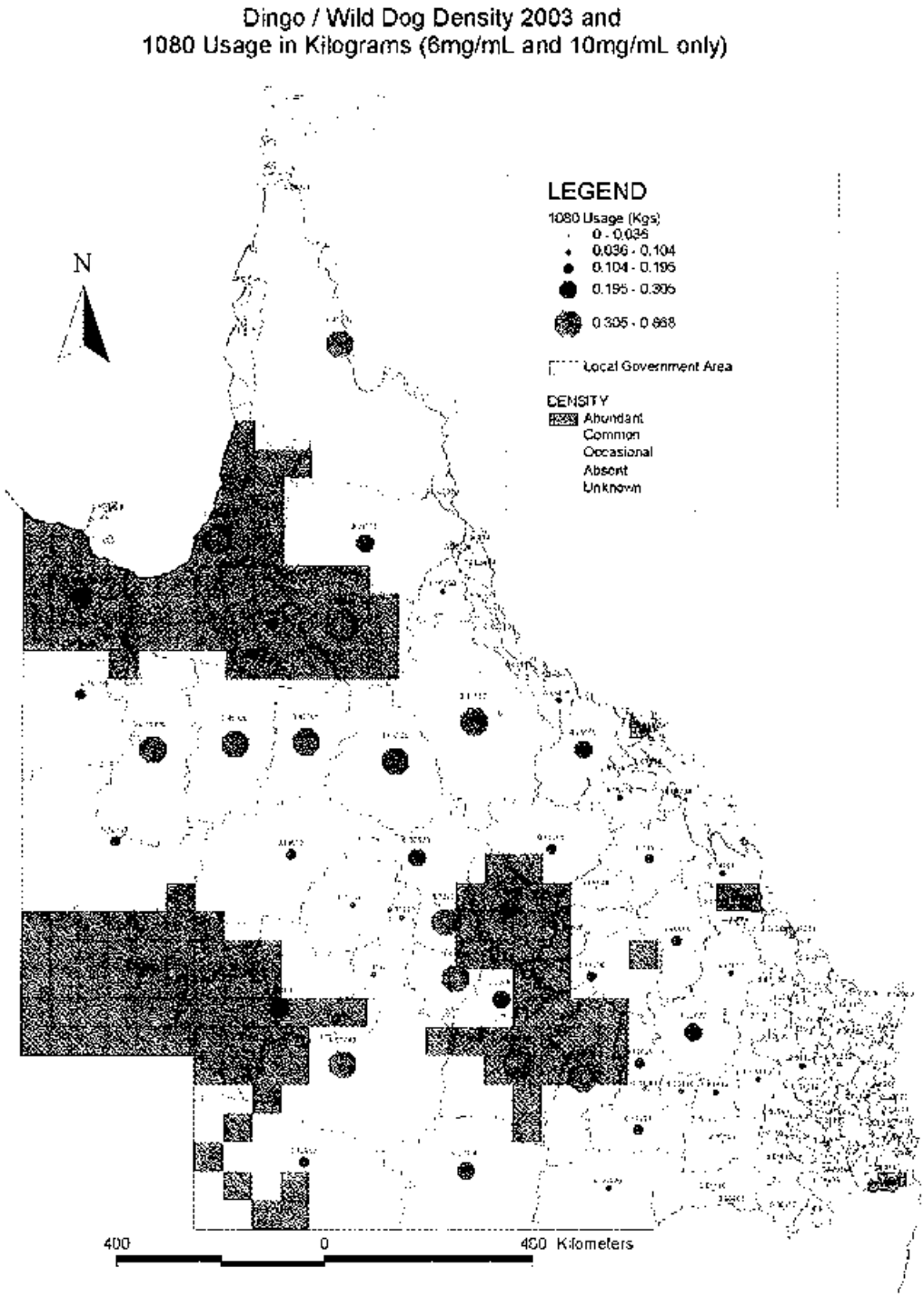
The case of a Boulia woolgrower

This grazier left the sheep industry because in his area, isolation makes it imperative to breed your own replacements. However, breeding became untenable three years ago when the lambing rate dropped from nearly 70% down to 35%, due largely to wild dog predation.

Several graziers expressed concern about downward pressure on cattle prices if sheep in Queensland are replaced by cattle, without particular reference to market forces (i.e. if the replacement is 'forced' by dog predation). Of greater significance might be the implications for risk management. Thus greater 'specialisation' in cattle means less diversification and a corresponding loss of protection against risk. Beyond the farm gate, however, cost efficiencies might arise in the areas of transporting, processing and marketing through having a larger cattle herd.

[21] Running a mix of sheep and cattle has often been used as a form of risk management by Queensland graziers. This was effective because cattle and wool prices have not moved in unison, and the two species can have complementary grazing habits while demanding similar skills in terms of management.

Figure 3: Wild dog distribution and 1080 usage in Queensland



3 Impact of wild dogs in semi-urban areas

3.1 Current issues

Wild dogs are ubiquitous throughout the state, with regular sightings on acreage around Brisbane, throughout the Sunshine Coast, and outside more northern cities and townships. The only limitation on their movement seems to be absence of habitat or physical barriers. As a consequence, wild dogs have the potential to impact on the residents of semi-urban areas, and as more people settle on the rural fringe, reports of 'distressing encounters' are becoming relatively common.

From the perspective of this study, it will be useful to highlight some of the major distinctions and parallels between wild dog impacts in rural and semi-urban areas.

Points of difference: In rural areas, the distinguishing feature of wild dogs is their potential to inflict large dollar losses on the farm business. It is possible to estimate these losses by relating rates of predation and incidence of disease to the livestock population, and by adding on cash outlays involved with control measures. In semi-urban areas, the major impact of wild dog is loss of amenity due to the menace 'factor'. The menace of wild dogs can manifest itself in many ways, from howling at night to the fear of physical attack. The reduction in quality of life due to wild dog harassment does not lend itself to quantification, but is nonetheless real and significant. Rural and semi-urban communities respond very differently to the presence of wild dogs.

- In specialised sheep production areas, the local community will usually be familiar with the 'wild dog threat' and, therefore, reasonably united in their response. Furthermore, because of their low population density, rural communities are relatively unrestricted in their ability to use 1080 baiting.
- In mixed sheep and cattle areas, the effort devoted to control programs may differ from one property to the next, but unanimity regarding control will still be reasonably high, and all producers will be relatively free to act in ways that meet their own best interests.
- In semi-urban areas, a distinctly different situation exists. For most people living in a semi-urban community, an encounter with wild dogs will be a new experience. They will be unprepared in terms of background knowledge, and have limited knowledge of what can and should be done. Rarely will be it be possible for residents to act unilaterally, and most people will harbour an expectation that low-cost, effective solutions are available from a government agency. Solutions may, in fact, be hard to design and implement due to the difficulty of getting a large group of people with disparate backgrounds to agree on the best way forward. Some group members will find it easier to blame others for obstructionism rather than seek out and develop solutions themselves.
- Experience shows that it can take some semi-urban communities a long time to reach consensus on a course of effective action (Scott O'Keeffe, pers. comm.).

Points of likeness: While the main impact of wild dogs in rural areas is economic loss, it is not the only impact. As with semi-urban areas, wild dogs can lower the quality of life in rural areas by posing a constant threat to livestock and, in exceptional circumstances, posing a threat to human safety. Threats to human safety are known to escalate when wild dogs encroach on settlements and are not actively repelled. The tendency for this is greatest at

tourist destinations (e.g. Fraser Island) where some people seek or encourage 'contact' with the wild dogs. Similar situations occur in settled areas where uncontrolled areas, such as rubbish tips and parks, provide reliable food sources for wild dogs.

This section of the report explains how wild dogs affect the quality of life in semi-urban areas of Queensland. Due to resource constraints, case studies are documented for the purpose of illustrating how wild dog impacts in semi-urban areas originate and unfold. The case studies give some background on these impacts, and the diversity of such, and on how dog problems have been treated and allayed in these areas.

3.2 Emergence of the problem

The past five years have seen a sharp increase in the number of reports involving wild dogs, as well as the number of wild dogs sighted in large packs roaming suburban streets in residential areas of coastal Queensland. These wild dogs have been the cause of complaints and incidents of threatening behaviour towards humans, family pets and medium-sized livestock on the fringe of settled areas.

Three years ago, NR&M appointed an officer to investigate the issue of wild dogs in settled areas. Since that time, the department has conducted many public meetings on the issue of wild dogs, the first of which was held in 2000 at Pullenvale—an outer suburb of Brisbane. Similar public meetings have been held around the state, where landholders and communities have perceived there are wild dog problems that need to be addressed. The focus of these meetings has been to educate and encourage the community at large to accept ownership of the problem, and develop effective solutions.

Semi-urban areas of Brisbane, Bribie Island, the Sunshine Coast and Townsville have all experienced problems with wild dogs. The proximity of national parks, and forestry and reserve lands to older, established and new communities alike has increased the interaction and impact that wild dogs have in these settled areas. Successful management of wild dogs has occurred in some areas of Queensland, with negligible financial impact on the residential landholder.

The debate surrounding wild dogs in semi-urban areas has focused on how to minimise impacts through acceptable control methods, education and awareness programs, responsible waste storage and removal. Sightings of 'skinny' wild dogs, for example, cause deliberate feeding by some people who are ignorant of the consequences. These animals become accustomed to humans and their environment, raise further litters of pups that are then unable to perform their natural role as a higher order predator in their natural environment, and the cycle continues.

Evidence is mounting that the entry of wild dog populations into urban areas is posing a disease threat to humans. In Townsville, the wild dogs caught in the suburbs as part of a control program were tested for parasites, and in a study conducted by Dr Bruce Copeman, Parasitologist of James Cook University, *Echinococcus granulosis* (hydatids) were discovered in 25% of the dogs tested.

In 2001, James Cook University undertook a comprehensive study of dingoes/wild dogs in suburbia. The dietary component concluded that macropods made up approximately 60% of their diet, with the allied rock wallaby preferred over the abundant agile wallaby, followed by bandicoot 25%, then piglet, bettong, rabbit and cat. Separate scat analysis concluded that 27% of scat material contained some evidence of scavenging. This 'material' included plastic,

alfoil, bone, claws, corn, sticky tape, bits of pencil, and apple seeds.

While attractants such as domestic rubbish, compost, leftover pet food and the odd chicken are present in the urban environment, Brisbane suburbs have plentiful supplies of wildlife. Such wildlife might also be the preferred prey of wild dogs in urban areas, and thereby attract them into backyards.

Corridors (roads, waterways and easements) link many types of land use and provide connectivity between ecosystem fragments. A variety of native and exotic fauna may use corridors. Wild dogs may also use corridors for movement, but this may not necessarily increase the vulnerability of native prey resident in ecosystem remnants. Predation in this situation could contribute to local disappearance of native fauna, but is unlikely to constitute a broadscale threat.

3.3 Case studies

3.3.1 A Brisbane suburb

The property at the centre of this case study is just 6.5 km from Brisbane's GPO. It is approximately 50 acres in size and is zoned 'rural residential'. The property is bordered by older style residential housing on one boundary, new residential development on another and bushland habitat to the rear. The landholder has lived on this property his entire life. He remembers his late father once saw a wild dog, which was quickly shot. That occurred approximately 35 years ago, and no further sightings occurred until December 2001.

From this time, sightings, howling at night, domestic dogs barking, and the loss of some livestock eventually spurred the owner into action. A private contractor was commissioned to humanely trap and remove the wild dogs causing problems. Several animals were caught over a few days. Contact was made with the landholder responsible for managing the neighbouring bushland habitat. This landholder agreed to manage pest animals using the following control plan:

- participate in public relations exercises with neighbouring property owners
- implement a trapping program
- monitor traps on a daily basis for a one-month period
- keep police informed of activities.

Due to the landscape and proximity to residential areas, chemical control was not considered an option. An extensive advertising program was implemented by the contractor to inform neighbouring property owners of the program and of their responsibilities. This ensured cooperation from all neighbours and also generated many positive contributions from others. Firearms were used in certain circumstances to destroy pest animals that were either trapped or observed roaming at large.

Detailed monitoring of animal activity prior to, and after, control work enabled the clients to gauge the success of the program.

Due to the pre-emptive actions of the landholder, minimal public involvement was involved, thereby avoiding the costs associated with community education, awareness and media reporting of wild dog impacts in a settled area. This outcome might be explained by the landholder's long association with the area and his confidence to act unilaterally. From this

perspective, the case study is possibly rare and should not be taken as a model for development of semi-urban defences against wild dogs.

> The landholder moved swiftly to eradicate the infestation. This restored security to resident native fauna and local livestock. The landholder, in this case, also circumvented any possible liability and compensation claims that might have arisen from failure to implement a control program.

3.3.2 Townsville

Sightings of a wild dog in suburban Townsville were reported in late 1998. By June 2001, following attacks on pets, the subject of controlling wild dogs was raised in the media. After many meetings of a task force involving the public and government agencies, a decision to use a 1080 baiting program was made. This decision was immediately met by public backlash. A petition was delivered to authorities that effectively halted all control work. The public stance against 1080 baiting has remained strong.

Subsequently, Townsville City Council (TCC) employed the services of a contractor from Victoria to trap the wild dogs. This resulted in the capture of one domestic Samoyed dog that was known to council, two bandicoots, two cats, one possum and a curlew. Clearly this program was a failure.

Another 'solution' involved pre-feeding wild dogs at a selected site so they could be tranquilised using a dart gun. After this method failed, passive non-lethal control methods were introduced to affected areas. These included improved waste storage and removal practices, and enhanced public awareness through the local media. It should be noted that, during this phase, the task force did not act on the advice of agencies more experienced in the control of wild dogs, which had stressed the need to examine, and deal with, the root cause of the problem.

On 3 July 2002, the *Townsville Bulletin* reported the attack by a wild dog on a two-year-old girl playing in her backyard. This incident, along with concerns that wild dogs in Townsville were considered a risk to public health, precipitated stronger action.

Soon after, at an expected cost of $10 000, TCC commissioned a Brisbane-based contractor to assist in the development of a Wild Dog Task Force, and to develop a strategy to overcome the problems that wild dogs were causing in the suburbs. The task force met on 18 July 2002, and comprised TCC officers, and representatives from the Premier's office, Queensland Police, Queensland Health, NR&M, RSPCA, QPWS, Department of Defence, James Cook University, Thuringowa City Council, Townsville Hospital, and a pest management contractor.

The Townsville program dealt with all issues associated with controlling wild dog impacts in urban areas. Regular press and television interviews and media releases demonstrating coordination among the task force members helped to obtain the community's confidence. More positive press along with letters of support to the editor were the result in this case, including one letter from a resident detailing the humane capture and return of her cattle dog.

This case study indicates the potential social and political problems that can arise if pest animal problems are dealt with in an *ad hoc* manner. It also shows how serious impediments are created by trying to avoid spending the optimal amount of time and effort on a rational

problem-solving exercise.

3.3.3 Maroochy Shire

The Maroochy Wild Dog Task Force was established in early 2002 in response to wild dog impacts. Sub-communities have been affected, and the local media have reported the regular harassment of livestock and family pets and, most concerning, attacks on people.

Many public meetings have taken place throughout the shire. Government agencies including NR&M, QPWS, DPI&F and the Queensland Police Service worked with the Maroochy Shire Council (MSC), RSPCA and landholders, to form a task force headed by independent MP Peter Wellington. The purpose of the group was to analyse the problem and develop an appropriate response. An important facet of the problem was lack of a system for collecting information on incidents involving dogs, and tracking movements of dogs. Collecting this type of information showed where dog activity 'hot spots' existed, and showed that a significant amount of the activity was incorrectly attributed to wild dogs. The task force coordinated control of wild dogs in identified 'hot spots' at Chevallum in the south, and at Ninderry/North Arm in the northern parts of the shire.

At a cost of $4000, which was shared between state government and MSC, 23 animals were caught (16 wild dogs, 4 foxes and 3 domestic dogs). This required a total of 142 hours of labour. The $4000 was intended as seed money to assist in the establishment of an effective response to the dog problem. It allowed the establishment of ongoing control works in areas where wild dogs continue to be active. Maroochy Shire Council has committed an additional $20 000 for wild dog management, as there is now an effective alternative to previous *ad hoc* approaches. Some private landowners have also commissioned pest management contractors to assist in the capture and removal of problem animals.

The MSC program also demonstrated that roaming domestic dogs are a serious problem, and one that must be addressed concurrently with wild dog management.

A strawberry farmer in the Chevallum area has suffered financial losses totalling approximately $30 000 caused by wild dogs chewing poly drip lines and lay-flat reinforced rubber hoses—equipment that is essential for watering crops. Other strawberry farms in the area have also suffered financial losses due to wild dogs.

Further damage is caused when dogs tear holes by walking on the silver plastic that covers strawberry rows. This damage has occurred at night, when irrigation of the crop normally takes place. Damage caused by dogs has resulted in flooded crop beds, lost crops and reduced income from strawberry sales.

The high labour costs needed to repair damage, buy and replace seedlings, and repeat this process became intolerable to the farmer. He eventually commissioned private contractors to remove dogs and the losses were stopped. This example demonstrates how wild dogs can inflict material losses outside the cattle and sheep industries.

3.3.4 Fernvale Boer goat and cattle producer

Wild dogs began to attack goats on the 300 acre Fernvale property in early 2001. During February, many attacks occurred and 50% of the goat herd was lost. Both wild dogs and domestic dogs had harassed the landowner's goats, and although the landowner had the right to destroy both groups, he returned the domestic dogs to their owners with a request that they be adequately controlled. The domestic dog issue was caused by the proximity of the property to urban and semi-rural development, where some of the landholders allow their pet dogs to roam.

When attacks continued, the goat herd was moved each night to holding yards close to the farm house. Talk-back radio was played all night as a preventive measure, and the fencing was checked daily. This worked well for a time until further attacks occurred just 20 m from the farm house. At great expense, additional floodlighting was erected to cover the yards with white light, illuminating the holding paddocks and providing livestock with extra security.

An application for chemical baiting with 1080 was approved by authorities and implemented by a private contractor and the landowner, along with trapping to improve the program. Combining these two methods removed many dogs, and the number of attacks decreased.

As a further preventative measure, two Maremma guardian dogs were introduced to the herd and remained resident for approximately two years. These dogs proved effective in preventing attacks on the goats. However, one dog succumbed to a snake bite, and the other began to wander from the property and became a nuisance to urban neighbours. This dog was eventually impounded by council and was not returned to the property.

At a cost of $5000, a successful Wild Dog Field Day was held on the property in 2002. It brought affected landowners together with authorities and dog owners, and gave everyone the opportunity to discuss their concerns and learn more about the issues that face landholders when dealing with wild dogs problems.

Limited 1080 baiting programs have since been implemented in the district without any other form of control taking place. Controlling dog activity on this Fernvale property has continued at great expense to the landowner.

In 2001, Esk Shire Council reintroduced a $10 bounty for dingo scalps, which has since been increased to $20.

3.4 Insights from the case studies

This chapter has attempted to demonstrate the broad impacts, including financial impacts, of wild dogs on landholders in the more densely settled areas of Queensland. The report has documented a number of impacts that have occurred in semi-urban areas due to a combination of housing developments encroaching on agricultural land and bushland habitat, and a lack of resident wild dog control prior to proceeding with development. In addition, some long established communities that were previously free of wild dog impacts are now experiencing incursions for the first time. It would appear that wild dogs have continued to migrate through the rural sectors to the more recently settled areas and beyond to older communities.

The impacts inflicted by wild dogs on semi-urban areas rarely lend themselves to quantification in monetary terms, but they do amount to inconvenience and a tangible loss of amenity. The problems that are often associated with increased contact between wild dogs

and humans in semi-urban environments include:

- fear created by the realisation that a potentially dangerous animal occurs in the local environment
- possible impacts on pets and the personal safety of household members, leading to general anxiety
- canvassing of neighbours to ascertain their awareness of wild dogs in the local environment and their attitudes towards control
- communications with the police and local and state government officers in expectation that they will have a ready-made and cheap solution
- participation in community-based meetings where the painful process of gaining knowledge, accepting responsibilities for the primary decision-making process, and achieving within-group agreement on the best course of action might start to unfold
- creating a local action committee and sharing the costs involved with employing the services of a professional pest control contractor
- monitoring the results of any control campaign and determining whether the original objectives were achieved, then assessing the campaign's cost effectiveness
- households adopting self-help practices that are likely to minimise the threat posed by wild dogs, e.g. high-quality perimeter fencing, better care of pets and livestock, removal of possible food sources and other attractants, keeping neighbours informed of wild dog movements and sightings, and alerts broadcast by local radio
- developing a 'community memory' for dealing with any further incidences of wild dog entry.

Figure 4 provides details of a possible model for community education and problem ownership. The best outcome for semi-urban areas confronted with a wild dog problem will be measured progression through the early stages of community involvement. This will enable agreement on control measures to be achieved effectively, thereby minimising costs and losses over the longer term.

3.5 Current situation

From the perspective of most affected communities, wild dog management is equated with eradication. However, the objective of nearly all pest management programs is 'effective control' that leads to a reduction in impacts in threatened areas and maintenance of ecological balance. Control in this sense will allow mainstream economic activities to remain viable in settled areas, without removing the benefits that are sometimes claimed for native dingoes.

It is apparent that the amount of money spent on control is low, relative to the cost of impact. The summary figures shown in Table 9 indicate that for every dollar spent on control measures about $5 is lost to predation, disease and other direct losses. While not suggesting that outlays on control should approximate direct losses, the disparity begs the question of why more money is not spent on control. In Table 10, possible explanations are offered and analysed in the light of contemporary knowledge.

Table 10: Constraints to spending more on wild dog control

Possible constraint	Analysis of relevance
Absence of effective control measures	A range of control measures exist but they all have drawbacks, including the time and expense of implementation. Easier and more cost-effective methods will always elicit greater usage, thus research into better control techniques, including combinations of measures, should be maintained.
Those suffering losses not able to exercise commensurate control	'Greater coordination and cooperation' is a common theme running through control strategies. This study has revealed the vulnerability of wool producers who are bordered by cattle producers who do not bait, or by households at the settlement interface to where wild dogs are attracted by more abundant food resources. Thus greater coordination will always pay dividends and should be an ongoing role of producer syndicates, government Land Protection Officers and departmental policy makers.
Affected group not properly aware of the losses they are suffering	We suspect that many cattle producers are not fully aware of the large losses they suffer from disease spread by wild dogs. An ongoing campaign to alert cattle producers about the disease hazard would result in benefits for the whole of Queensland agriculture. The Land Protection division of NR&M and AgForce should take lead roles in encouraging cattle producers to become proactive.
Insufficient assistance being offered to affected groups	Given the meagre work force available to rural Queensland, sheer manpower is a problem for any program that is labour intensive and otherwise costly. It is clear from the dollar figures in Table 9 that the government is committed to pest management generally. However, the nature and extent of this commitment is periodically reviewed to ensure that the effort and funding levels are fully commensurate with the scale of the wild dog problem. This includes a large component of social costs linked to disease and perceived safety risks, and the need to optimise investment in control on a statewide basis.
No overt recognition of the risks that wild dogs pose to human health	The threat of rabies to human health and the role of wild dogs in its transmission are well understood (see Fleming et al 2001, p.52). Future risk analyses might link the rabies threat with a wild dog control strategy in the event of rabies entering Queensland.

The Agricultural Protection Board of Western Australia recently commissioned a stakeholder panel to evaluate the efficacy of Western Australia's Wild Dog Control Program. The panel has now reported (May 2003), and it is apparent that Queensland can benefit from the experience in Western Australia. While the entire evaluation should be considered for relevance to the local scene, one of the panel's recommendations is noted immediately:

> *That the medium to long term management of wild dog numbers in WA will require a move away from the present over reliance on aerial baiting and a return to the sustained widespread deployment of **ALL** available control techniques in combination (ground baiting, aerial baiting, trapping and shooting).*

The Western Australia experience is also a useful reference with respect to protection of native fauna from attack by feral animals. Armstrong (1998) reported that the Western

Australian Department of Conservation and Land Management has embarked on a wildlife conservation initiative of international significance known as Western Shield. This initiative distributes fox baits to over five million hectares of crown land in the south-west of Western Australia. Armstrong states that 'control of feral predators has been demonstrated conclusively to make a significant contribution to the conservation of native wildlife in Western Australia'.

3.6 Baiting

On a statewide basis, 1080 baiting is by far the most potent and most popular weapon in the fight against wild dogs. Considerable research has been done on both bait preparation and baiting strategies. To this extent, the means already exist to exercise control over large areas (see Thompson 1986). Chapter 7 in Fleming et al (2001) provides detailed guidelines relating to problem definition, planning, implementation and evaluation of strategic control programs.

However, effective completion of the steps in strategic baiting requires professional assistance (to coordinate the strategy) and cooperation from landholders in the affected area. Provision of 'professional assistance' would appear to be satisfied through the efforts of LPOs and shire council officers throughout the state. Clearly there exists an ongoing need to ensure that the placement and funding of these officers is commensurate with wild dog incidence and impact in particular regions. The issue of universal landholder cooperation is possibly more complex.

Ideally, landholders will cooperate with neighbours and the local LPO because they sense this to be in their own best interests. Our study found no problem with cooperation among woolgrowers, but apparently some cattle producers are not yet convinced that coordinated control measures are beneficial[22]. While the poisoning risk for working dogs is acknowledged, cattle producers need to assess and manage this risk in view of the wild dog-related losses that they are no doubt suffering.

Regardless of the merits of baiting, it is not the universal solution to dog problems. Some of the worst problems reported by graziers were caused by individual dogs that were wary of baits and operating close to the homestead. These so-called problem dogs have to be shot or trapped.

One bad dog

A Longreach grazier, from an area that 'never' had dog problems, reported that he had lost about 90 sheep valued at $2300 to one dog, over a period of 18 months. After spending an enormous amount of time and effort to work out the dog's movements and special habits, it was eventually trapped. The grazier estimated that the cost of this one dog, in terms of sheep losses and capture costs, was over $3000.

[22] The concerns of some non-cooperators are based on genuine concerns. Among the reasons tendered for non-participation were fears of poisoning own working dogs, and some are yet to be convinced of the private benefits. It is also apparent that ignorance, apathy and antagonism play a role. The challenge, therefore, is to overcome these barriers.

3.7 Barrier fences

Prior to any coordinated dog fencing, bounties were paid by 'dingo boards' for the purpose of encouraging landholders to control marsupials, dingoes and foxes. The Dingo Barrier Fence Scheme (now called WDBF) was proposed by the coordinating board in 1948, and designed to enclose the established sheep areas of the state. The government provided the netting and undertook to supervise construction and ongoing maintenance.

The rising maintenance cost has been a recurring problem for the WDBF, leading to numerous inquiries and studies. In the EconSearch (2000) cost–benefit analysis, the cost of maintaining the fence was put at $1.68 million in 1997–98. No further analysis is attempted on this occasion, except to note that some of the problems surrounding maintenance are highly intractable. For example, shires and individual graziers have vastly differing views regarding their need for the fence, its efficacy and how much cost in maintenance is reasonable. These divisions are compounded by the historical and cultural significance of the fence. All these issues serve to highlight the difficulty of managing any program burdened by high overhead costs and multiple stakeholders with varying levels of commitment. Determination of the annual budget for WDBF maintenance is in the hands of a 'fence panel' comprising representatives of affected local governments and NR&M officers.

Apart from such general observations, this study recommends maintenance of the WDBF for the role it might play in perpetuating a Queensland sheep and wool precinct. In this context, a physical barrier to reinvasion would help to make other control measures more effective. Thus it should be possible to create and maintain dog-free areas inside the fence, due to a maintained fence preventing reinvasion. Such a strategy would imply no diminution of control measures outside the fence, but would provide scope for making control measures inside the fence more meaningful, effective and permanent.

Some landholders are attempting to make their boundary fences secure against wild dog incursion by electrifying one or several wires in the fence. Clearly this is an expensive exercise, but it might offer the most cost-effective control where the option of a chemical barrier is not available and a complementary suite of controls is being put in place. It is recommended that further research be conducted into new forms of fencing that are effective against wild dogs and other animals that damage fencing, such as kangaroos, emus and feral pigs[23].

3.8 Trapping and shooting

Several graziers made the observation that it is becoming increasingly difficult to secure the services of a dogger to trap or shoot so-called 'problem' dogs that are wary of baits and cause huge losses. However, some woolgrowers did report using doggers. A Murweh grazier recently employed a dogger who charged $300 for each problem dog destroyed plus fuel, while a Warroo grazier paid his dogger $500 per adult dog taken on the property. Doggers employed by the local shire are often paid a bonus of $100 by the owner of the property on which particular dogs are caught.

[23] The extensive cattle industry is currently undertaking R&D into so-called virtual fencing. With virtual fencing there is no physical structure, but animals are 'directed' to stay inside or outside particular areas by sensory impulses. Providing it can be made technically effective and economic, this technology should have many applications in outback areas.

3.9 Bounties

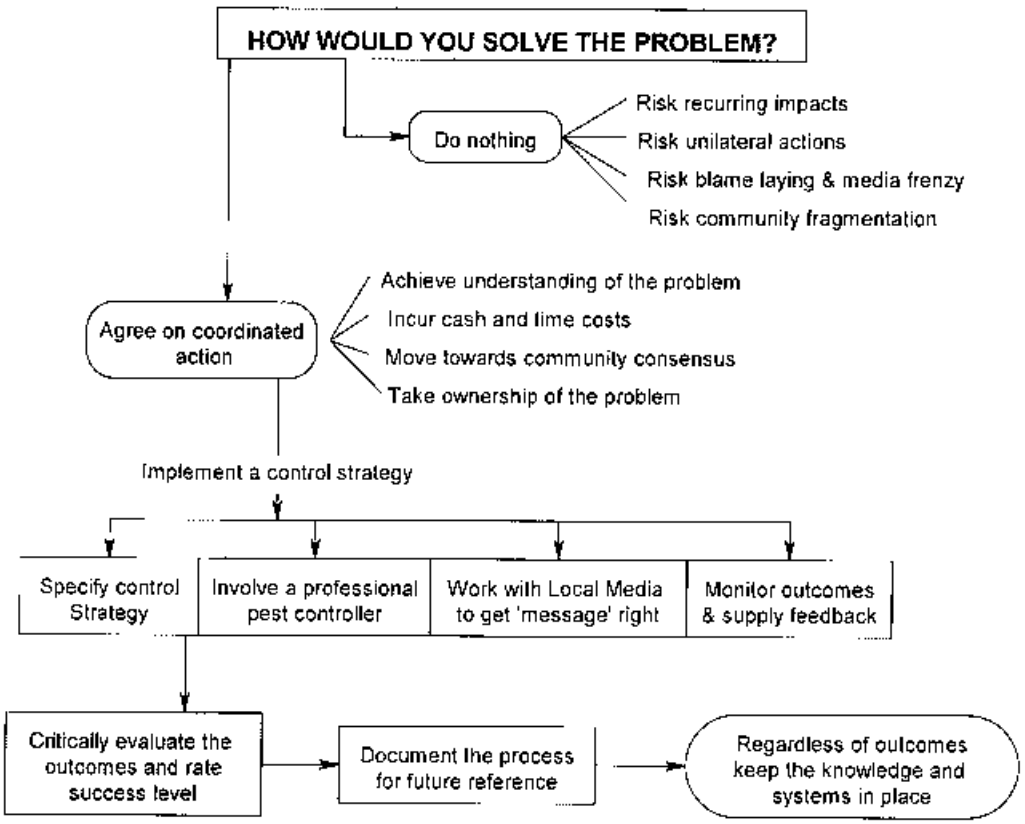
Bounties are still paid by many shires throughout Queensland and are designed to encourage targeted removal of pest animals. These days, many people consider bounties as inefficient and prone to misuse, but they may still have a role to play within a mosaic of measures that cater to a range of circumstances. In very isolated areas, for example, routine trapping might be the best way of keeping wild dogs out of particular areas.

A Jundah grazier reported trapping over 100 wild dogs a year on his boundary. This strategy was effective in keeping dogs out of his sheep flock, but was very expensive in terms of time, fuel and effort. The point was made by the Jundah grazier that bounties help to offset costs and provide an economic incentive for doggers to go after problem dogs.

No-one is claiming that a bounty, on its own, can seriously reduce wild dog numbers. However, a bounty could be a useful part of a robust strategy that attempts to address the full array of circumstances. Apart from its capacity to act on 'problem' dogs, a bounty is seen to have desirable social impacts. For example, bounty payments are directly proportional to effort, and there can be little doubt that most payments would go to people in financial need and, possibly, to people with 'bush skills' (skills that Australia should be trying to preserve and propagate). At the margin, bounty payments should help to keep people in outback areas.

Providing that an efficient collection system is established, a bounty would furnish the means for gathering data on the incidence, and nature of wild dog movements and diet, etc. Many professional doggers already provide autopsy data to research agencies on dogs captured.

Figure 4: A model for confronting the wild dog problem in semi-urban areas



Appendix 1 comprises a short report on the Mackay Wild Dog Chemical Trial Program. Other semi-urban communities may find this report useful for the purposes of developing a strategy for countering any wild dog problems that emerge.

4 Conclusions and recommendations

4.1 Conclusions

The study found that wild dogs impose significant cost impacts on several sectors of the Queensland economy. In geographic terms, the cost impacts extend over most of the state, as wild dog activity occurs in nearly all rural areas reliant on domestic livestock and in numerous semi-urban communities. It is apparent that wild dogs impose real costs in both rural and semi-urban areas, but with key differences in how the costs are inflicted. The difference can be explained thus:

- In rural areas, wild dogs impose costs by preying on livestock and spreading disease. These costs impact directly on the earning capacity of graziers and, in some cases, where no effective control is possible, the predation losses can be very large and threaten economic viability. The scale and persistence of wild dog predation has been the determining factor in putting some Queensland graziers out of the woolgrowing business. On an aggregate basis, income losses have tended to be large relative to outlays on control.
- In semi-urban areas, wild dogs occasionally inflict direct losses (see case study on strawberry farm), but more typically the costs arise through reduced amenity or lower quality of life. While loss of amenity is not likely to affect earning capacity, it can cause anxiety and fear and may even threaten personal safety. Indeed, wild dogs can cause 'fear and anxiety and threaten safety' wherever they occur, particularly in areas where they have started to intermingle with itinerant residents, chiefly tourists, who might try to 'befriend' them. In rare cases, the perception that wild dogs are a serious problem can reduce the market value of affected properties and thereby inflict a monetary cost. In recent years, semi-urban areas have started incurring cash costs associated with organised control schemes. Once again, the cost of control measures appear to have been low, relative to the potential losses.

The nature of the wild dog problem in both rural and semi-urban areas of the state is complex, and is clearly subject to change depending on how management and environmental influences interact. In rural Queensland, the displacement of sheep by cattle over recent years, and the coincidence of drought, appears to have seriously undermined the efficacy of traditional control programs and resulted in wild dogs finding their way into areas where they have not been sighted for decades.

Traditional control programs relied on unbroken coverage of geographic areas so that wild dogs could not penetrate 'protected areas'. But when some properties lying in the buffer zones suddenly choose not to participate in coordinated control programs, gaps open up and the wild dogs soon find their way through to new territory. It is apparent that successful re-establishment of buffer zones will depend on blanket coverage and associated cooperation among all landholders in affected areas.

The control of wild dogs in semi-urban areas is complicated by the need to educate residents about the nature of the problem and the difficulties associates with control options before anything tangible can be attempted. To date, departmental LPOs have borne the brunt of the consultation and coordination activities, with private contractors called in to handle the relatively minor activity of implementing the agreed control measures. Scope would seem to exist for entry of more fully integrated control services offered by private contractors, provided the market can be educated to properly reward those offering a complete service. The 'first step' might be the introduction of an industry and government-backed accreditation scheme for animal pest controllers based on integrated pest management principles.

4.2 Recommendations

While the focus of this study was on quantification of wild dog impacts, the assessment has inevitably led to development of various perspectives on the best way forward. These are outlined below in the form of recommendations.

- Our main recommendation is that cattle producers throughout Queensland should be made more aware of the role that wild dogs play in spreading disease. In particular, cattle producers should be made aware that hydatidosis and *Neospora caninum* are spread by wild dogs when they contaminate pastures, and subsequently inflict large losses on the state's cattle industry[24]. Further R&D is needed to determine the exact relationship between wild dog control measures and the rate of loss due to transmissible diseases. However, existing knowledge of the link between wild dogs and disease, combined with the threat of direct predation losses on calves, should be enough to initiate pre-emptive action.

- Similarly, people moving into rural residential communities should be made aware of the presence of wild dogs and the potential for adverse encounters. Reliable information about the strategies that households and communities can put into place to minimise the problem should be made readily available.

- Finally, scope exists to more clearly enunciate the respective roles and responsibilities of the public and private sectors, thus the work of government agencies should be focused on generating public benefits. Because the market economy is ill equipped to grapple with the full spectrum of wild dog impacts, it is imperative that all arms of government remain closely involved in the overall strategy and achieve control outcomes that are effective at a local level, and acceptable to the community at large. Government agencies will make private sector efforts more effective if they can implement systems that enhance community knowledge of pest animal problems, encourage coordinated control and foster an expectation that those who benefit most from any pest management program should be primarily responsible for the associated input of resources.

[24] It is commonly argued that any reduction in liver condemnations will benefit processors but not producers, thereby denying producers any incentive to control hydatid infection. This line of argument defies economic logic. If there is a high probability that cattle livers will be infected (as is the case now), processors will be inclined to discount all purchases accordingly. If, however, the probability distribution were to tilt in the opposite direction (i.e. most or all known slaughter cattle are free of hydatid infection) competitive forces would induce processors to incorporate the higher expected value of the carcass into their offer prices and reward producers accordingly. If, therefore, producers were to implement an effective means of reducing hydatid infections in their herds, they would eventually be rewarded via returning prices. Clearly, however, the connection between action and rewards would be slow to unfold.

5 Appendix

Mackay Wild Dog Chemical Trial Program

Abstract

Increased wild dog activity within the Mackay semi-urban area led to a wild dog public meeting. Landholders progressed from this meeting into strategic working groups, based on identified problem areas. Each area supported unique geography and, therefore, 'best practice' wild dog management was determined within each specific site. Within numerous sites, best practice was identified as 1080 chemical control. In areas where best practice was identified as chemical control and the community showed support, commitment and involvement, chemical control programs proceeded. Seventeen areas undertook 1080 chemical control, directly involving some 85 landholders. Within the 17 strategic locations, 1224 kg of meat was used. The program resulted from the support and commitment of the community.

Aims

- To reduce the impact of wild dogs on the economic, environmental and social values within the Mackay District.
- To increase community ownership, roles and responsibility in wild dog management.

Introduction

Dingoes typically breed once per year, with domestic dogs and dingo hybrids breeding twice per year in good conditions. March through to April is typically the breeding season, with pups on the ground and dispersing around July/August. These periods typically coincide with wild dog reports throughout the Mackay Region.

Mackay District wild dog reports increased substantially during 1998–99. These reports detailed economic, environmental and social losses including noise pollution, visual reports, human approaches and domestic, stock and native animal losses. Wild dog reports were generally occurring within semi-urban areas (i.e. within 5 km of township areas and 2 km of dwellings), and thus in areas prohibited from using chemical controls.

The semi-urban wild dog problem areas that were identified included Cape Hillsborough; Haliday Bay; Black Mountain; Mt Vince/Pownells Road; St Helens; Midge Point/Laguna Quays; Exmoor/Mentmore; Mt Ossa; Mt Charlton; Calen; Rise and Shine; Yalbaroo; Rocky Mountains; Cathu; Geeburga/Buthurra; Devereux Creek; Habana; The Leap; Balnagowan; Richmond; Seaforth/Mt Dukes; Homebush; Bloomsbury; Farleigh; Dumbleton; Nebia-conningsby; Glenella; Kuttabul; Pleystowe; Palmyra; and Eton.

Wild dog 'best practice' management is dependent on the specific problem site. Factors such as locality, topography, area affected, number of landholders affected, proximity to townships and housing, and environmental factors are all issues that were considered prior to determining control options.

Under the old *Rural Lands Protection Act 1985 (RLPA)*, the roles of the state/local government and landholders in declared animal management are as follows:

Landholders:

Section 80 RLPA: Occupiers of private land to control declared plants and animals.

The occupier of any private land who fails to control declared plants and animals on that land commits an offence against the RLPA.

Local government:

Local government enforces control of declared animals on private land under Section 99 of the RLPA.

Section 99 RLPA: Authorised persons or inspectors may order destruction of declared animals.

Local government may also provide on-ground assistance and analysis of declared animal problems.

State government:

The government's role, through the Land Protection unit of the Department of Natural Resources and Mines (NR&M), is to provide technical advice on declared animal management to both local government and landholders. This includes training of local government officers and monitoring of declared animal ecology and management.

Methodology and results

On 26 and 27 October 1999, NR&M in conjunction with Mackay City Council (MCC) held two wild dog public meetings at Mackay and Calen respectively. The meetings were conducted in response to community demand and were well attended, with the following community interest groups involved:

- rural landholders
- urban landholders
- MCC mayor and councillors
- MCC management and ground staff
- state urban pest management officer (NR&M)
- Land Protection (NR&M)
- Forestry (NR&M)
- Health Department
- media.

The role of the Queensland Parks and Wildlife Service (QPWS) within the community, and the need for their involvement, was noted. Issues addressed at the meetings included:

- identification of wild dog problem areas, and why wild dogs represented problems within these areas.
- wild dog biology (i.e. breeding cycle, home ranges etc.)

- best practice methods of wild dog control and their respective advantages and disadvantages (i.e. chemical baiting, trapping, shooting, fencing)
- roles of state and local governments and landholders in declared animal management
- techniques being used for urban wild dog management according to locality and determinants of success or otherwise.

At both public meetings, wild dog survey forms were distributed to the landholders present and then collected.

At the conclusion of the meetings, landholders were questioned about how they believed the issue would be best addressed, if addressed at all. The majority agreed that where 1080 could be applied safely, and in accordance with departmental requirements, this was the preferred approach. It was felt that an integrated approach was essential for long-term wild dog management in the district.

Following the community meetings, MCC officers mapped the collated information on wild dog localities. An aerial survey using a helicopter was conducted via MCC and NR&M to initially access and investigate options of best practice within each identified locality. The survey was a quick, accurate and reliable method of looking at the identified problem areas and determining:

- topography (i.e. connecting ridgelines)
- type of wild dog habitat
- housing (regulations for chemical control)
- viability of ground versus aerial chemical baiting.

The aerial survey indicated the areas where chemical baiting could potentially be used, but extensive ground surveys were essential to ascertain community support and commitment. The MCC committed to employing a professional trapper/shooter in wild dog problem areas where chemical control was not a viable option.

Wild dog problem areas were broken up according to survey findings, and a community coordinator was appointed for each. Each community coordinator (a prominent landholder within the area) was approached by NR&M and agreed to become involved within the campaign. A total of 17 coordinators were appointed to cover the 21 initial sites, and each was sent a map of their area identifying the proposed site for wild dog control.

Coordinators were asked to:

- speak with the community and provide a list of stakeholders who did, or did not, support the program
- look at the proposed sites, together with the community, and determine their proximity to wild dog areas
- identify alternatives, if the proposed site was unsuitable
- relay collated information back to NR&M and MCC.

The underlying aim of this activity was to garner the support and commitment of the

community and determine which areas should proceed with the program. The emphasis throughout was on local commitment to the problem. If community support and commitment was not apparent within a particular area, the program did not proceed.

In areas where support was obtained, NR&M and MCC conducted follow-up ground surveys that involved addressing all landholders (i.e. those not already approached by the coordinator) within a 2 km radius of the site area, on the proposed program. Landholders were shown maps of the proposed site and were asked for any comments/concerns with the program. Absent landholders were left, or sent, correspondence explaining the basic concept of the program, with contact phone numbers attached. Program support was indicated via the landholder's consent/agreement that 1080 was the best practice option for their locality. Absent landholders were asked to contact the department if they had any concerns or problems with the proposed program. If no response was received by MCC or NR&M from absent landholders, it was assumed that their support had been obtained, but the vast majority of landholders were contacted personally. The whole process was expensive, requiring a five to six-month period to complete on account of the ground survey coverage.

Final decisions about program implementation were made after completion of the aerial and ground surveys, and coordinator feedback. The program proceeded in all areas where community support for the wild dog program exceeded 90%, within a 2 km radius of the bait site location.

Four final community meetings were undertaken at Calen, Kuttabul, The Leap and Homebush. Such meetings were conducted to:

- provide an overview of each area's final bait site and the overall objective of the program
- emphasise safety requirements and regulations that were to be placed on indemnity forms. All landholders involved received a map of their property stipulating areas where bait placement was, or was not, to occur.
- detail the date, location and time of bait days
- inform and discuss with landholders the method of bait placement (i.e. ground or aerial). At any bait localities where baits could physically be placed by hand, ground baiting was used. Such baits were to be tied, buried (at least 10 cm deep to deter quolls) and retrieved within 14 days. In sites that were inaccessible (i.e. range country) aerial control (helicopter) was used. Such conditions were stipulated on the appropriate indemnities.
- emphasise bait size and quantity requirements. All baits were at least 250–300 g (with no bone or excess fat), and were dyed green to deter raptor movement. Meat quantities were derived on the basis of one bait being placed every 50 m for aerial sites, and one bait every 100 m on-ground.
- ensure all landholders who could not make it to the mixing stations, issue an authorization to their representatives to sign on their behalf an Authority to Sign form, when collecting the baits. '
- discuss what procedures to undertake in the event of adverse weather conditions
- form into 'bait site' groups and discuss arrangements for the bait day (meat requirements, attendance, materials required etc.)

The bait site locations included a northern and southern bait centre. Such sites were chosen

with consideration given to:

- areas/landholders involved in the campaign
- travel distances
- isolation of area, i.e. proximity to housing
- water availability
- helicopter and car access
- power lines
- proximity to declared roads/public visibility
- ability to provide directions.

Bait day 1 was at Wagoora, and day 2 was at Balnagowan.

A total of 17 areas were baited, directly involving some 85 landholders. Within these 17 strategic locations, 1224 kg of meat were used.

Media campaigns were associated with all stages of the program. Media releases were undertaken prior to all community meetings and, most importantly, prior to the bait days. In reference to the bait day media, the general public were given a two-week baiting period in which baiting occurred within the last two days (i.e. to determine genuine calls regarding participation in the baiting activity).

Conclusions

- Declared animals do not recognise artificial boundaries created by man, making semi-urban wild dog management both difficult and challenging. Any semi-urban wild dog program should involve assessments of available techniques and geography, integration of techniques where appropriate, and input from all relevant agencies, departments and landholders. Future adjustments to the Mackay wild dog campaign should include:
- use of dual indemnity forms for both the aerial contractor and landholders
- a media strategy that involves more than one designated person
- improvements in coordination, and consistency with other departmental and community groups
- monitoring the activity and numbers of wild dog and native fauna, both before and after the campaign. (Anecdotal information was not considered sufficient to determine the success or otherwise of the campaign.)

The Mackay semi-urban wild dog program was based on strategic wild dog problem areas being addressed via 'Best Practice' control options. The campaign eventuated due to the support and commitment of the community. Positive outcomes post-campaign included:

- increased community knowledge, awareness and ownership of wild dog issues
- training of local government officers in urban wild dog management
- coordination of wild dog management throughout the district

- integrated techniques available to semi-urban residents, i.e. employment by MCC of a professional trapper and shooter
- anecdotal results confirming a decrease in wild dog numbers and impacts in the district.

Subsequent control campaigns in the Mackay region have been conducted at a much lower cost than the inaugural program outlined above. For subsequent programs, there has not been the same need for community consultations as a corporate memory regarding systems and affected areas has emerged. Also a community-wide appreciation is now in place regarding the necessity to coordinated baiting, and other measures, to maximise effectiveness. Thus the feelings of frustrations and uncertainty that prevailed three to four years ago have been replaced by a sense of control and self confidence (Cassandra Chopping, pers. comm).

Question 1. What pest animal causes you greatest concern?

Question 2. What problems do these animals cause for you or your community?

- [x] Safety
- [x] Nuisance
- [ ] Health
- [ ] Property damage
- [ ] Damage to crops
- [x] Wildlife predation
- [x] Injury or death of livestock

Question 3. Do you have evidence that pest animals cause the damage you have described?

Question 4. Where do you live?

Question 5. How would you describe the area where you live?

- [x] *Rural (properties mostly > 40 ha.)*
- [ ] *Semi-rural (properties between 1 ha. & 40 ha.)*
- [ ] *Urban (properties mostly > 1 ha.)*

Question 6. Who is affected by these pest animals (tick one or both)

- [x] Yourself and family
- [x] Other members of your community

Question 7. Who do you think should be involved in solving the problems you have described? (tick any number of boxes)

- [ ] Urban residents
- [x] Primary producer groups
- [x] Local Government
- [ ] Department of Health
- [x] Department of Natural Resources
- [ ] Private Pest Controllers
- [ ] Community Groups
- [ ] Environmental Protection Agency
- [ ] Department of Primary Industries
- [x] Affected rural land holders

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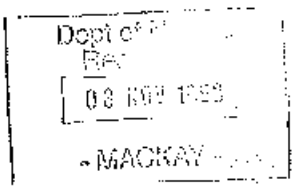

Question 8. Would you be prepared to make any additional commitment towards solving the problem with these animals? (if you tick yes, you may also like to describe what contribution you could make).

☐ Yes _____

☐ No (please describe why) _____

_____

Question 9. Listed below are a number of control methods for pest animals. When would the use of these be acceptable to you as a control method in the area where you live? Please tick the box for each method in the appropriate column.

	Always	On a Case-by-case basis	Undecided	Rarely	Never
Shooting	☒	☐	☐	☐	☐
Poisoning- 1080	☒	☐	☐	☐	☐
Poisoning- strychnine	☒	☐	☐	☐	☐
Cage trapping	☐	☐	☐	☐	☐
Leg hold (soft-catch) trapping	☐	☐	☐	☐	☐
Fertility control	☐	☐	☐	☐	☐
Fencing and other exclusion methods	☐	☐	☐	☐	☐
Other- please specify	☐	☐	☐	☐	☐

Question 10. Do you have any other comments to make about pest animal management?

_____

_____

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