

CHUDITCH RECOVERY PLAN

1992-2001

by

Peter Orell¹ and Keith Morris¹

for the Chuditch Recovery Team

¹ Western Australian Department of Conservation and Land Management
Western Australian Wildlife Research Centre,
P.O. Box 51, Wanneroo, W.A. 6065

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Department of Conservation and Land Management
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COMO, W.A. 6152

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Preparation by: Jill Pryde

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FOREWORD

The Western Australian Department of Conservation and Land Management (CALM) publishes Wildlife Management Programs to provide detailed information and management actions for the conservation of threatened or harvested species of flora and fauna. Wildlife Management Program No. 7 for the Chuditch was published in late 1991 (Serena *et al.* 1991) and most of the following information and recovery actions were taken from that document. This Recovery Plan provides more detailed descriptions of actions and accurate costing of them.

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of an endangered or vulnerable species or ecological community. The attainment of objectives and the provision of funds is subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views nor the official positions of any individuals or agencies represented on the Recovery Team. This Recovery Plan has been approved by the Executive Director, Department of Conservation and Land Management, the National Parks and Nature Conservation Authority and the Minister for the Environment.

Approved Recovery Plans are subject to modification as directed by new findings, changes in species' status and completion of recovery actions.

A Recovery Plan was first prepared for the Chuditch, *Dasyurus geoffroii*, in 1991 and submitted to the Australian Nature Conservation Agency (ANCA) for funding under the National Endangered Species Program to supplement funds already available from CALM and World Wide Fund for Nature Australia (WWF). Funds were provided by ANCA in 1992 with an indication that it would continue to fund a portion of the total costs indicated in the Plan in future years. A Recovery Team was established to oversee the implementation of this plan and first met in August 1992. The Recovery Team reviewed the plan after it had been in operation for 11 months and decided that minor changes were necessary. This revised Recovery Plan was prepared in 1993 and reflects these changes, which include an increase in the budget, due mainly to an extension in the captive breeding program. The results of completed recovery actions are presented in annual reports.

Information in the Plan is accurate at December 1993

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SUMMARY

CURRENT SPECIES STATUS: Endangered (ANZECC, 1991); Endangered (Schedule 1 of Endangered Species Protection Act 1992); Threatened species (WA. Wildlife Conservation Act 1950). The Chuditch had a distribution covering 70% of the Australian continent at the time of European settlement. It is estimated that fewer than 6 000 Chuditch now remain in the south-west of Western Australia, mostly in the Jarrah forest but also scattered through the southern and eastern wheatbelt. The Chuditch is considered vulnerable to local extinction because of the low population densities and the patchy distribution of populations.

HABITAT REQUIREMENTS AND LIMITING FACTORS: Chuditch can utilise a range of habitats including forest, woodland and desert. Densest populations have been found in riparian forest. Chuditch require adequate numbers of suitable den and refuge sites (horizontal, hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles and small mammals) to survive. Activities which reduce these are a threat to Chuditch. These include land clearing, particularly of riparian vegetation, and competition from, and predation by, foxes and feral cats. Road traffic, poisoning and trapping are also threats to Chuditch. The impact of fox control programs in the Jarrah forest has been determined; the effects of timber harvesting and prescribed burning regimes need to be determined.

RECOVERY PLAN OBJECTIVES: Downlisting to vulnerable (ANZECC) within 10 years of the implementation of this plan.

RECOVERY CRITERIA:

1. Average daily trap success rates at monitoring sites in Jarrah forest remaining at or increasing above 1%.
2. The maintenance of a population in at least one semi-arid monitoring site.
3. At least one self-sustaining population established outside present range.

ACTIONS NEEDED: Recovery Team comprising representatives of CALM, Perth Zoo, WWF and other organisations as appropriate will be appointed to coordinate and supervise the following actions:

1. Habitat management.
2. Research into the effects of the fox and fox baiting programs.
3. Population and habitat monitoring.
4. Research to determine distribution and habitat requirements in wheatbelt and semi-arid areas.
5. Captive breeding.
6. Translocation.

ESTIMATED COST OF RECOVERY: 1991 prices in \$000s/year.

Actions	1	2	3	4	5	6	Total
1992	32.3	27.4	30.0	7.5	109.6	79.1	285.9
1993	23.3	0	26.3	7.6	61.9	25.6	144.7
1994	57.2	0	11.0	10.8	61.9	12.7	153.6
1995	79.0	0	11.2	7.9	61.9	7.8	215.5
1996	127.1	0	11.6	8.0	61.9	97.9	306.5
1997	153.4	0	11.8	8.0	61.9	47.5	282.6
1998	143.8	0	12.2	8.0	61.9	39.0	264.9
1999	126.6	0	12.6	8.1	61.9	39.3	248.5
2000	129.6	0	13.0	8.1	61.9	39.7	252.5
2001	80.3	0	13.4	8.1	0	41.9	193.5
Total	1049.8	27.4	153.1	82.6	604.8	430.5	2348.2

BIODIVERSITY BENEFITS: Chuditch occupy the higher trophic levels in the forest and woodland communities of southwest WA and may be regarded as an indicator species, i.e. presence indicates high productivity in the lower trophic levels. Maintenance of den and refuge sites may benefit other species with similar requirements. Fox baiting in Chuditch monitoring and translocation sites will benefit other endangered fauna such as the Woylie (*Bettongia penicillata*) and the Numbat (*Myrmecobius fasciatus*).

1. INTRODUCTION

1.1 Description of species

The Chuditch (*Dasyurus geoffroii* Gould 1841) is the largest carnivorous marsupial (family Dasyuridae) occurring in Western Australia. At maturity it is about the size of a small domestic cat, males weighing an average of 1.3 kg and females an average of 0.9 kg. The Chuditch is distinguishable from other mammals within its present range by its white spotted brown pelage, large rounded ears, pointed muzzle, large dark eyes and a non-hopping gait. The tail is about three quarters of the head and body length, and has a black 'brush' over the distal portion.

1.2 Distribution

The Chuditch formerly ranged over nearly 70 percent of the continent, occurring in every mainland state and territory (Figure 1). It was relatively abundant over this large range at the time of European settlement (Collett 1887, as cited by Serena *et al.* 1991; Whittell 1954; Johnson and Roff 1982; Burbidge *et al.* 1988). However, a drastic decline and contraction of range has occurred since that time. Specimens were last collected in New South Wales in 1841, Victoria in 1857 and in Queensland between 1884 and 1907. Chuditch were last reported in the arid zone in the mid-1950s (Finlayson 1961). In Western Australia, the species was still abundant in the south-west in 1907, but had disappeared from coastal areas north of Geraldton by this time (Shortridge 1909). Chuditch occurred on the Swan Coastal Plain until the 1930s.

Chuditch are now restricted to the south-west of Western Australia, about 5% of their former range. The present distribution (Figure 2) is based on Western Australian Museum specimens, reliable sightings and road kill records within the last 15 years. The major portion of the remaining populations occurs in Jarrah (*Eucalyptus marginata*) forests, but they are patchily distributed and at low densities. There are also records from drier woodland and mallee shrubland in the wheatbelt. Chuditch have never been recorded in pure Karri (*E. diversicolor*) forest. The present total Chuditch population has been estimated to be less than 6 000 (Serena, Soderquist and Morris 1991). In the Jarrah forest, numbers have been estimated at 2 500-4 400 (based on trapping records from 1974-1988).

1.3 Habitat

Their former range suggests that Chuditch utilised a wide variety of habitats including woodland associations, dry sclerophyll forests, beaches and deserts (Thomas 1906; Shortridge 1909; Burbidge *et al.* 1988). In the Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Riparian vegetation appears to support higher densities of Chuditch, possibly because the food supply is better, or more reliable, and better cover offered by dense undergrowth may reduce vulnerability to predators. Chuditch also appear to utilise native vegetation along road reserves in the wheatbelt.

1.3.1 Home range

Chuditch are solitary animals for most of their life. They occupy relatively large home ranges, males ranging over 15 km² and females 3-4 km² (Serena and Soderquist 1989). A home range includes a smaller 'core area' defined by den locations, and these areas are about 4 km² and 0.9 km² for males and females respectively (Serena and Soderquist 1989). Females tend to be territorial and their core areas are typically non-overlapping (Serena and Soderquist 1989). Both sexes occur at similar densities in the Jarrah forest.

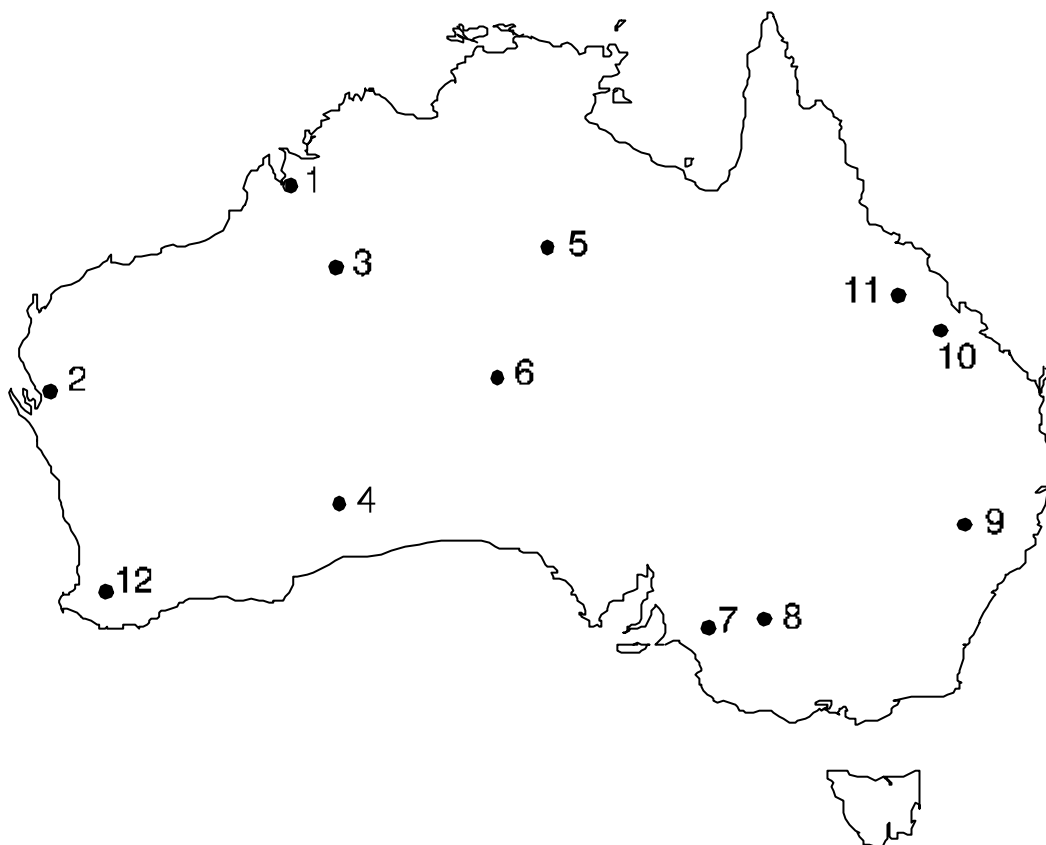


Figure 1

The distribution of Chuditch at the time of European settlement, as documented by museum specimens.

1 Derby, WA; 2 Shark Bay, WA; 3 Kuduarra Well, WA; 4 Rawlinna, WA; 5 Barrow Creek, NT; 6 S of Musgrave/N of Everard Ranges, SA; 7 Murray River, SA; 8 Juncture of Murray/Darling Rivers, VIC; 9 Liverpool Plains, NSW; 10 Coomooboolaroo, QLD; 11 Peak Downs, QLD; 12 Arthur River, WA.

From Serena *et al.* (1991).

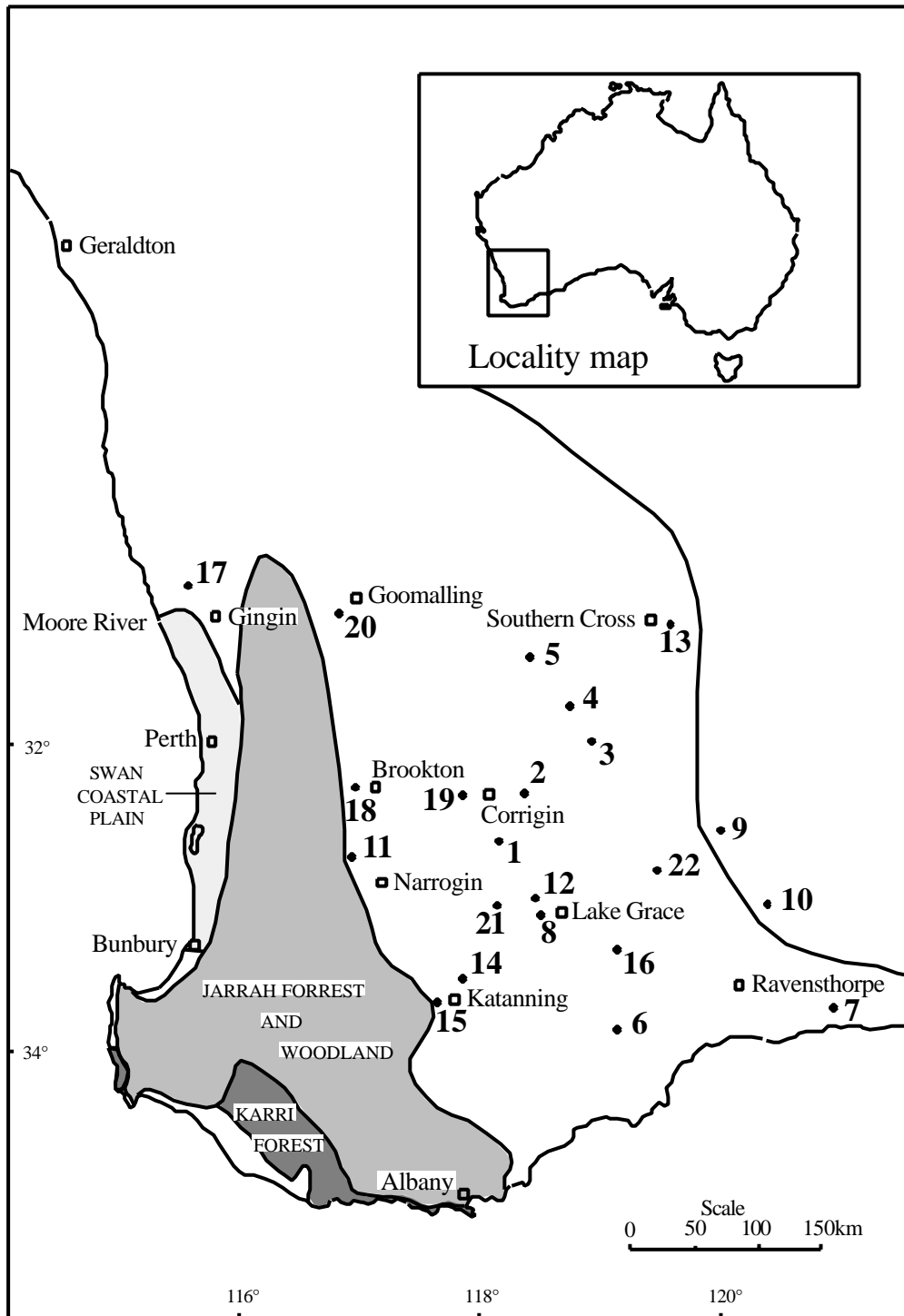


Figure 2

Present distribution of Chuditch based on museum specimens and reliable sightings and road kill records from 1975-1990.

Chuditch have been recorded throughout the Jarrah forest and woodlands and from the numbered sites outside the Jarrah forest. 1 Kulin, 1975; 2 Bending, 1976; 3 Welcome Hill, 1976; 4 Mt Cramphorne, 1977; 5 Merredin, 1977; 6 Fitzgerald River N.P., 1980; 7 Munglinup, 1983; 8 Lake Grace, 1983; 9 Forrestiana, 1984/85; 10 Frank Hann N.P., 1987; 11 Dryandra, 1987; 12 Lake Grace, 1989; 13 Ghooli, 1989; 14 and 15 Katanning, 1990; 16 Lake Magenta, 1989; 17 Caren Caren Brook, 1987; 18 Brookton, 1989; 19 Corrigin, 1988; 20 Goomalling, 1990; 21 Harrismith, 1990; 22 Lake Varley, 1986. From Serena *et al.* (1991).

1.3.2 Den requirements

Desert Chuditch denned in earth burrows, hollow logs and tree limbs, and hollows in termitaria (Johnson and Roff 1982; Burbidge *et al.* 1988). In the Jarrah forest, Chuditch den sites usually consist of horizontal, hollow logs or earth burrows. To be suitable as a den site, logs must have a diameter of at least 30 cm but usually >50 cm, a hollow diameter of 7-20 cm and the den typically 1 m or more from the entrance. Most burrows are located beneath surface features such as trees, stumps, logs or rock outcrops, which offer increased protection and may facilitate den construction by supplying pre-existing channels or cavities. Over the course of a year, an average adult female Chuditch will utilise an estimated average of 66 logs and 110 burrows within her home range.

1.4 Life history and ecology

1.4.1 Diet and foraging activity

Chuditch are opportunistic feeders, foraging primarily on the ground and at night. They may climb trees to obtain prey or to escape from predators. Insects and other large invertebrates comprise the bulk of their diet, though small mammals, birds and lizards are also included. The red pulp surrounding *Zamia (Macrozamia riedlei)* seeds is sometimes consumed, as well as small fruits and parts of flowers (Hancock 1991). Chuditch will also scavenge for food scraps around campsites.

Chuditch are sometimes active during the day, especially during the breeding season or when cold, wet weather restricts nocturnal foraging. Food is most limited during the colder months from June to August.

1.4.2 Reproduction and mortality

Jarrah forest Chuditch are seasonal breeders. Females enter oestrus, and mating occurs, in late April to early July. Following a gestation period of about 17-18 days, females give birth to 2-6 young which are about 5 mm long and weigh 9-15 mg. The young remain in the mother's pouch for about 61 days and are then left in the den while the mother forages. By 110 days of age they are well furred and begin eating solid food. They are fully weaned at 170 days of age and subsequently disperse.

Both males and females are sexually mature and breed in their first year. Fecundity appears to be highest in first year females, which also comprise more than half the breeding female population. The population sex ratio is close to parity, both in the case of pouch young and breeding adults.

Wild Chuditch usually die before their fourth year; the average life span for established adults is two years (Soderquist 1988). Factors contributing to Chuditch mortality in the Jarrah forest include being hit by motor vehicles; illegal shooting near roads; predation by foxes, raptors and feral cats; injury in rabbit traps; natural accidents and disease. Chuditch commonly forage along dirt roads and tracks, hence many animals are hit by motor vehicles. This habit may also serve to increase the frequency of encounters with foxes.

1.4.3 Fire ecology

The effects of prescribed burning patterns and wildfires on Chuditch are poorly understood. However, it has been demonstrated that Chuditch are capable of surviving the current prescribed burning regimes (generally 5-7 year rotation) undertaken in most of the Jarrah forest and utilise burnt areas for at least several months following fire. Cooler spring burns which result in patches of unburnt vegetation remaining are probably preferable for Chuditch. Den logs are generally not consumed by these burns

and the invertebrate fauna recovers more quickly. Further research is required to investigate the abundance of dietary items and recruitment in the first and second breeding season following fire.

1.4.4 Vulnerability to poisoning programs

In Western Australia, fox control is currently achieved through the distribution of dried meat baits injected with Compound 1080 (sodium fluoroacetate). This compound is now used in preference to other poisons, such as strychnine and cyanide, since it has been shown that many native animals in south-western Australia have a higher tolerance to the toxic effects of 1080 than do introduced species (King *et al.* 1989; McIlroy 1986).

Current fox baiting programs in WA. use 4.5 mg 1080 injected into a 120 g fresh meat bait, which is then dried to 40 g before being distributed. The estimated 'safe' dose for adult Chuditch (i.e. one which would probably not kill) is 5 mg/kg (King *et al.* 1989). Captive feeding trials have shown that Chuditch may consume any of the types of baits commonly used in predator control programs (Serena *et al.* 1991) and are therefore potentially at risk, especially when other factors are considered. Relative sensitivity to 1080 may be increased by lower environmental temperatures (Oliver and King 1983) and smaller body size and weight. Increased metabolic demands may lead to more bait and consequently higher doses of 1080 being consumed. It has been demonstrated that sublethal doses consumed by lactating female Tamar Wallabies (*Macropus eugenii*), Brush-tailed Possums (*Trichosurus vulpecula*) and Northern Quoll (*Dasyurus hallucatus*) can kill pouch young (McIlroy 1981). Recent research suggests that levels of 2.5 mg 1080 per bait may be feasible in the future (McIlroy and King 1990).

When this Recovery Plan was first prepared in 1991, it was not known whether Chuditch consume baits in the wild or whether there are any detrimental effects to Chuditch populations where baiting is carried out. Nor was it known whether foxes significantly affect Chuditch numbers through predation or competition, although it had been suspected that foxes are partly responsible for the dramatic decline in distribution. Research into the effects of foxes and fox baiting programs on Chuditch in the Jarrah forest was completed in 1993 as prescribed recovery action 3.2. Meat baits containing 4.5 mg 1080 were distributed at three monthly intervals at a density of approximately 4 baits km⁻² in an area of approximately 13 000 ha. The results showed that Chuditch sometimes consume baits, or portions thereof, but are not affected in terms of survival or breeding. Chuditch numbers increased after fox baiting commenced whilst remaining low in a neighbouring unbaited area, suggesting that foxes suppress Chuditch populations in the Jarrah forest. However, it is not clear whether foxes suppress Chuditch by predation or competition. Although similar research will be required for semi-arid populations, fox baiting can now be used as a standard management prescription for Chuditch and other threatened mammals in the Jarrah forest.

1.5 Reasons for listing

The Chuditch has been listed as endangered by the Australian and New Zealand Environment and Conservation Council (ANZECC) (ANPWS 1991) and has also been listed in Schedule 1, Part 1 (endangered) of the Commonwealth Endangered Species Protection Act 1992. In Western Australia, it was gazetted as a Threatened Species (WA Wildlife Conservation Act 1950) in 1983, in recognition of its dramatically reduced range. Chuditch have a short average life span and, within their present range, are patchily distributed at low densities, even in high quality habitat. Chuditch populations are consequently vulnerable to extinction due to chance events or normal environmental fluctuations as well as natural catastrophes and habitat destruction (Shaffer 1981; Soulé 1985).

Many factors may have contributed to the decline of the Chuditch including habitat alteration caused by rabbit and livestock grazing, changing fire regimes, and land clearing; predation by, and competition from, foxes and feral cats; epidemic disease, shooting and poisoning (Shortridge 1909; Wood Jones 1923; Marlow 1958; Finlayson 1961; Burbidge and Fuller 1979; Johnson and Roff 1982; Burbidge *et al.* 1988). However, decreases in productivity and the diversion of resources to humans, domestic stock and feral animals, associated with habitat alteration and predation by exotic mammals, may be the primary cause in the decline of many native mammals including Chuditch (Burbidge and McKenzie 1989).

The major threats facing Chuditch at present include: land clearing, particularly riparian vegetation, and the removal of suitable den logs and den sites from Chuditch habitat; predation by, and competition from, foxes and feral cats; poisoning, trapping and illegal shooting; and road traffic through Chuditch habitat. The impact of predator control programs, timber harvesting and prescribed fire regimes needs to be assessed.

1.6 Existing conservation measures

Chuditch habitat in the Jarrah forest is currently affected by a variety of human activities such as timber harvesting, prescribed burning, water catchment management, bauxite mining and recreation. Despite these activities, Chuditch have survived in the Jarrah forest whilst declining elsewhere. However, the conservation of the species can be significantly enhanced by the accommodation of Chuditch habitat requirements in forest management practices. Retaining adequate den logs and large habitat trees in harvested areas and maintaining mature forest along streams has become routine practice in multiple use State forest in Western Australia. Provision of artificial den sites has been attempted on a trial basis in rehabilitation work following surface mining for bauxite.

To help provide an indication of present distribution and numbers, reports of sightings and road kills have been encouraged through articles in local news media and the distribution of information kits to regions where Chuditch are known to occur or may still exist. Regular monitoring of known populations has been carried out at Lane-Poole Reserve, Wellington Mill and Collie River, and Perup Nature Reserve to provide information on the condition, breeding biology, diet and population densities of Chuditch. It also enables the effects of forest management practices and forest diseases to be assessed.

A successful captive breeding program for Chuditch has been established at Perth Zoo and captive bred Chuditch will be used for a proposed translocation program.

A management program for the Chuditch has been published by CALM (Serena, Soderquist and Morris 1991), in which management prescriptions for the conservation of Chuditch have been detailed.

1.7 Strategy for recovery

This Recovery Plan will run for a term of 10 years from 1992 to 2001 inclusive. Six primary strategies will be pursued during this term and are presented below in chronological order. However, once commenced, the implementation of these strategies will be run concurrently.

- (i) Habitat management in the Jarrah forest. Research into the effect of prescribed burning regimes and timber harvesting practices commenced in 1992. Results of this research will be incorporated into fire prescription and silviculture guidelines.

- (ii) Research into the effect of the fox and fox baiting programs on Chuditch in the Jarrah forest. This was carried out in 1991-1992. The findings from this research demonstrates that modifications to operational fox baiting procedures were not necessary.

- (iii) Monitoring of Chuditch populations and habitat at representative sites, initially in the Jarrah forest and later in semi-arid areas. Population monitoring is ongoing and habitat monitoring will be implemented as soon as possible. Results of this program will be used initially to assess the well-being of the Jarrah forest Chuditch populations, and later populations in semi-arid areas.
- (iv) Undertake further research into Chuditch distribution and habitat requirements, particularly in semi-arid areas. Fauna trapping surveys are now being carried out in the Jarrah forest by CALM district operations staff and Alcoa, providing further information on Chuditch distribution. Further research in semi-arid areas will commence in 1994.
- (v) Continuation of captive breeding at Perth Zoo. A captive breeding program is currently in progress and will continue. Chuditch from this program are being bred from stock obtained from the Jarrah forest, and have been used for the translocation project in 1992 and 1993. A separate colony will be established from Chuditch obtained from semi-arid areas for translocation to a suitable semi-arid area outside the present range. A Chuditch health monitoring program has been established at Perth Zoo as part of the captive breeding and translocation programs.
- (vi) Translocation to areas of vacant, suitable habitat. An experimental translocation to Julimar Conservation Park was undertaken in 1992 to develop techniques for successfully translocating Chuditch. This project was successful and a subsequent translocation to a semi-arid site will be undertaken in 1996 following further research and monitoring of extant semi-arid populations.

A Chuditch Recovery Team was appointed in 1992 to coordinate the research and management of the Chuditch as outlined in this Recovery Plan. The team comprises representatives from CALM Science and Information Division, Nature Conservation Division and relevant Regions, Perth Zoo, World Wide Fund for Nature Australia (WWFA) and Alcoa. Other organisations that become involved with the program in the future may be invited to join the Recovery Team.

The Recovery Team will report annually in January to CALM's Corporate Executive and to funding agencies.

2. RECOVERY OBJECTIVE AND CRITERIA

The objective of this Recovery Plan is to achieve downlisting of Chuditch status from endangered to vulnerable (ANZECC) within 10 years by:

- (1) ensuring that the species persists within its present range; and
- (2) increasing population numbers by expansion into former range.

The criteria for successfully achieving this objective will be

- (1) that average daily trap success rates* for Chuditch at selected monitoring sites in the Jarrah forest, using standard trapping techniques+, remain at or increase above 1%,

*Average daily trap success rate:

The average of the number of animals caught each day per 100 traps in one trapping period

+ Standard trapping techniques:

Cage traps are placed at designated trap points at 200 m intervals along vehicle tracks in a line transect usually for four consecutive nights. Traps are baited with a mixture of peanut paste, rolled oats and sardines and the rear portion of the trap

covered with hessian to provide shelter for the animals and to protect the bait. For Chuditch surveys the minimum number of traps used is usually 100 traps.

- (2) the maintenance of a population in at least one semi-arid monitoring site where population densities do not fall below initial estimates using standard trapping techniques (a minimum trap success rate will be determined after further research), and
- (3) the establishment of at least one self-sustaining population outside the present Chuditch distribution. The translocation site will be chosen following research into distribution and habitat requirements in the semi-arid zone. This research will provide potential population densities which will be used as additional criteria for the successful establishment of a self-sustaining population at this location.

It is unlikely that the Chuditch will be removed from National and State threatened fauna lists within the time frame of the Recovery Plan. Chuditch will probably require indefinite management after 10 years.

3. RECOVERY ACTIONS

Recovery actions for the Chuditch are presented below. Costings have been calculated at 1991 prices. Unless otherwise stated, CALM contributions include salaries for a Research Scientist (RS), Technical Officer (TO) and operations staff (OS). A TO was employed in 1992 to work on Chuditch conservation from WWFA funds, which will continue until 1994. After 1994 a salary for the TO will be required to continue implementing the Recovery Plan. Some actions, such as those involving rehabilitation operations in mined areas, are the responsibility of the mining companies and have not been costed. Actions undertaken as normal operations by CALM staff have also not been costed.

3.1 Habitat management

The Chuditch is presently distributed at low densities throughout the Jarrah forest and its requirements need to be incorporated into forest management activities if the Chuditch is to persist. Chuditch has survived in the Jarrah forest while it has become extinct throughout most of its former range. However, if Chuditch densities are to be enhanced in the Jarrah forest, there is a need to undertake research into the impact of prescribed burning regimes and timber harvesting activities on this species.

3.1.1 Research into effects of burning regimes on Chuditch diet and breeding

Research is required to assess the impact of current prescribed burning regimes on Chuditch in the Jarrah forest. This research will fit in with current operational procedures and be directed towards assessing the effect of spring and autumn burns on the capacity of the forest to support Chuditch. The research will be undertaken in the Batalling forest near Collie, and involve a site selection phase and an experimental phase where sites of various burn ages will be sampled for Chuditch and presence of den logs, and will also involve radio tracking Chuditch, over a period of six years. This research will be linked to a study of the effects of fire on forest invertebrates and small vertebrates undertaken concurrently in the same study area, to provide information on Chuditch prey abundance.

(a) Selection of Treatment Sites, 1992

Selection of the treatment sites required RS to consult with Collie District Operations staff and inspect possible sites. Three treatments will be implemented at the study site:

- i. spring burn programmed;
- ii. autumn burn programmed; and
- iii. no burn programmed.

Each treatment will have two replicates hence six treatment sites have been selected.

Selection required one week of RS's time plus travel. National Endangered Species Program (ESP) funds were utilised for vehicle running costs and consumables.

Costs (\$)/Year 1992

Total Cost: **1600**

(b) Trapping and Invertebrate Sampling, 1993-1998

Treatment sites will be monitored for Chuditch and den logs by trapping and radio tracking at 2-3 monthly intervals commencing in 1994. Sampling of invertebrate and small vertebrate fauna commenced in 1993.

Funds are required for vehicle running costs and consumables. Funds are also required to employ a contract zoologist for two months in each of 1994, 1995, 1996, 1997 and 1998 to identify invertebrates. From 1995 to 1998, Funds are also required for the TO salary, as existing funding arrangements for the position cease at the end of 1994.

Costs (\$)/Year 1993 1994 1995 1996 1997 1998

Total Cost: **7 700 18 100 55 000 55 200 56 600 57 700**

3.1.2 Maintenance of adequate refuge and den logs

The availability of adequate den sites (logs and burrows) is essential for the continued survival of Chuditch in the Jarrah forest. The Jarrah forest is presently subject to logging operations and firewood collecting activities. This impacts on only a small part of the foresty each year, however there is a need to:

- (a) assess the effectiveness of existing silviculture guidelines in providing adequate refuge sites for Chuditch; and
- (b) assess the impact of firewood collecting.

3.1.2.1 Effectiveness of silviculture guidelines

Under current forest management, habitat trees and suitable logs and stumps are retained during timber harvesting operations to provide refuge for hole nesting fauna including Chuditch (CALM Silviculture Specification 2/91). The effectiveness of this practice can be demonstrated by determining if Chuditch return to or remain in recently harvested areas. This work will be undertaken at Kingston and Warrup forest blocks near Manjimup and will be linked to a wider study including other forest fauna such as the Woylie (*Bettongia penicillata*), Southern Brown Bandicoot (*Isodon obesulus*) and Brushtail Possum (*Trichosurus vulpecula*). It will involve preharvesting surveys for Chuditch and monitoring Chuditch for three years after harvesting. Preharvesting surveys and monitoring will require thirteen days for the purpose of trapping and radio tracking Chuditch.

Funds are required for travel allowance, vehicle running costs, radio collars and consumables. Funds are also required for the TO salary from 1999 to 2001 as explained above.

<i>Costs (\$)/Year</i>	1994	1995	1996	1997	1998	1999	2000	2001
Total Cost:	11 900	7 000	7 200	12 200	7 200	53 300	54 700	54 800

3.1.2.2 Assess the impact of commercial firewood collecting.

Commercial firewood collecting is carried out under licence in allocated areas in the Jarrah forest and is restricted to dead timber on the ground. Ground timber is also being harvested for the production of charcoal for use in silicon extraction by Simcoa Operations Pty Ltd. This intensive utilisation of ground habitat has the potential to reduce Chuditch den sites and this may be occurring in some areas. Assessments of the effect on Chuditch populations of firewood collecting and the harvesting of logs for charcoal production are required to aid appropriate management of these areas.

The assessment of firewood collecting will be carried out in CALM's Central Forest Region at two selected sites:

- (i) existing firewood area; and
- (ii) potential firewood area.

Visual assessment and selection of these sites will take two days. Subsequently, 13 days will be required for trapping and radio tracking Chuditch at both sites once per year for the next three years. An additional 13 days may be required in the potential firewood area once it becomes active. Assessment of log harvesting for charcoal production will be carried out in the Harvey and Collie Districts in the same way.

Funds are required for travel allowance, vehicle running costs, radio collars and consumables.

<i>Costs (\$)/Year</i>	1997	1998	1999	2000	2001
Total Cost:	11 100	9 600	9 900	10 400	10 500

3.1.3 Rehabilitation after surface mining

Bauxite and gold mining operations are undertaken in the Jarrah forest. Rehabilitation techniques are required to ensure that Chuditch recolonise these disturbed areas as quickly as possible. The following actions are necessary:

- (a) provision of den sites in rehabilitated sites and gravel pits - research needs to be conducted to determine their effectiveness;
- (b) development of moderately dense vegetation and deep ground litter in rehabilitated areas; and
- (c) use of rehabilitation techniques that encourage rapid development of prey biomass - the effectiveness of these techniques needs to be assessed through a comparison of Chuditch dietary information with analyses of arthropod biomass in rehabilitated areas of different age and floristics.

The implementation of this recovery action is the responsibility of mining companies which operate minesites in the Jarrah forest. These costs have therefore not been included.

3.1.4 Clearing of habitat

Further extensive clearing of privately owned Jarrah forest, woodlands and mallee for agriculture and residential development will be discouraged through appropriate channels. In particular, clearing of land adjacent to or including riparian habitats will be discouraged.

Where clearing is proposed, the potential of the area as Chuditch habitat needs to be assessed. These assessments would be made by a CALM Officer at a cost of about \$500 per year per District in the Swan, Central Forest, Southern Forest, Wheatbelt and South Coastal Regions. An additional \$1 000 per year is required to carry out trapping surveys where necessary to determine presence or absence of Chuditch.

<i>Cost (\$)/Year</i>	1992
Total Cost:	10 100

Uncleared corridors connecting smaller reserves with larger areas of uncleared land on the fringes of Jarrah forest, woodlands and mallee shrublands need to be maintained. Road reserves in the wheatbelt may be regarded as Chuditch habitat and also need to be maintained. It will involve liaison with Local Government Authorities, the Main Roads Department and groups such as the Roadside Conservation Committee and Land Conservation District Committees, and recommendations will be implemented through appropriate channels. Costs additional to normal operating costs would be negligible.

3.1.5 Public education and forest traffic management

3.1.5.1 Erection of visitor information signs and warning signs

Chuditch will forage around camping areas and access roads and hence are likely to be seen occasionally by campers and visitors in the Jarrah forest. Basic information about Chuditch should be provided by way of visitor information signs at popular picnic and camping spots to enhance the protection and appreciation of these rare animals. A total of 50 signs are required to be informed of the likely presence of Chuditch in certain areas. This can be done by erecting warning signs of the type used for kangaroos along roads in these areas. A total of 30 Chuditch warning signs are required.

Illegal shooting is also a source of mortality in some areas of State Forest and perhaps also in Nature Reserves. This is a law enforcement problem and particular problem areas will require increased patrols by Wildlife Officers. However, the problem is not restricted to CALM land and in at least some instances Chuditch may get shot due to a lack of recognition or confusion with feral cats. This problem will be addressed through public education and may involve articles in the local press and other media as well as talks and displays (see section 3.5.2).

Funds are required for the cost of construction, erection and maintenance of information and warning signs.

<i>Costs (\$)/Year</i>	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	9 600	1 600	1 600	1 600	1 600	1 600	1 600	1 600	1 600	1 600

3.1.5.2 Reporting of road kills and sightings

Reports of road kills and sightings are an important source of information about Chuditch distribution. These reports together with Museum records form the basis of the present known distribution of Chuditch in the wheatbelt and Jarrah forest. CALM staff and the public are encouraged to collect and report Chuditch road kills and to report sightings to District Offices or Research Division. This is an ongoing program and is undertaken in the course of normal CALM operations.

3.2 Research into the effects of the fox and fox baiting programs

As predator control is an essential part of the recovery strategies for a number of critical weight range mammals (Burbidge and McKenzie 1989) such as the Numbat (*Myrmecobius fasciatus*), Woylie (*Bettongia penicillata*) and the Tamar Wallaby (*Macropus eugenii*), 1080 baiting programs for fauna conservation are now widely implemented in Western Australia. At the commencement of implementation of this Recovery Plan in 1992, urgent research was required to determine the effect of 1080 baiting on Chuditch populations since widespread fox baiting could not be conducted in areas occupied by Chuditch until its effects were known. This research was also designed to determine whether foxes have any significant impact on Chuditch, through either direct predation, or competition for food.

Fox baiting commenced in February 1991 in the Batalling forest block, east of Collie, as part of a Woylie reintroduction program. Chuditch also occur in this area. The research involved radio tracking radio-collared Chuditch through at least two fox baiting programs (November 1991 and February 1992) and monitoring Chuditch numbers by trapping. Markers placed in the baits were used to determine if the Chuditch were eating the baits. In addition, Chuditch population density was assessed in an adjacent unbaited forest block to determine if foxes were suppressing Chuditch numbers. This research was completed in 1993 and results are referred to in section 1.4.4.

CALM contributed salaries of staff and the cost of 1080 baits at the Batalling site. ESP funds were utilised in 1992 for the cost of radio-collars, vehicle running, travel allowances, and consumables.

<i>Costs (\$)/Year</i>	1992
Total Cost:	19 700

3.3 Population and habitat monitoring

Regular monitoring of representative Chuditch populations enables the effect of forest management and forest diseases to be assessed as well as providing information on the condition, breeding biology, diet and population densities of Chuditch in the Jarrah forest. Populations have been monitored at various locations in the Jarrah forest for the past 2-10 years. Chuditch monitoring sites are shown in Figure 3. Monitoring of a semi-arid population will also be required (see 3.4).

Monitoring at each site will include measurement of habitat variables as the correlation of any of these with the presence or absence of Chuditch will provide a better understanding of Chuditch requirements and assist in their management. Habitat variables will include the presence or absence of forest disease, changes in forest fuel loads, fire history, timber harvesting and regeneration or thinning activity, den log formation and disappearance, and abundance of dietary invertebrates.

Monitoring of Jarrah populations in 1992-93 was undertaken by Science and Information staff. District operations staff will be responsible for the monitoring from 1994 onwards. Each site will require five days trapping along predetermined, mapped routes of at least 15 km. Trapping will be conducted in June/July to obtain information on population density at breeding and on pouch young. Following research in 1994 to find suitable sites (see section 3.4), monitoring of at least one semi-arid population will be undertaken by CALM Science and Information Division staff for the first three years and then by district operations staff. Management prescriptions, including predator control, derived from research on semi-arid populations (3.4) will be implemented at this monitoring site. ESP funds were required for travel allowance (for Research Scientist and Technical Officer, 1992-93), vehicle running costs (two vehicles for each site in 1992-93) and consumables such as bait.

<i>Costs (\$)/Year</i>	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total Cost:	21 700	20 000	8 600	8 800	9 200	9 400	9 800	10 200	10 600	11 000

3.4 Research to determine distribution and habitat requirements in wheatbelt and semi-arid areas

Knowledge of Chuditch distribution is not yet complete. Reports of road kills and sightings need to be combined with trapping surveys to obtain more accurate information. Although many parts of the Jarrah forest have not been adequately surveyed, far less is known about Chuditch distribution in the wheatbelt and the semi-arid woodlands to the east of the wheatbelt. Surveys of large (> 10 000 ha) reserves in these regions are essential in order to identify remaining populations of Chuditch and assess their population densities and conservation status. At least one site will be chosen to undertake regular monitoring and research into the biology and habitat requirements of Chuditch in semi-arid environments. The effect of foxes and feral cats on these populations will also need to be examined. Information obtained from this research will be used to select appropriate sites for future translocations and establish appropriate management prescriptions for semi-arid populations.

At least two trapping surveys per year will be undertaken by a RS and a TO in the wheatbelt or the semi-arid woodlands. Each survey will take five days using standardised trapping techniques. The cage traps used will also catch other animals such as Brushtail Possums and Woylies, hence these surveys may increase the knowledge of the distribution of other rare or threatened fauna. Chuditch need to be selectively acquired from these areas for the captive breeding program prior to the semi-arid translocation in 1996. From 1994 onwards, Perth Zoo will participate in one of these trips per year to assist in the acquisition of Chuditch for the captive breeding program by providing two staff and a vehicle plus 50 cage traps. Funds are required for travel allowance, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total Cost:	5 700	5 800	9 000	6 100	6 200	6 200	6 200	6 300	6 500	6 600

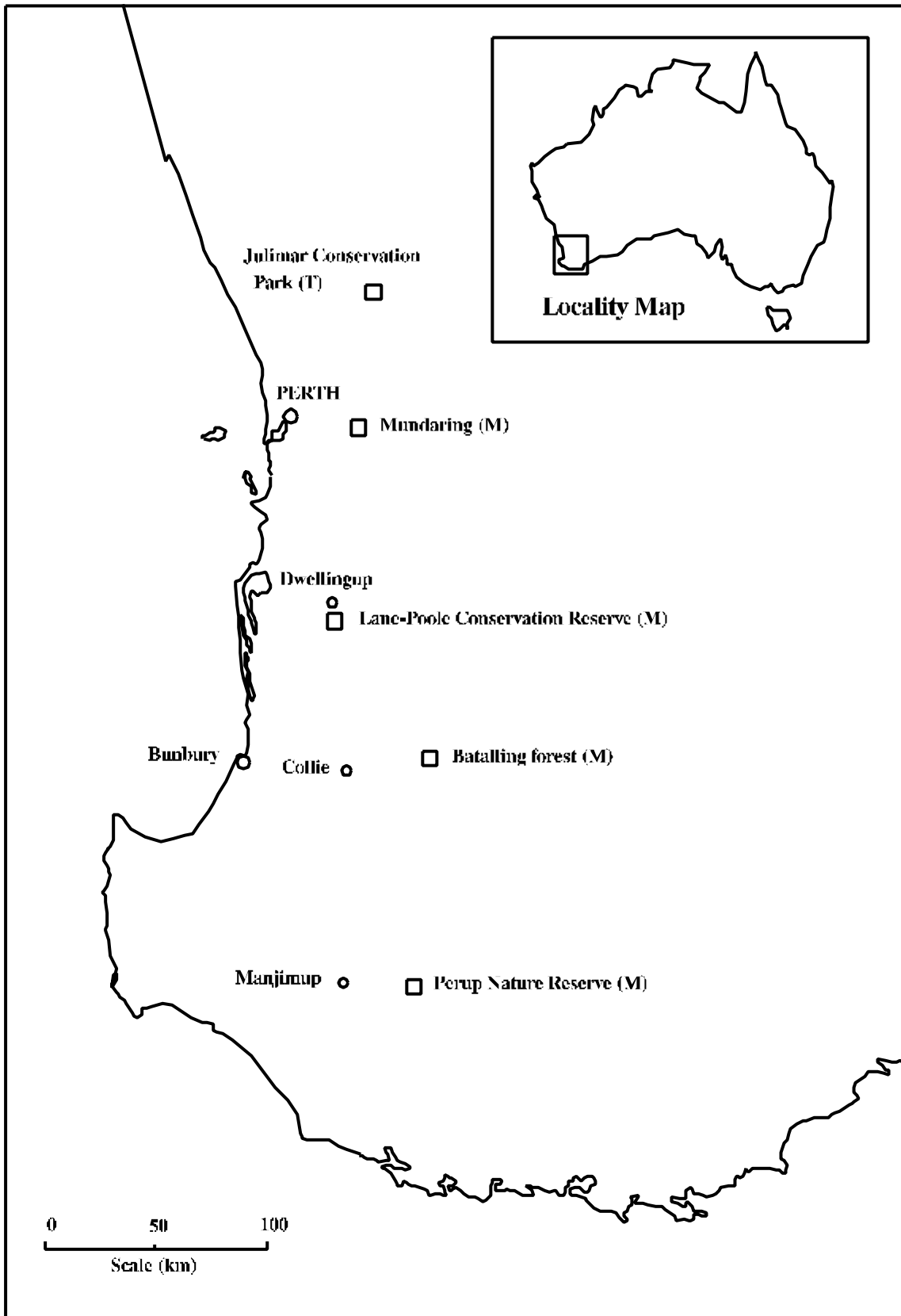


Figure 3

The location of Chuditch monitoring sites (M) and the trial translocation site (T) in the southwest of Western Australia.

3.5 Captive breeding

3.5.1 Husbandry of captive Chuditch

A captive breeding program for Chuditch is currently in operation at Perth Zoo. Captive breeding of Chuditch will provide a source of animals for translocation programs, and for display and education purposes. The characteristically low density of Chuditch populations means that taking individuals from the wild for translocations and display will be both time-consuming and potentially problematic for the parent population. The only feasible alternative is to generate surplus animals through a captive breeding program. Private involvement in the captive breeding may be considered where and when appropriate.

At present, the Chuditch breeding colony is derived from individuals obtained from Jarrah forest locations and will only be used to supply Chuditch for reintroduction to other Jarrah forest areas. The translocation of Chuditch to a semi-arid location will require animals bred from stock acquired from semi-arid populations. Chuditch from semi-arid areas will be supplied to the Perth Zoo breeding program in 1994 and will need to be kept separate from the Jarrah forest colony.

A Chuditch health monitoring program has been established at Perth Zoo and involves biochemical, bacteriological and parasitological screening of blood and faecal samples from captive bred Chuditch, translocated Chuditch and wild Chuditch. As well as monitoring the health of translocated Chuditch, this program will provide information on the presence and prevalence of disease which may assist in the management of natural and translocated populations.

Perth Zoo is able to contribute 0.2 of a keeper's time to attend to the Chuditch colony, and initially had only seven cages suitable for housing and breeding Chuditch. Other cages were being used but were not suitable for breeding as they were conducive to stress due to location and design. Because of their aggressive disposition, Chuditch must be housed in separate cages, with no physical or visual contact possible between individuals. This avoids stress, serious injuries and fatalities. Translocations will require 30 animals and therefore the Zoo's facilities have had to be upgraded to enable up to 40 Chuditch to be kept at any one time. This number may need to be increased once a colony of semi-arid origin is established.

ESP funds were utilised in 1992 to provide another 33 cages. An additional 0.5 full time keeper is required under the Zoo's current roster system to care for and feed 40 animals, maintain cages, observe and monitor condition and behaviour of animals and maintain records. Funds are required to undertake DNA fingerprinting of all captive bred stock. Funds are also required to provide veterinary services and supplies, as well as food, nesting boxes and materials and equipment such as scales for monitoring the weight of individuals. Invertebrate and white mice colonies will be established to provide live food.

<i>Costs (\$)/Year</i>	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total Cost:	51 900	35 500	35 500	35 500	35 500	35 500	35 500	35 500	35 500

*Alcoa of Australia Ltd contributed funds to provide food for the Chuditch in 1992

3.5.2 Development of appropriate exhibit and public information program

Community awareness and support is an important part of any species recovery process and can be encouraged through appropriate exhibits and public information programs. Perth Zoo required funding to develop a Chuditch exhibit in the Nocturnal House which includes a comprehensive graphics display. A mobile display unit including mounted specimens and photographs is also required for a public education program and CALM staff training.

<i>Cost (\$)/Year</i>	1992
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3.6 Translocation

To achieve the third recovery criterion it will be necessary to translocate captive bred Chuditch (from Perth Zoo) into parts of their former range. A previous attempt at translocating Chuditch in the Jarrah forest near Dwellingup was unsuccessful, however several factors were identified as contributors. Firstly, only a small number of animals were released, most of which were juveniles. Secondly, introduced predators were present and thirdly, illegal shooting activity was prevalent in the release area. These factors can be addressed and it was proposed that before a translocation is undertaken to a remote semi-arid site, a trial translocation be undertaken in vacant Jarrah forest closer to Perth. A subsequent translocation to a semi-arid site will be undertaken in 1996 and it is also proposed that a translocation to Uluru be undertaken in 1999. The Uluru translocation would be the responsibility of the Conservation Commission of the Northern Territory and its costs are not included here. Translocation to privately owned reserves may also be considered.

Each translocation will be undertaken in four phases:

- (a) selection of translocation site;
- (b) preparation of release sites;
- (c) undertake translocation;
- (d) monitor success of translocation.

3.6.1 Trial translocation to Julimar Conservation Park

3.6.1.1 Selection of translocation site

Julimar Conservation Park (see Figure 3) was chosen as a suitable site for a trial translocation as it is conveniently close to Perth (for intense and efficient monitoring), is sufficiently large (approximately 25 000 ha) and under CALM control. Chuditch were recorded in the area up until 1973 and the absence of recent records as well as the results of trapping surveys since then suggest that the area was vacant. A further trapping survey was undertaken at Julimar to establish whether Chuditch were present.

ESP funds were required in 1992 for cage traps, field allowance, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1992
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Total Cost:	5 300
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3.6.1.2 Preparation of release sites

A fox baiting program was implemented in Julimar Conservation Park before the translocation began in September 1992 to reduce the impact of predation and competition from foxes. Prior to baiting, all neighbours with properties adjoining Julimar Conservation Park were notified and informed, and warning signs were

erected at strategic points around the park. Baiting will be ongoing and will involve distribution of '1080' dried meat baits by vehicle along designated roads and tracks over the conservation park every three months with the assistance of Mundaring District staff. Brushtail Possums (*Trichosurus vulpecula*) were reintroduced to Julimar in 1993 and it is anticipated that Woylies (*Bettongia penicillata*) (see Burbidge *et al* 1993) and possibly Southern Brown Bandicoots (*Isodon obesulus*) will also be reintroduced in 1994, thus fox baiting Julimar Conservation Park will also benefit other native species.

Grids of invertebrate pit traps were installed to sample and monitor invertebrate prey biomass inside and outside the release area in spring, summer, autumn and winter.

ESP funds were required in 1992 for the purchase of pit traps, fox baiting Julimar Conservation Park, field allowance, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1992
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Total Cost:	12 700
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3.6.1.3 Undertake trial translocation

The translocation involved two releases. The first release took place in September 1992 and 24 captive bred Chuditch of mixed ages, mostly from the 1990 and 1991 breeding seasons, were released. Of these, 20 were fitted with radio collars and radio tracked intensively for three weeks following release to determine survivorship, movements and choice of den sites. Radio tracking was undertaken from an aircraft when Chuditch could not be located from the ground. Chuditch were radio tracked less intensively following this three week period and monitoring by trapping was carried out for the first time after the release in November 1992 (see 3.6.1.4).

The second release was undertaken in March 1993 and comprised 19 Chuditch from the 1992 breeding season as well as some older individuals. Of these, 10 were fitted with radio collars, though radio tracking was not as intense on this release.

ESP funds were required in 1992 for radio telemetry equipment, aircraft hire, field allowance, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1992
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Total Cost:	16 600
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3.6.1.4 Monitoring success of translocation

Monitoring after translocation involves trapping and radio tracking. Standard trapping techniques (see section 2) have been employed along routes determined following the initial monitoring by radio tracking. Trapping provides information on the condition and breeding status of the translocated Chuditch and individuals have been examined by Perth Zoo veterinary staff as part of the Chuditch health monitoring program. Each trapping trip requires an RS and TO to spend five days at Julimar. Trapping was undertaken in November 1992, January, May, September and November 1993, and will be undertaken at six monthly intervals in 1994 and then annually.

Fox baiting is being continued at three monthly intervals and has now been taken up by Mundaring District as part of normal operations. The invertebrate pits are opened at three monthly intervals to obtain summer, autumn, winter and spring samples of invertebrate prey biomass.

It is important that the new population has the genetic viability for long term survival and continuing evolution. The genetic viability of the new population will need to be monitored every five years by taking blood samples from individuals for DNA fingerprinting. New captive bred males and females may be introduced to maintain genetic diversity and reduce inbreeding if required, or to replace individuals lost to predation or starvation in the initial translocation phase. Based on Chuditch densities in other fox free Jarrah forest sites, Julimar should be able to support up to 60 Chuditch.

Funds are required for fox baiting, DNA fingerprinting, field allowance, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total Cost:	13 400	17 700	9 500	6 000	4 700	4 700	4 700	4 800	5 000	5 100

3.6.2 Translocation to a semi-arid location

3.6.2.1 Selection of translocation site

A suitable translocation site will be selected early in 1996 subsequent to further research into the biology and distribution of Chuditch in semi-arid regions (see 3.4.1).

3.6.2.2 Preparation of release sites

Control of introduced predators will need to be initiated before a translocation can be undertaken. There is evidence to suggest that the removal of foxes in semi-arid locations can lead to a dramatic increase in the feral cat population. The control of feral cats may therefore need to be considered in addition to fox baiting. A predator control program will require publicity and the notification of adjoining neighbours as well as the erection of warning signs at strategic points in the area to be baited.

Sampling and monitoring of prey biomass will also be undertaken. Large pit traps (20 l buckets) to sample small vertebrate fauna as well as invertebrate pit traps will be installed at selected sites in the release area. The area will need to be sampled before the translocation.

Funds are required for baiting the translocation site, purchase of pit traps, field allowance, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1996
Total Cost:	20 300

3.6.2.3 Undertake translocation

This translocation will essentially follow the same recipe as the Julimar translocation. Before translocation, all Chuditch will be bled for DNA fingerprinting and about 15-20 individuals will be fitted with radio collars. One month of intensive monitoring by radio tracking will be undertaken immediately following the spring release. Radio tracking will be done from an aircraft if individuals cannot be located during ground searches. A second release will be undertaken in the subsequent autumn following the successful establishment of the first released Chuditch.

Funds are required for field allowance, vehicle running costs, consumables including food for the Chuditch, radio collars, aircraft hire and DNA fingerprinting.

<i>Costs (\$)/Year</i>	1996
Total Cost:	24 900

3.6.2.4 Monitoring success of translocation

Trapping and radio tracking will be undertaken six weeks and then three months after the initial one month translocation period. Monitoring will then be undertaken at three monthly intervals for at least one year, or longer if considered necessary, and then annually. Each trip will require an RS and TO to spend one week (including travel time) at the translocation site. Predator control will be ongoing and will require District or Regional support. Pit traps will be re-activated to monitor prey biomass. Blood samples will be taken from Chuditch in the new population five years after release for DNA fingerprinting to monitor genetic variation and viability.

Funds are required for fox baiting, DNA fingerprinting (in 2001), field allowance, salary for a contract zoologist, vehicle running costs and consumables.

<i>Costs (\$)/Year</i>	1996	1997	1998	1999	2000	2001
Total Cost:	9 700	25 000	18 500	18 700	18 900	20 000

4. IMPLEMENTATION SCHEDULE

Task	Task Description	Priority	Feasibility	Responsible Party	Funding	Cost Estimates (\$000s/year)										
						1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
3.1	Habitat Management															
3.1.1	Research into effect of burning regimes on Chuditch diet	1	95%	Science & Information Division /Fire Branch	a+	1.3	6.5	10.9	8.1	8.3	8.3	8.3				51.7
					b	0.3	1.2	7.2	46.9	46.9	48.3	49.4				200.2
					c	1.6	7.7	18.1	55.0	55.2	56.6	57.7				251.9
3.1.2	Maintenance of adequate refuge and den logs															
3.1.2.1	Effectiveness of silviculture guidelines	1	100%	Science & Information Division	a			6.3	3.6	3.8	3.8	3.8	6.4	6.7	6.8	41.2
				/Silviculture Branch	b			5.6	3.4	3.4	8.4	3.4	46.9	48.0	48.0	167.1
					c			11.9	7.0	7.2	12.2	7.2	53.3	54.7	54.8	208.3
3.1.2.2	Assess impact of firewood collecting	1	100%	Science & Information Division	a						8.7	7.5	7.8	8.3	8.4	40.7
					b						2.4	2.1	2.1	2.1	2.1	10.8
					c						11.1	9.6	9.9	10.4	10.5	51.5
3.1.3	Rehabilitation after surface mining	2	90-100%	Mining companies												
3.1.4	Clearing of habitat	2	100%	Science & Information Division /Regional Plan Off.	a	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	90.0
					b	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11.0
					c	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	101.0
3.1.5	Public education and forest traffic management															
3.1.5.1	Erection of visitor information signs and warning signs	2	100%	Regional Ops. Offs./ District Managers	a	0	0	0	0	0	0	0	0	0	0	0
					b	9.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	24.0
					c	9.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	24.0
3.1.5.2	Reporting of road kills and sightings	3	100%	Regional Ecologist/ Science & Information Division												

+ a: CALM Contribution; b: Other Funds Required; c: Total Cost of Action; d: Perth Zoo Contribution; e: Alcoa Contribution.

Task	Task Description	Priority	Feasibility	Responsible Party	Funding	Cost Estimates (\$000s/year)											
						1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	
3.2	Research into the effects of the fox and fox baiting programs	1	100%	Science & Information Division	a	12.0											12.0
					b	7.7											7.7
					c	19.7											19.7
3.3	Population and habitat monitoring	2	100%	Science & Information Division	a	13.4	13.7	6.2	6.4	6.8	7.0	7.4	7.8	8.2	8.6		85.5
				/ District Mangers	b	8.3	6.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4		33.8
					c	21.7	20.0	8.6	8.8	9.2	9.4	9.8	10.2	1.06	11.0		119.3
3.4	Research to determine distribution and habitat monitoring in wheatbelt and semi-arid areas	2	95%	Science & Information Division	a	3.9	4.0	4.2	2.8	2.9	2.9	2.9	3.0	3.2	3.3		33.1
				Perth Zoo	d			3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5		13.5
					b	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8		18.0
					c	5.7	5.8	9.0	6.1	6.2	6.2	6.2	6.3	6.5	6.6		64.6
3.5	Captive breeding																
3.5.1	Husbandry of captive Chuditch	2	100%	Perth Zoo	d	11.2	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1			84.0
					e	3.0											3.0
					b	37.7	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4		248.9
					c	51.9	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5		335.9
3.5.2	Development of appropriate exhibit and public education program	3	100%	Perth Zoo/ CALM	a	0											0
					b	10.0											10.0
					c	10.0											10.0
3.6	Translocation																
3.6.1	Trial translocation to Julimar Conservation Park																
3.6.1.1	Selection of trial translocation site	2	100%	Science & Information Division	a	2.0											2.0
					b	3.3											3.3
					c	5.3											5.3
3.6.1.2	Preparation of release sites	2	100%	Science & Information Division	a	2.7											2.7
					b	10.0											10.0
					c	12.7											12.7
3.6.1.3	Undertake trial translocation	2	100%	Science & Information Division	a	6.0											6.0
					b	10.6											10.6
					c	16.6											16.6
3.6.1.4	Monitoring success of translocation	2	100%	Science & Information Division	a	6.2	9.8	6.3	4.2	2.9	2.9	2.9	3.0	3.2	3.3		44.7
					b	7.2	7.9	3.2	1.8	1.8	1.8	1.8	1.8	1.8	1.8		30.9
					c	13.4	17.7	9.5	6.0	4.7	4.7	4.7	4.8	5.0	5.1		75.6

Task	Task Description	Priority	Feasibility	Responsible Party	Funding	Cost Estimates (\$000s/year)										
						1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
3.6.2	Translocation to a semi-arid location															
3.6.2.1	Selection of translocation site	2	100%	Science & Information Division						Costs covered in 4.1 Further research to determine distribution						
3.6.2.2	Preparation of release sites	2	100%	Science & Information Division	a					3.8						3.8
					b					16.5						16.5
					c					20.3						20.3
3.6.2.3	Undertake translocation	2	100%	Science & Information Division	a					7.9						7.9
					b					17.0						17.0
					c					24.9						24.9
3.6.2.4	Monitor success of translocation	2	100%	Science & Information Division	a					6.7	9.0	4.5	4.7	4.9	5.0	34.8
					b					3.0	16.0	14.0	14.0	14.0	15.0	76.0
					c					9.7	25.0	18.5	18.7	18.9	20.0	110.8
TOTAL ANNUAL COST OF CHUDITCH RECOVERY					a	56.5	43.0	42.9	34.1	52.1	51.6	46.3	41.7	43.5	44.4	456.1
					d	11.2	9.1	12.1	10.6	10.6	10.6	10.6	10.6	10.6	1.5	97.5
					e	3.0										3.0
					b	107.6	46.3	49.3	85.4	121.9	110.2	104.0	98.1	99.2	73.8	895.8
					c	178.3	98.4	104.3	130.1	184.6	172.4	160.9	150.4	153.3	119.7	1452.4

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