RECOVERY PLAN FOR

THE CHUDITCH

(*Dasyurus geoffroii*)

(Draft)

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by

Peter Orell and Keith Morris

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

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PREFACE

The Western Australian Department of Conservation and Land Management (CALM) publishes Wildlife Management Programs to provide detailed information and management actions for the protection of certain exploited or threatened species of flora and fauna. A management program has recently been published for the Chuditch (Serena, Soderquist and Morris 1991) and most of the following information and recovery actions were taken from this document.

SUMMARY

Current Species Status:
Endangered (ANZECC, 1991); Threatened species (W.A. Wildlife Conservation Act 1950).
Chuditch had a distribution covering 70% of the Australian continent at the time of European settlement. It is estimated that fewer than 6000 Chuditch now remain in the south-west of Western Australia, mostly in the Jarrah forest but also scattered throughout the southern 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 woodland, forest and desert. Densest populations appear to favour 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. This includes land clearing, particularly riparian vegetation, and competition from, and possibly predation by, foxes and feral cats. Road traffic, poisoning and trapping are also a threat to Chuditch. The impact of exotic predator control programs, timber harvesting and prescribed burning regimes needs to be determined.

Recovery Plan Objectives:
Downlisting to vulnerable (ANZECC) within 10 years.
However, indefinite protection will still be required after 10 years.

Recovery Criteria:
(1) Population densities at monitoring sites in Jarrah forest remain at or increase above 0·25 individuals/km^2.
(2) One self-sustaining population established outside present range.

Actions Needed:
A Recovery Team comprising members from CALM, Perth Zoo, ANPWS and other organisations, as appropriate, will be appointed to coordinate and supervise the following actions:
(1) Integration of Chuditch habitat requirements into forest management practices.
(2) Development and application of fox control programs for other fauna that are 'Chuditch-safe'.
(3) Monitoring of representative Chuditch populations and habitat.
(4) Further research into Chuditch distribution, habitat requirements and disease.
(5) Captive breeding to provide animals for translocations.
(6) Development of techniques for translocating Chuditch into areas of vacant, suitable habitat.

Estimated Cost of Recovery: 1991 prices in $000's/year.
Total cost (TC) and Endangered Species Program (ESP) funds required (= TC - CALM contribution)

Actions	(1)		(2)		(3)		(4)		(5)		(6)		Total	
	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP
1992	28·9	12·2	19·7	7·7	21·7	8·3	3·9	1·8	56	47·7	95·3	52·4	225·5	130·1
1993	29·3	9·9			20	6·3	4	1·8	29·6	23·4	43.6	19·9	126·5	61·3
1994	41·7	15·5			8·6	2·4	4·2	1·8	29·6	23·4	21	12·6	105·1	55·7
1995	73·7	53			8·8	2·4	2·8	1·8	29·6	23·4	18.2	12·6	133·1	93·2
1996	74·1	53			9·2	2·4	2·9	1·8	29·6	23·4	18.4	12·6	134·2	93·2
1997	91·6	60·8			9·4	2·4	2·9	1·8			14.9	12	118·8	77
1998	73·2	49·6			9·8	2·4	2·9	1·8			13.7	10·8	99·6	64·6
1999	74·9	50·9			10·2	2·4	3	1·8			13.8	10·8	101·9	65·9
2000	76·8	52			10·6	2·4	3·2	1·8			14	10·8	104·6	67
2001	77	52			11	2·4	3·3	1·8			15.3	12	106·6	68·2
Total	641·2	408·9	19·7	7·7	119·5	33·8	33·1	18	174·4	141·3	268·2	166·5	1255·9	776·2

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.

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. A white spotted brown pelage, large rounded ears, pointed muzzle, large dark eyes and a non-hopping gait distinguish the Chuditch from other mammals within its present range. 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 (Fig.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 this 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 (Fig. 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 occur 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 6000. In the Jarrah forest, numbers are estimated at 2500-4400 (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

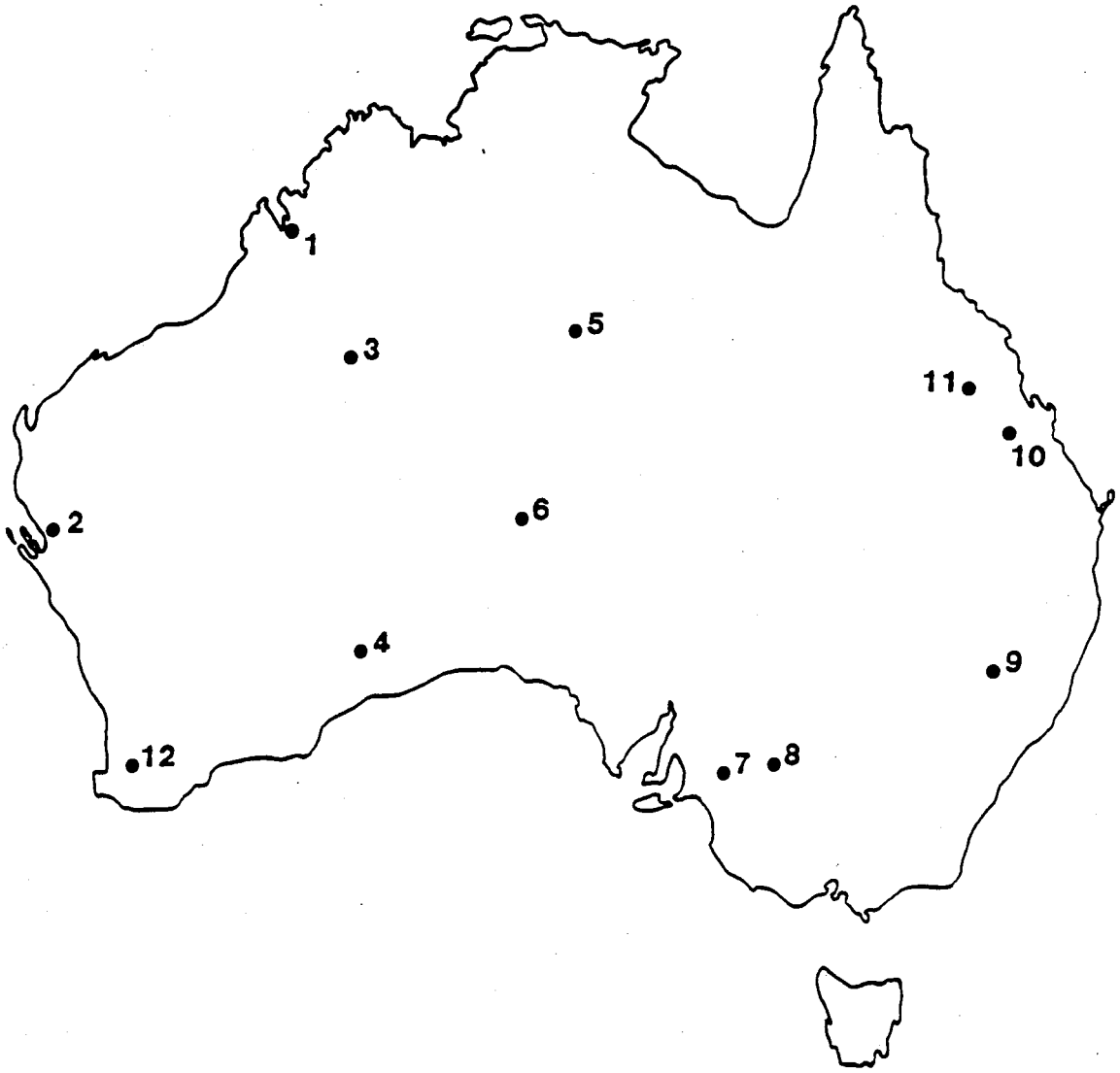

Figure 1

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, QD; (11) Peak Downs, QD; (12) Arthur River, WA.

From Serena et al. (1991)

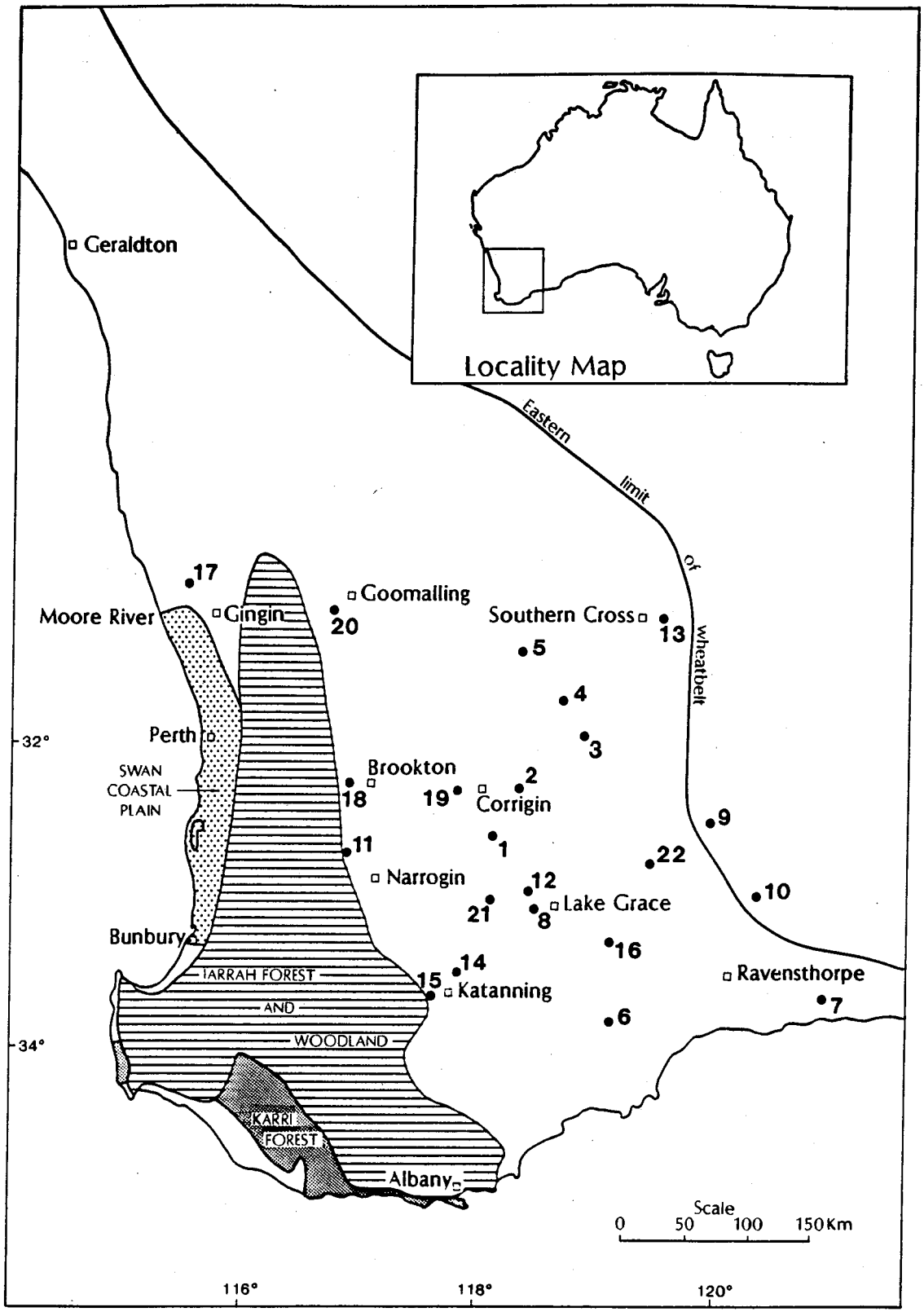

Figure 2

Present distribution of Chuditch based on museum specimens and reliable sighting 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 Bendering, 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; 17 Caren Caren Brook; 18 Brookton, 1989; 19 Corrigin, 1988; 20 Goomalling, 1990; 21 Harrismith, 1990; 22 Lake Varley, 1986.

From Serena et al. (1991)

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 km^2 and females, 3-4 km^2 (Serena and Soderquist 1989). A home range includes a smaller 'core area' defined by den locations, and these areas are about 4 km^2 and 0·9 km^2 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.

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 66 logs and 110 burrows within her home range.

1.4 Life History/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 the 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 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. The habit may also serve to increase the frequency of encounters with foxes.

1.4.3 Fire Ecology

The effect 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 W.A. 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 being consumed, and consequently higher doses of 1080. It has been demonstrated that sublethal doses consumed by lactating female Tammar 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).

However, it is still not known whether Chuditch consume baits in the wild and whether there are any detrimental effects to Chuditch populations where baiting is carried out. Nor is it known whether foxes significantly affect Chuditch numbers through predation or competition, although it has been suspected that foxes are partly responsible for the dramatic decline in distribution. Further research is urgently required to investigate the effect of fox baiting programs and the impact of introduced predators on Chuditch populations.

1.5 Reasons for Listing

The Chuditch has been listed as endangered by CONCOM (now ANZECC) (1991). 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; Soule 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; competition from, and possibly predation by, 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, 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; competition from, and predation by, 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 protection, 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 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 roadkills 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 is 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 the Perth Zoo and captive bred Chuditch will be used for a proposed translocation program.

A management program for the Chuditch has recently 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) Development and application of appropriate predator control programs.
Research and development of baiting programs will be carried out in 1991-1992. Findings from this research will be used to modify operational fox baiting procedures if necessary.

(ii) Continuation of a captive breeding program at the Perth Zoo.
A captive breeding program is currently in progress and will be ongoing. Chuditch from this program will be used for the translocation programs in 1992 and 1995.

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

(iv) 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.

(v) Development of techniques for successfully translocating animals into areas of vacant, suitable habitat.
A translocation to Karroun Hill Nature Reserve will be undertaken in 1992 and will constitute a significant northward expansion of the present Chuditch distribution. Subsequent monitoring will provide information on the biology of Chuditch in semi-arid habitat.

(vi) Undertake further research into Chuditch distribution and habitat requirements, particularly in semi-arid areas, as well as diseases and parasites.
Further research into distribution will be carried out in 1992 when resources become available. Research by other institutions will also be encouraged.

A Chuditch Recovery Team will be appointed to coordinate the research and management of the Chuditch as outlined in this Recovery Plan. The team will comprise representatives from CALM Research Division, Nature Conservation Division and relevant regions, Perth Zoo, the Australian National Parks and Wildlife Service, the Agriculture Protection Board and any other organisations that become involved with the program in the future.

2 RECOVERY OBJECTIVE AND CRITERIA

The objective of this Recovery Plan is to achieve downlisting of Chuditch status 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 Chuditch population densities at selected monitoring sites in the Jarrah forest remain at or increase above 0·25 individuals/km^2, and

(2) the establishment of at least one self-sustaining population outside the present Chuditch distribution. This population will be established in Karroun Hill Nature Reserve in the north-eastern extremity of the wheatbelt. Future research into the ecology of Chuditch in semi-arid habitats may indicate potential population densities which can 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 the Western Australian Threatened fauna list within the time frame of the Recovery Plan. Chuditch will still require indefinite protection 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). Between 1992 and 1994 a TO will be employed for Chuditch conservation using World Wide Fund for Nature Australia funding. 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. Details of Recovery costings are provided in Appendix 1.

3.1 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 Tammar Wallaby *Macropus eugenii*, 1080 baiting programs for fauna conservation are now more widely implemented in Western Australia. Urgent research is required to determine the effect of 1080 baiting on Chuditch populations. The outcome of this research will influence fox baiting operations throughout the southwest of Western Australia. This research will also determine whether foxes have any significant impact on Chuditch, through either direct predation, or competition for food.

Fox baiting has recently commenced in the Batalling forest block, east of Collie, as part of a Woylie reintroduction program. Chuditch also occur in this area. The research will involve radio tracking radio-collared Chuditch through at least two fox baiting programs (November 1991 and February 1992). Markers placed in the baits will be used to determine if Chuditch are eating the baits. In addition, Chuditch population density will be assessed in an adjacent unbaited forest block to determine if foxes are suppressing Chuditch numbers.

CALM will contribute salaries of staff and the cost of 1080 baits. ESP funds are required for the cost of radio-collars, vehicle running, travel allowances, and consumables.

CALM Contributions:	$12 000
ESP Funds Required:	$7 700
Total Cost of Action:	$19 700

3.2 CAPTIVE BREEDING PROGRAM

3.2.1 Husbandry of Captive Chuditch

A captive breeding program for Chuditch is currently underway at the 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.

Perth Zoo is able to contribute 0·2 of a keeper's time to attend to the Chuditch colony, and have seven cages suitable for housing and breeding Chuditch. Other cages are being used but are not suitable for breeding as they are 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 must be upgraded to be able to keep up to 40 Chuditch at any one time.

ESP funds are required to provide another 33 cages. An additional 0·5 full time keeper will be 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. ESP funds are required to undertake DNA fingerprinting of all captive bred stock. ESP 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 colonies will be established to provide live food.

	1992	1993	1994	1995	1996
Perth Zoo	$8 300	$6 200	$6 200	$6 200	$6 200
ESP Funds required	$47 700	$23 400	$23 400	$23 400	$23 400
Total Cost of Action	$56 000	$29 600	$29 600	$29 600	$29 600

3.2.2 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. The Perth Zoo will require ESP funding to develop a Chuditch exhibit in the Nocturnal House which will include 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.

Perth Zoo and CALM Contribution:	0
ESP Funds Required:	$10 000

3.3 HABITAT MANAGEMENT

3.3.1 Research into Effects of Burning Regimes on Chuditch Diet

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 Lane Poole Reserve near Dwellingup, and involve a site selection phase and an experimental phase where sites of various burn ages will be sampled for Chuditch, presence of den logs and invertebrate prey items over a period of six years.

(a) Site Selection, 1992

Selection of sites will require RS to consult with Dwellingup Operational staff and inspect possible sites. Four sites will be selected:

(i) long unburnt - no burn programmed;
(ii) long unburnt - burn programmed;
(iii) recent burn - spring burn programmed;
(iv) recent burn - autumn burn programmed.

Selection will require one week of RS's time plus travel. ESP funds are required for vehicle running costs and consumables.

CALM Contributions:	$1 300
ESP Funds Required:	$300
Total Cost of Operation:	$1 600

(b) Trapping and Invertebrate Sampling, 1993-1997

Chuditch and the presence of den logs and invertebrate fauna will be sampled. Sampling of all four sites will require 15 days per sampling period.

ESP funds are required for vehicle running costs and consumables. ESP funds are also required to employ a contract zoologist for two months in each of 1993, 1994, 1995, 1996 and 1997 to identify invertebrates. From 1995 to 1997, ESP funds are also required for

the TO salary*, as existing funding arrangements for the position cease at the end of 1994.

	1992	1993	1994	1995	1996	1997
CALM Contribution:	$6 400	$10 400	$10 900	$8 100	$8 300	$8 300
ESP Funds Required:	$1 200	$7 200	$7 200	$46 900	$46 900	$48 300
Total Cost of Action:	$7 600	$17 600	$18 100	$55 000	$55 200	$56 600

3.3.2 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. There is a need to

(a) assess the effectiveness of existing silviculture guidelines in providing adequate refuge sites for Chuditch;

(b) assess the importance of providing artificial den sites;

(c) assess the impact of firewood collecting

3.3.2.1 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 5/89). The effectiveness of this practice can be demonstrated by determining if Chuditch return to recently harvested areas. This work will involve selection of four sites, undertaking 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 at all four sites. This research will involve 3.3.3.2 'Assess Importance of Artificial Den Sites' and costings are presented below. ESP funds are required for machinery time for pushing stumps, travel allowance, vehicle running costs, radio collars and consumables. ESP funds are also required for the TO salary from 1998 to 2001 as explained above.

	1994	1995	1996	1997	1998	1999	2000	2001
CALM Contribution:	$6 300	$3 600	$3 800	$3 800	$6 300	$6 400	$6 700	$6 800
ESP Funds Required:	$5 600	$3 400	$3 400	$8 400	$45 600	$46 900	$48 000	$48 000
Total of Action:	$11 900	$7 000	$7 200	$12 200	$51 900	$53 300	$54 700	$54 800

* See page 38 for details

3.3.2.2 Assess Importance of Artificial Den Sites

Where timber harvesting and regeneration is occurring in areas with a scarcity of den logs and other refuge sites there may be a need to generate burrows or artificial den sites. Burrow sites may be generated by pushing stumps over so that their root mass is pulled partly out of the ground but remains partly anchored. Research needs to be conducted to determine their effectiveness. Two of the sites selected for 3.3.3.1 above will be used and monitored for this experiment.

One day will be required to assess the sites prior to pushing stumps. Subsequently, about 5 stumps/ha will be pushed over and, where fewer stumps are available, artificial den sites may be constructed by piling up rocks, branches and small logs. Each site will then be monitored once a year for the next three years.

3.3.2.3 Assess the Effect 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 Swan Region at two selected sites:

(i) existing firewood area;

(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/Collie Districts in the same way.

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

	1997	1998	1999	2000	2001
CALM Contribution:	$8 700	$7 500	$7 800	$8 300	$8 400
ESP Funds Required:	$2 400	$2 100	$2 100	$2 100	$2 100
Total Cost of Action:	$11 100	$9 600	$9 900	$10 400	$10 500

3.3.3 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;

(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 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.

3.3.4 Clearing of Habitat

3.3.4.1 Appropriate Assessments of Areas to be Cleared

Further extensive clearing of Jarrah forest and mallee for agriculture and residential development will be discouraged through appropriate channels as part of Regional recommendations. 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 (1991 prices) per year is required to carry out trapping surveys where necessary to determine presence or absence of Chuditch.

CALM Contribution	$9 000/year
ESP Funds Required	$1 100/year
Total Cost of Action	$10 100/year

3.3.4.2 Maintenance of Uncleared Corridors on Fringes of Forest and Mallee

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 Road Verge Committee, and will be implemented through Regional recommendations. Costs additional to normal operating costs would be negligible.

3.3.5 Public Education and Forest Traffic Management

3.3.5.1 Erection of Warning Signs and Visitor Information Signs

Road kills are a major source of Chuditch mortality in the Jarrah forest, and elsewhere. Motorists need 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.

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.

ESP funds are required for the cost of construction, erection and maintenance of these signs.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ESP Funds	$9 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600

3.3.5.2 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.

3.4 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. Proposed monitoring sites are shown in Fig. 3.

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 in 1992-93 will be undertaken initially by Research 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. ESP funds are 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.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CALM Cont^{n}:	$13 400	$13 700	$6 200	$6 400	$6 800	$7 000	$7 400	$7 800	$8 200	$8 600
ESP Funds:	$8 300	$6 300	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400
Total Cost:	$21 700	$20 000	$8 600	$8 800	$9 200	$9 400	$9 800	$10 200	$10 600	$11 000

3.5 TRANSLOCATION PROGRAM

To achieve the second recovery objective it will be necessary to translocate captive bred Chuditch into parts of their former range. The 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.

3.5.1 Selection of Translocation Site

Karroun Hill Nature Reserve (KHNR) has been selected as an appropriate site for a translocation (Fig. 3). Situated in the north-eastern extremity of the wheatbelt and covering an area of 310 000 ha, it is the largest reserve in south-west Western Australia, and includes a variety of semi-arid habitat. There are no recent records of Chuditch and the reserve lies well north of the present Chuditch distribution. It is important however to confirm the presence or absence of Chuditch, and to assess the suitability of habitat for Chuditch. This will be done through a trapping program in early 1992. The operation will require an RS and TO to spend 10 days at KHNR. If no Chuditch are found in KHNR, the actual release sites within this area will be determined. If Chuditch are present, a further trapping survey will be required at another site. For the purposes of this recovery plan, it will be assumed that the trial translocation will occur at KHNR.

ESP funds are required for cage traps, field allowance, vehicle running costs and consumables.

CALM Contributions:	$3 900
ESP Funds Required:	$2 900
Total Cost of Action:	$6 800

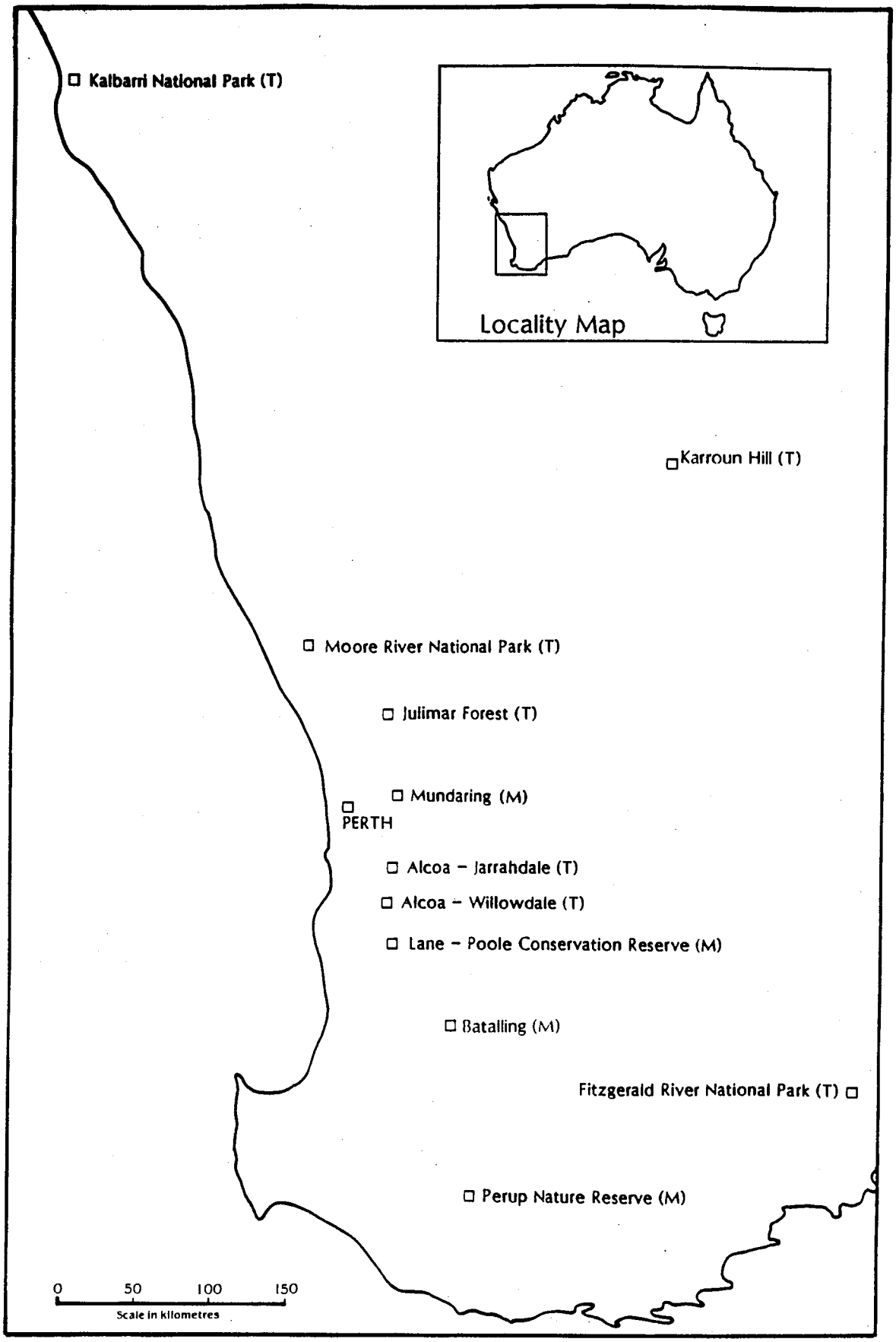

Figure 3

The location of proposed Chuditch monitoring sites (M) and translocation sites (T) in the south-west of Western Australia. After Serena et al. (1991).

3.5.2 Preparation of release sites

To reduce the impact of predation and competition, fox baiting will need to be undertaken in KHNR before a Chuditch translocation can commence, provided baiting is safe for Chuditch (see section 3.1). This will require aerial distribution of '1080' baits over the reserve. Numbats (*Myrmecobius fasciatus*) have been translocated to KHNR and CALM is currently committed to baiting 40 000 ha within the reserve. A Woylie (*Bettongia penicillata*) translocation may also be undertaken at KHNR, thus the cost of fox baiting the entire reserve would be shared between at least three endangered species. Presented in this Recovery Plan is the cost of aerially baiting 200 000 ha once per year.

Chuditch will be released at five sites in the translocation. They will need to be kept in cages at the release sites to acclimatise them to their new surroundings and ensure optimum body condition and minimal stress before being released. Thirty cages (six at each site) need to be purchased and transported to the release sites. Invertebrate pit traps will be used to sample invertebrate biomass at the release sites. The RS and TO will require five days to assemble the cages at the release sites and to prepare them for the translocation, and to install pit traps.

ESP funds are required for the purchase and transport of cages, pit traps, field allowance, vehicle running costs and consumables. Funds are also reqiured for the aerial baiting of KHNR.

CALM Contributions:	$2 700
ESP Funds Required:	$20 300
Total Cost of Action:	$23 000

3.5.3 Undertake Translocation

Translocation will require an RS, TO and OS to work 60 days (three months) at KHNR with two vehicles. Thirty Chuditch will be transported to the release sites and kept in the cages prepared for them. Invertebrate pits will be re-activated and sampled to monitor invertebrate biomass. A contract zoologist will be employed for two months to identify invertebrates trapped. Prior to release, 15 Chuditch will be fitted with radio transmitters and will subsequently be located by radio tracking at least twice a week. This may sometimes need to be done from an aircraft and an allowance of 16 hours of aircraft hire, including the flight to and from KHNR, should be sufficient. Food supplements will be provided near the release sites and body weight and fat index will be monitored. Other observations will include the time taken to establish home ranges and the behavioural responses of translocated males.

ESP funds are required for field allowance, vehicle running costs (for two vehicles), consumables including food for the Chuditch, 1080 meat baits, radio telemetry equipment, aircraft hire and salary for a contract zoologist.

Cost of Action 3.5.3 Undertake Translocation:

CALM Contribution:	$32 400
ESP Funds Required:	$27 400
Total Cost of Action:	$59 800

3.5.4 Monitoring Success of Translocation

Following the three month translocation period, the Chuditch will need to be monitored at fortnightly intervals for the next three months, at monthly intervals for the next six months and at three monthly intervals for the next three years. Thereafter, the population will be monitored twice yearly. Fox baiting will be continued. In particular, the monitoring will aim to determine survivorship and breeding success of translocated Chuditch. In addition, the experiment will help to determine the value of predator control to Chuditch conservation. Each monitoring period will require five days of trapping and radio tracking at KHNR by RS and TO. Regional CALM staff may also be used, particularly for fox baiting.

It is important that the new population at KHNR will have 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.

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

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CALM Contn:	$3 900	$23 700	$8 400	$5 600	$5 800	$2 900	$2 900	$3 000	$3 200	$3 300
ESP Funds:	$1 800	$19 900	$12 600	$12 600	$12 600	$12 000	$10 800	$10 800	$10 800	$12 000
Total Cost:	$5 700	$43 600	$21 000	$18 200	$18 400	$14 900	$13 700	$13 800	$14 000	$15 300

3.6 FURTHER RESEARCH

3.6.1 Research to Determine Distribution 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. A more complete knowledge of present distribution outside the Jarrah forest will help to rationalise the selection of appropriate sites for future translocations.

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 Brush-tailed Possums and Woylies, hence these surveys may increase the knowledge of the distribution of other rare or threatened fauna. ESP funds are required for travel allowance, vehicle running costs and consumables.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CALM Contn	$3 900	$4 000	$4 200	$2 800	$2 900	$2 900	$2 900	$3 000	$3 200	$3 300
ESP Funds	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800
Total Cost	$5 700	$5 800	$6 000	$4 600	$4 700	$4 700	$4 700	$4 800	$5 000	$5 100

3.6.2 Research into Parasites and Disease

The limited distribution of viable Chuditch populations leaves the species vulnerable to decline as a result of disease. Identification of diseases and parasites that affect Chuditch will help to diagnose any future changes in population health. Research into parasites and disease may be undertaken by tertiary institutions and the Western Australian Museum.

3.6.3 Arthropod Recovery in Rehabilitated Minesites

The suitability of rehabilitated bauxite minesites as Chuditch habitat needs to be assessed through comparisons of Chuditch dietary information with analyses of arthropod biomass in rehabilitated areas of different age and floristics. This research will be the responsibility of bauxite mining companies.

4 IMPLEMENTATION SCHEDULE

Task # 3.*	Task Description	Priority	Feasibility	Responsible Party		Cost Estimate ($000's/year) 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
1	Research into effects of fox baiting programs	1	100%	Research Division	a	12.0										12.0
					b	7.7										7.7
					c	19.7										19.7
2	Captive breeding program															
2.1	Chuditch husbandry	2	100%	Perth Zoo	d	8.3	6.2	6.2	6.2	6.2						33.1
					b	47.7	23.4	23.4	23.4	23.4						141.3
					c	56.0	29.6	29.6	29.6	29.6						174.4
2.2	Exhibit and public information program	3	100%	Perth Zoo / CALM	d	0										0
					b	10.0										10.0
					c	10.0										10.0
3	Habitat management															
3.1	Research into effect of burning regimes	1	95%	Research Division / Fire Branch	a	7.7	10.4	10.9	8.1	8.3	8.3					53.7
					b	1.5	7.2	7.2	46.9	46.9	48.3					158.0
					c	9.2	17.6	18.1	55.0	55.2	56.6					211.7
3.2	Maintenance of adequate refuge and den logs															
3.2.1	Effectiveness of silviculture guidelines	1	100%	Research Division / Silviculture Branch	a			6.3	3.6	3.8	3.8	6.3	6.4	6.7	6.8	43.7
3.2.2	Artificial den sites				b			5.6	3.4	3.4	8.4	45.6	46.9	48.0	48.0	209.3
					c			11.9	7.0	7.2	12.2	51.9	53.3	54.7	54.8	253.0

a: CALM Contribution; b: ESP Funds required; c: Total cost; d: Perth Zoo Contribution

Task # 3.*	Task Description	Priority	Feasi-bility	Responsible Party		Cost Estimate ($000's/year) 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
3.2.3	Assess impact of firewood collecting	1	100%	Research Division	a						8.7	7.5	7.8	8.3	8.4	40.7
					b						1.4	1.3	1.3	1.3	1.3	10.8
					c						11.1	9.6	9.9	10.4	10.5	51.5
3.3	Rehabn after mining	2	90-100%	Mining companies		Responsibility of mining companies										
3.4	Clearing of habitat															
3.4.1	Appropriate assessments of areas to be cleared	2	100%	Research Division & Regional Plan Officer	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
3.4.2	Maintenance of uncleared corridors	2	100%	Regional Plan Off.		Negligible additional requirements										
3.5	Public education and forest traffic mgt															
3.5.1	Erectn of traffic warning signs & information signs	3	100%	Regional Ops. Offs / District Mngrs	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
3.5.2	Reporting of road kills and sightings	3	100%	Regional Ecologist Research Division		Negligible additional requirements										
4	Population and habitat monitoring	2	100%	Research Division / District Mngrs	a	13.4	13.7	6.2	6.4	6.8	7.0	7.4	7.8	8.2	8.6	85.5
					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	10.6	11.0	119.3

Task # 3.*	Task Description	Priority	Feasi-bility	Responsible Party		Cost Estimate ($000's/year) 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
5	**Translocation program**															
5.1	Selection of translocation site	2	100%	Research Division	a	3.9										3.9
					b	2.9										2.9
					c	6.8										6.8
5.2	Preparation of release sites	2	100%	Research Division	a	2.7										2.7
					b	20.3										20.3
					c	23.0										23.0
5.3	Undertake translocation	2	95%	Research Division	a	32.4										32.4
					b	27.4										27.4
					c	59.8										59.8
5.4	Monitoring success of translocation	2	95%	Research Division	a	3.9	23.7	8.4	5.6	5.8	2.9	2.9	3.0	3.2	3.3	62.7
					b	1.8	19.9	12.6	12.6	12.6	12.0	10.8	10.8	10.8	12.0	115.9
					c	5.7	43.6	21.0	18.2	18.4	14.9	13.7	13.8	14.0	15.3	178.6
6	**Further research**															
6.1	Research to determine distribution	2	95%	Research Division	a	3.9	4.0	4.2	2.8	2.9	2.9	2.9	3.0	3.2	3.3	33.1
					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	6.0	4.6	4.7	4.7	4.7	4.8	5.0	5.1	51.1
6.2	Research into parasites and disease	3	100%	Tertiary institns / Res. Division		Responsibility of tertiary institutions										
6.3	Arthropod recovery in rehabilitated minesites	3	90-100%	Research Division / Mining cos		Responsibility of mining companies										

Task # 3.*	Task Description	Priority	Feasibility	Responsible Party	Cost Estimate ($000's/year) 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Total annual cost of Chuditch recovery				CALM Contribution	95.4	65.2	49.4	39.9	41.0	41.8	35.0	36.0	37.6	38.4	479.0
				ESP Funds Required	130.1	61.3	55.7	93.2	93.2	77.0	64.6	65.9	67.0	68.2	776.2
				Total Cost	225.5	126.5	105.1	133.1	134.2	118.8	99.6	101.9	104.6	106.6	1255.2

ACKNOWLEDGEMENTS

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APPENDIX 1

DETAILS OF RECOVERY COSTINGS

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1 RESEARCH INTO THE EFFECTS OF THE FOX AND FOX BAITING PROGRAMS

(a) Description

Research Scientist (RS) and Technical Officer (TO) require 20 days (4 x 5 days) at research site in Batalling forest block in November 1991 and 10 days (2 x 5 days) in 1992.

(b) CALM Contributions

Salaries: RS @ $250/day x 30	$7 500
TO @ $140/day x 30	$4 200
	$11 700
1080 bait	$320
Total	**$12 020**

(c) ESP Funds Required

Travel Allowance: @ $85/night x 24 x 2	$4 080
Vehicle running costs: 6 600 km @ 25c/km	$1 650
Consumables	$300
Radio telemetry equipment: 15 collars @ $110 each	$1 650
Total funds required:	**$7 680**

(d) Total Cost of Action

CALM	$12 000
ESP Funds	$7 700
Total	**$19 700**

2.1 Husbandry of Captive Chuditch

(a) Description

Husbandry requires 1·4 keepers to care for up to 40 animals. A total of 40 cages are required, as well as accessories such as nesting boxes, and other equipment.

	1992	1993...
(b) Perth Zoo Contributions		
Salary: 1·4 Keepers, 1 hr/day ($35 000/year FTE)	$6 130	$6 130
Cages: 7 cages @ $300 each	$2 100	
Food: 21 animals @ ~ $3 each/week	$60	$60
Total contribution:	**$8 290**	**$6 190**
(c) ESP Funds Required		
Salary: 0·5 Keepers @ $35 000/FTE	$17 500	$17 500
Cages: 33 cages @ $350 each	$11 550	
Nesting boxes: 19 @ $21 each	$400	
Nesting material: 40 boxes @ $4 each	$160	$160
Food: standard, 19 animals @ ~ $3 each	$60	$60
invertebrate colonies for live food	$1000	
annual maintenance (excluding 1991/92)		$200
Veterinary services	$3 000	$3 000
supplies	$1 500	$1 500
DNA fingerprinting	$1 500	$1 000
Equipment: e.g. scales & catching nets	$1 000	
Total funds required:	**$37 670**	**$23 420**

(d) Total Cost of Action

	1992	1993	1994	1995	1996
Perth Zoo	$8 300	$6 200	$6 200	$6 200	$6 200
Funds required	$37 700	$23 400	$23 400	$23 400	$23 400
Total Cost	**$46 000**	**$29 600**	**$29 600**	**$29 600**	**$29 600**

2.2 Development of Appropriate Exhibit and Public Information Program

(a) Description

Chuditch exhibit, including graphis display, to be set up in Nocturnal House at Perth Zoo. Mobile display unit with mounted specimen and photos to be prepared. Funds required 1991/92.

(b) Perth Zoo Contributions	0
(c) ESP Funds Required	
Chuditch exhibit:	$8 000
Mobile display unit:	$2 000
Total funds required:	$10 000

3.1 Research into the Effects of Burning Regimes on Chuditch Diet

(a) Description

(1) Site Selection, 1992

Selection of four experimental sites will require one week of Research Scientist's time plus travel.

(2) Trapping and Invertebrate Sampling, 1993-1997

Sampling of all 4 sites to be undertaken by RS and TO over 15 days for each sampling period. Sites will be sampled in autumn and spring from 1993 to 1997. Sampling of site (ii) will begin in 1992.

(b) CALM Contributions

(1) Salary: Research Scientist @ $250/day x 5 **$1 250**

	1992	1993	1994	1995	1996	1997
No. of days	2x5	4x5	4x5	4x5	4x5	4x5
(2) Salary: RS	$2 500 $250/day	$5 000 $250/day	$5 400 $270/day	$5 600 $280/day	$5 800 $290/day	$5 800 $290/day
TO	$1 400 $140/day	$2 900 $145/day	$3 000 $150/day	0	0	0
Vehicle standing fee	$2 500	$2 500	$2 500	$2 500	$2 500	$2 500
Total:	$6 400	$10 400	$10 900	$8 100	$8 300	$8 300

(c) ESP Funds Required

(1) Vehicle running costs: 1 000 km @ 25c/km $250

Consumables: $50

Total ESP for (1): **$300**

	1992	1993	1994	1995	1996	1997
No. of days	2x5	4x5	4x5	4x5	4x5	4x5
(2) TO salary*				$39 700	$39 700	$41 100
Vehicle costs: 2 000 km/5 days @ 25c/km	$1 000	$2 000	$2 000	$2 000	$2 000	$2 000
Consumables:	$200	$200	$200	$200	$200	$200
Contract zoologist:		$5 000	$5 000	$5 000	$5 000	$5 000
Total for (2):	$1 200	$7 200	$7 200	$46 900	$46 900	$48 300

* See page 38 for details

(d) Total Cost of Action; (1) & (2)

	1992	1993	1994	1995	1996	1997
CALM Contribution:	$7 700	$10 400	$10 900	$8 100	$8 300	$8 300
ESP Funds:	$1 500	$7 200	$7 200	$46 900	$46 900	$48 300
Total Cost:	$9 200	$17 600	$18 100	$55 000	$55 200	$56 600

3.2 Maintenance of Adequate Refuge and Den Logs

3.2.1 Effectiveness of Silviculture Guidelines and 3.2.2 Assess Importance of Artificial Den Sites

(a) Description

Involves selection of four sites, undertaking prelogging surveys and monitoring, from 1993 to 2001. Prelogging surveys and monitoring surveys require 13 days (2 x 5 + 3 days). Also involves pushing stumps to assess importance of artificial den sites.

	1994	1995	1996	1997	1998	1999	2000	2001
# Days	2+13	13	13	13	13	13	13	13

(b) CALM Contribution

Salaries: RS	$4 050 $270/day	$3 640 $280/day	$3 770 $290/day	$3 770 $290/day	$3 770 $290/day	$3 900 $300/day	$4 160 $320/day	$4 290 $330/day
TO	$2 250 $150/day	0	0	0	0	0	0	0
Vehicle standing:					$2 500	$2 500	$2 500	$2 500
Total:	$6 300	$3 640	$3 770	$3 770	$6 270	$6 400	$6 660	$6 790

*** TO Salary, 1995-2001**

	1995	1996	1997	1998	1999	2000	2001
Salary:	$29 500	$29 500	$30 600	$31 400	$32 300	$33 200	$33 200
Maintenance (14%):	$4 300	$4 300	$4 400	$4 500	$4 700	$4 800	$4 800
Administration (20%):	$5 900	$5 900	$6 100	$6 300	$6 500	$6 600	$6 600
Total:	$39 700	$39 700	$41 100	$42 200	$43 500	$44 600	$44 600

	1994	1995	1996	1997	1998	1999	2000	2001
# Days	2+13	13	13	13	13	13	13	13

(c) ESP Funds Required

TO salary*					$42 200	$43 500	$44 600	$44 600
Travel Allowance @ $85/night x 2	$2 550	$2 210	$2 210	$2 210	$2 210	$2 210	$2 210	$2 210
Vehicle[a]	$1 250	$1 000	$1 000	$1 000	$1 000	$1 000	$1 000	$1 000
Consumables	$150	$150	$150	$150	$150	$150	$150	$150
Pushing stumps[b]				$5 000				
Radio telemetry[c]	$1 650							
Total:	$5 600	$3 360	$3 360	$8 360	$45 560	$46 860	$47 960	$47 960

[a] Vehicle running costs: 1 000 km/2 days, 4 000 km/13 days @ 25c/km
[b] Pushing stumps: 20 ha, 5 stumps/ha, 0·5 hr/stump @ $100/hr = $250/ha
[c] Radio telemetry: 15 radio collars @ $110 each

(d) Total Cost of Action

	1994	1995	1996	1997	1998	1999	2000	2001
CALM Contribution	$6 300	$3 600	$3 800	$3 800	$6 300	$6 400	$6 700	$6 800
ESP Funds	$5 600	$3 400	$3 400	$8 400	$45 600	$46 900	$48 000	$48 000
Total:	$11 900	$7 000	$7 200	$12 200	$51 900	$53 300	$54 700	$54 800

3.2.3 Assess the Effect of Commercial Firewood Collecting, 1997-2001

(a) Description

Two days required for visual assessment and selection of two sites by RS. Subsequently, 13 day surveys undertaken once per year by RS and TO from 1997 to 2001. Additional survey may be required in potential firewood area once it becomes active.

	1997	1998	1999	2000	2001
No. of days	4+2x13	2x13	2x13	2x13	2x13

(b) CALM Contributions

Salary: RS	**$8 700** $290/day	**$7 540** $290/day	**$7 800** $300/day	**$8 320** $320/day	**$8 540** $330/day

* See page 38 for details

(c) ESP Funds Required

Vehicle costs: 3 600 km/13 day survey @ 25c/km 600 km for assessment trip	$2 100	$1 800	$1 800	$1 800	$1 800
Consumables:	$300	$300	$300	$300	$300
Total funds required:	**$2 400**	**$2 100**	**$2 100**	**$2 100**	**$2 100**

(d) Total Cost of Action

CALM Contribution:	$8 700	$7 500	$7 800	$8 300	$8 400
ESP Funds:	$2 400	$2 100	$2 100	$2 100	$2 100
Total Cost:	**$11 100**	**$9 600**	**$9 900**	**$10 400**	**$10 500**

3.3 Rehabilitation After Surface Mining

Responsibility of bauxite mining companies.

3.4 Clearing of Habitat

3.4.1 Appropriate Assessments of Areas to be Cleared

(a) Description

Assessments undertaken by OS, 15 % of total working time. Of this, an estimated 10% is exclusively for Chuditch habitat assessment. One OS per District, 17 Districts. An allowance is needed for 5 day trapping surveys to be undertaken where necessary, which will require 2 people.

(1) Salary: OS @ $150/day
227 working days/year x 15% x 10% = 3.4 days/year
3.4 x $150 x 17 = $8 670

(2) Vehicle running costs for habitat assessments: $100/year

(3) Chuditch trapping surveys: $1 000/year

(b) CALM Contribution: $9 000/year

(c) ESP Funds Required: $1 100/year

(d) Total Cost of Action: $10 100/year

3.4.2 Maintenance of Uncleared Corridors on Fringes of Forest and Mallee

(a) Description

Involves liaison with groups involved and implemented through Regional recommendations. Costs: negligible additional requirements.

3.5 Public Education and Forest Traffic Management

3.5.1 Erection of Warning Signs and Visitor Information Signs

(a) Description

30 traffic warning signs are required on major roads through Chuditch habitat and 50 visitor information signs are required in picnic and camping areas in Chuditch habitat.

(b) CALM Contributions **0**

(c) ESP Funds Required

MRD road warning signs: 30 @ $100/sign (including plant & installation)	$3 000
Visitor information signs: 50 @ $100/sign (including plant & installation)	$5 000
Annual maintenance and replacement: 20%	$1 600
Total Funds Required: 1992	**$9 600**

(d) Total Cost of Action

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ESP	$9 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600	$1 600

3.5.2 Reporting of Road Kills and Sightings

(a) Description

Involves the printing and distribution of information leaflets and data sheets, as well as curatorial costs for roadkill specimens. Normal CALM operations.

4 POPULATION AND HABITAT MONITORING

(a) Description

Monitoring of populations and habitat will be carried out at Mount Dale, Lane-Poole Reserve, Batalling Block and Perup Nature Reserve. Monitoring in 1992-93 will involve training District personnel in trapping and handling Chuditch.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
No. of days	4x5	4x5	4x5	4x5	4x5	4x5	4x5	4x5	4x5	4x5

(b) CALM Contribution

Salaries:										
RS	$5 000	$5 000								
	$250/d	$250/d								
TO	$2 800	$2 900								
	$140/d	$145/d								
OS (2)	$5 600	$5 800	$6 200	$6 400	$6 800	$7 000	$7 400	$7 800	$8 200	$8 600
	$280/d	$290/d	$310/d	$320/d	$340/d	$350/d	$370/d	$390/d	$410/d	$430/d
Total:	$13 400	$13 700	$6 200	$6 400	$6 800	$7 000	$7 400	$7 800	$8 200	$8 600

(c) ESP Funds Required

Travel A.	$1 360	$1 360								
$85/night x2										
Vehicles:										
Research	$2 500	$2 500								
10 000km @ 25c/km										
District	$2 000	$2 000	$2 000	$2 000	$2 000	$2 000	$2 000	$2 000	$2 000	$2 000
4 x 2000 km @ 25c/km										
Consumables	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400
Invert/pits	$2 000									
Total:	$8 260	$6 260	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400

(d) Total Cost of Action

CALM Contn:	$13 400	$13 700	$6 200	$6 400	$6 800	$7 000	$7 400	$7 800	$8 200	$8 600
ESP Funds:	$8 300	$6 300	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400	$2 400
Total Cost:	$21 700	$20 000	$8 600	$8 800	$9 200	$9 400	$9 800	$10 200	$10 600	$11 000

5 TRANSLOCATION PROGRAM

5.1 Selection of translocation site, 1992

(a) Description

10 days (2 x 5 days) trapping at KHNR by RS & TO to determine presence or absence of Chuditch and appropriate release sites.

(b) CALM Contributions

Salaries: RS @ $250/day x 10	$2 500
TO @ $140/day x 10	$1 400
	$3 900

(c) ESP Funds Required

Field Allowance: @ $36/night x 8 x 2	$580
Vehicle running costs: 4 000 km @ 25c/km	$1 000
Cage traps: 40 @ $30 each	$1 200
Consumables (bait, etc.):	$100
Total funds required:	**$2 880**

(d) Total Cost of Action

CALM	$3 900
ESP Funds	$2 900
Total	**$6 800**

5.2 Preparation of release sites, 1992

(a) Description

5 days required by RS and TO to set up 5 release sites with cages at KHNR. A further 2 days for fox baiting.

(b) CALM Contributions

Salaries: RS @ $250/day x 7	$1 750
TO @ $140/day x 7	$980
	$2 730

(c) ESP Funds Required

Field Allowance: @ $36/night x 5 x 2	$360
Vehicle running costs: 3 500 km @ 25c/km	$880
Equipment: 30 cages @ $250 each	$7 500
Invertebrate pit traps	$500
Transport of cages:	$2 000

Subtotal previous page:		*$11 240*
Aerial baiting: 12 000 baits @ 40c each		$4 800
18·5 hrs flying time @ $200/hr		$3 700
personnel		$500
Consumables:		$100
Total funds required:		**$20 340**

(d) Total Cost of Action	CALM	$2 700
	ESP Funds	$20 300
	Total	**$23 000**

5.3 Undertake translocation, 1992

(a) Description

Translocation requires 60 days (12 x 5 days) work (involving care of caged animals, release and radio tracking) at release sites with RS, TO and Operations staff (OS).

(b) CALM Contributions

Salaries: RS @ $250/day x 60	$15 000
TO @ $140/day x 60	8 400
OS @ $150/day x 60	$9 000
	$32 400

(c) ESP Funds Required

Travel Allowance: @ $36/night x 48 x 3	$5 180
Vehicle running costs: 2 vehicles required	
48 000 km @ 25c/km	$12 000
Radio telemetry equipment:	
10 radio collars @ $110 each	$1 100
transceiver and aerial	$1 600
Aircraft hire: (radio telemetry) 16 hrs @ $120/hr	$1 920
Consumables:	$600
Contract zoologist: invertebrate identification, 1 month	$5 000
Total funds required:	**$27 400**

(d) Total Cost of Action	CALM	$32 400
	ESP Funds	$27 400
	Total	**$59 800**

5.4 Monitoring of success of translocation, 1992-1996

(a) Description

Monitoring to be carried out by Research Scientist and Technical Officer for 5 day periods at translocation site
at fortnightly intervals for next 3 months,
at monthly intervals for next 6 months,
at 3 monthly intervals for next 3 years
and twice each year thereafter.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
No. of days	2x5	12x5	4x5	4x5	4x5	2x5	2x5	2x5	2x5	2x5

(b) CALM Contribution

Salaries:

RS	$2 500	$15 000	$5 400	$5 600	$5 800	$2 900	$2 900	$3 000	$3 200	$3 300
	$250/d	$250/d	$270/d	$280/d	$290/d	$290/d	$290/d	$300/d	$320/d	$330/d
TO	$1 400	$8 700	$3 000	0	0	0	0	0	0	0
	$140/d	$145/d	$150/d							
Total	$3 900	$23 700	$8 400	$5 600	$5 800	$2 900	$2 900	$3 000	$3 200	$3 300

(c) ESP Funds Required

Field Allow. $36/night x2	$720	$4 320	$1 440	$1 440	$1 440	$720	$720	$720	$720	$720
Vehicle: 2000km/5 days @ 25c/km	$1 000	$6 000	$2 000	$2 000	$2 000	$1 000	$1 000	$1 000	$1 000	$1 000
Consumables	$100	$600	$200	$200	$200	$100	$100	$100	$100	$100
Aerial bait.		$9 000	$9 000	$9 000	$9 000	$9 000	$9 000	$9 000	$9 000	$9 000
DNA analysis						$1 200				$1 200
Total:	$1 820	$19 920	$12 640	$12 640	$12 640	$12 020	$10 820	$10 820	$10 820	$12 020

(d) Total Cost of Action

CALM Contn:	$3 900	$23 700	$8 400	$5 600	$5 800	$2 900	$2 900	$3 000	$3 200	$3 300
ESP Funds:	$1 800	$19 900	$12 600	$12 600	$12 600	$12 000	$10 800	$10 800	$10 800	$12 000
Total Cost:	$5 700	$43 600	$21 000	$18 200	$18 400	$14 900	$13 700	$13 800	$14 000	$15 300

6.1 Research to Determine Distribution in Wheatbelt and Semi-arid Areas

(a) Description

10 days (2 x 5 days) a year are required for trapping surveys by RS and TO at selected localities in wheatbelt and semi-arid areas.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
No. of days	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5

(b) CALM Contribution

Salaries:

RS	$2 500	$2 500	$2 700	$2 800	$2 900	$2 900	$2 900	$3 000	$3 200	$3 300
	$250/d	$250/d	$270/d	$280/d	$290/d	$290/d	$290/d	$300/d	$320/d	$330/d
TO	$1 400	$1 450	$1 500							
	$140/d	$145/d	$150/d							
Total	$3 900	$3 950	$4 200	$2 800	$2 900	$2 900	$2 900	$3 000	$3 200	$3 300

(c) ESP Funds Required

Field Allowance: $36/night x 2 x 8	$580/year
Vehicle running costs: 2 000 km @ 25c/km	$1 000/year
Consumables:	$200/year
Total funds required:	$1 780/year

(d) Total Cost of Action

CALM Contⁿ	$3 900	$4 000	$4 200	$2 800	$2 900	$2 900	$2 900	$3 000	$3 200	$3 300
ESP Funds	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800	$1 800
Total Cost	$5 700	$5 800	$6 000	$4 600	$4 700	$4 700	$4 700	$4 800	$5 000	$5 100

6.2 Research into Parasites and Disease

Responsibility of tertiary and other institutions.

6.3 Arthropod Recovery in Rehabilitated Minesites

Responsibility of mining companies.