

**WOYLIE (*BETTONGIA PENICILLATA OGILBYI*):
A REVIEW OF ITS STATUS.**

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DEPARTMENT OF CONSERVATION
& LAND MANAGEMENT
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1. Background

1.1 Historical distribution of *Bettongia*.

The genus *Bettongia* is currently recognised as having had four species at European settlement (Table 1). The most widespread were *B. lesueur* and *B. penicillata*. Two subspecies of *B. penicillata* are recognised; typical *B. p. penicillata* (brush-tailed bettong) in eastern Australia and *B. p. ogilbyi* (woylie) in the west.

Table 1. The currently recognised species of *Bettongia* present at European settlement including subspecies of *B penicillata*.

Taxon	Common name	Distribution	Status (ANZECC)
<i>B. gaimardi</i>	Tasmanian Bettong	se Australia incl. Tas	secure
<i>B. lesueur</i>	Burrowing Bettong	much of s and w Australia	threatened
<i>B. p. ogilbyi</i>	Woylie	sw mainland Australia	reviewed here
<i>B. p. penicillata</i>	Brush-tailed Bettong	se mainland Australia	presumed extinct
<i>B. tropica</i>	Northern Bettong	ne Queensland	threatened

The geographical relationship between the two subspecies and the subspecific status of central Australian *B. penicillata* is not clear. Indeed the former distribution of the species is not fully known. Fig. 1 presents the locations at which it is known to have lived. The map was compiled by Nelson *et al.* 1992. The data comes from two sources, European (including specimen) records (adapted from Finlayson 1958; the north Queensland record refers to *Bettongia tropica*.) and the knowledge of Aboriginal people who used to hunt it for food (Burbidge *et al.* (1988). The incomplete status of both data sets is emphasised by their differences. The species may have been present in some of the large areas south of the Tropic of Capricorn for which there are no records. However it was probably not widespread in the wet-dry tropics.

1.2 Pattern of decline.

Regardless of the incomplete knowledge of the former distribution of *B penicillata* and its infra-specific variation across that distribution it is clear that the only form of the species known to be extant is the woylie, *B. p. ogilbyi* which survived in its natural habitat as three relict populations in the forests and adjacent woodlands in far south west Western Australia.

Those were declining until active management, principally protection from foxes, was initiated fifteen years or so. There were also some captive animals as well as introduced
1 four South Australian islands (Wedge Island, St. Peter Island and two other very
is). The founders were captive-bred, Western Australian stock).

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The woylie, like many Australian mammal species, had declined drastically, almost to extinction, since European settlement. Several hypotheses have sought to explain the causes of the declines (see Burbidge and McKenzie 1989 for a review).

Burbidge and McKenzie showed that most non-marine Australian mammals that have become extinct or have significantly declined fall within a Critical Weight Range (CWR) now recognised as 35g to 5.5kg mean adult body weight. The decline has been more severe in the arid zone than in better watered areas. The woylie (1-1.5kg) lies within the CWR and conforms to the typical pattern, surviving in the most mesic part of its former range.

Several authors (eg, Troughton 1957, Christensen 1980, Christensen and Maisey 1987, King *et al.* 1981) implicate the fox as a predator of woylies and this is now supported in the south-west of WA by quantitative data. For example at Batalling Forest the capture rate was <1% before fox baiting commenced in February 1991. It rose to about 2% in November 1991, 9% in October 1992 and 14% in October 1993 (Courtenay 1994) and 24% in July 1995 (Keith Morris personal communication; data obtained on Courtenay's standard transects.). Data from other sites is presented in Courtenay 1994. At Batalling woylies are being trapped in adjacent unbaited areas where they were previously not known to occur, probably a consequence of immigration from the baited area.

Calaby (1971) suggested that *B. penicillata* survived in south-west Western Australia because it inhabited vegetation in which thickets of *Gastrolobium* species were abundant. *Gastrolobium* contains sodium monofluoroacetate ('1080'). 1080 is very toxic to non-indigenous mammals including domestic stock and feral predators such as foxes, but indigenous mammals (and other animals) of the south-west have evolved a high level of tolerance.

Gastrolobium thickets are a feature at Perup, Dryandra and Tutanning, the three sites woylies are known to have survived in the wild. Secondary poisoning of feral predators eating animals that have ingested *Gastrolobium* may account for the phenomenon. Foxes eating rabbits poisoned with 1080 have died (David Algar personal communication). 1080 is the toxin now used in baits to control foxes for protection of threatened fauna in south west WA and in SA.

A more detailed account of the history of the status of the woylie is contained in the Recovery Plan (see below).

1.3 Statutory status

Bettongia penicillata is declared as "fauna which is likely to become extinct or which is rare" pursuant to the Western Australian Wildlife Conservation Act, and in South Australia is listed on Schedule 7 (Endangered Species) pursuant to the National Parks and Wildlife Act. The species is listed as endangered nationally by ANZECC (ANPWS 1991) and is included in Schedule 1, Part 1 (species that are endangered) of the Commonwealth Endangered Species Protection Act. The 1992 Marsupial and Monotreme Action Plan (Kennedy 1992) listed the woylie as Endangered.

2. Recovery Plan

In 1990 ANCA (then ANPWS) introduced to Australia the concept of preparing and implementing Recovery Plans for threatened species. A Recovery Plan details, schedules and costs the actions necessary to support the recovery of species or communities in the wild. There should be only one Recovery Plan to cover the requirements for any one species across its range (ESU 1993).

It is important to note that "recovery" relates to the process of halting or reversing the decline of a species in the wild and ensuring its future chance of survival (and if appropriate, expansion). It is not the process of re-establishing a species throughout its former range; That should be a subsequent action in so far as it is possible.

A Recovery Plan for the woylie (Hall *et al.* 1991) was one of the first to be written. That edition specified recovery actions to be implemented during the next ten years in South Australia and Western Australia by a Recovery Team¹ comprising people from CALM, SADENR and ANCA. However there were so many positive developments during the first two years that the Recovery Team revised the plan extensively (Start *et al.* 1995). A major change was the foreshortening of the life of the plan to five years (to December 1995).²

The specific objectives of the revised Woylie Recovery Plan were to:

1. Determine the current wild distribution of the woylie in Western Australia.
2. Establish a population of woylies on a mainland area in South Australia without using predator-proof fences.
3. Develop prescriptions for the maintenance and extension of woylie populations in multiple-use forest in Western Australia.
4. Ensure that translocated woylie populations maintain genetic variability.
5. Review the conservation status of the woylie, using internationally accepted criteria, and recommend changes if necessary.

The actions implemented by the Recovery Team comprised:

1. Control of exotic predators, particularly foxes.
2. Survey and establishment of monitoring programs.
3. Range expansion (where feasible) and translocation.
4. Set up experiments to determine the effects of forest management practices
5. Genetic assessment and re-stocking.
6. Employment of Scientist, South Australia.
7. Education and publicity.

3. Purpose of this review.

The Recovery Plan requires the Recovery Team to "Review the conservation status of the woylie, using internationally accepted criteria, and recommend changes if necessary" at the conclusion of its recovery action program in December 1995 (Objective 5; see above). This paper constitutes the Recovery Team's review against the current IUCN criteria for fauna (IUCN 1994). The Recovery Plan also contains criteria which, being specific to woylies,

¹ Appendix 1 lists current Members of the Recovery Team.

² Appendix 2 is the summary sheet from the Recovery Plan. It lists the Objectives and the Criteria for success as well as summarising and costing the actions set out in the Recovery Plan for 1994 and 1995.

enabled the Recovery Team to set specific targets for its actions program. They are also reviewed. Nevertheless it is the IUCN criteria which are definitive.

3.1. International Criteria.

The IUCN Red List Categories: Version 2.2 (IUCN 1994) details the criteria that are currently used to classify the conservation status of species. It is attached as Appendix 3. It uses five independent topics to allocate the conservation status of a species to one of the categories outlined in Table 2.

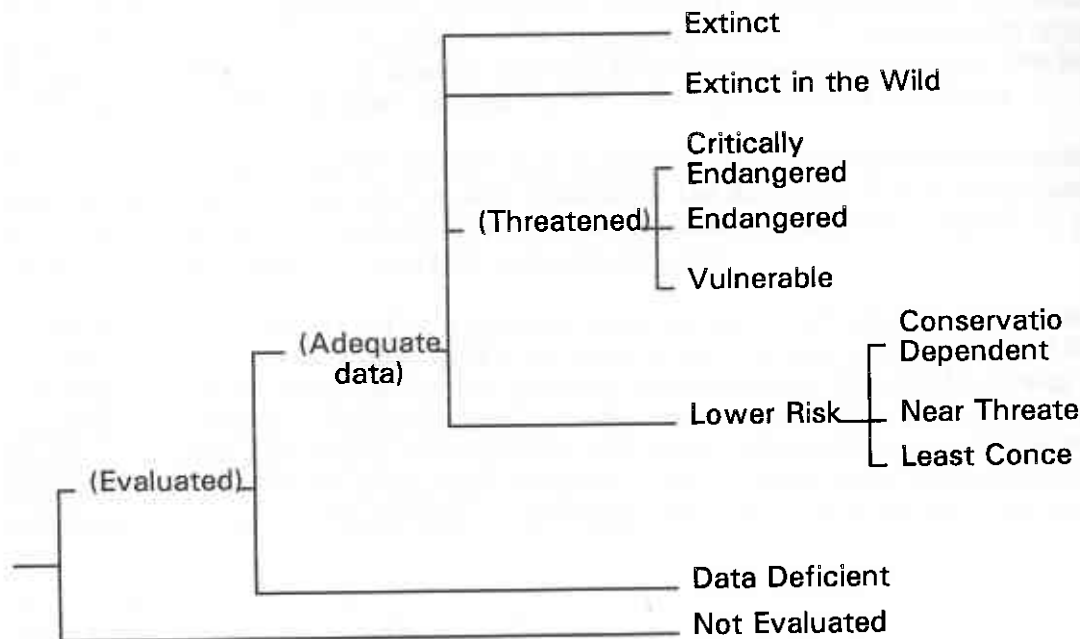
Table 2. Definitions of the categories used in the current IUCN Red Lists

CATEGORY	SUMMARY EXPLANATION (see Appendix 3 for full detail.)
EX Extinct	No reasonable doubt the last one has died
EW Extinct in the wild	Survives but not wild in its natural range
CR Critically endangered	Extremely high risk of extinction in the wild in the immediate future
EN Endangered	Not CR but very high risk of extinction in near future
VU Vulnerable	Not EN but high risk of extinction in mid-term future
LR Lower Risk	None of the above nor DD but warrants monitoring
DD Data Deficient	Insufficient data to classify
NE Not Evaluated	Not yet assessed against the criteria

The category Lower Risk has three sub-categories. They are

SUB-CATEGORY	SUMMARY EXPLANATION (see Appendix 3 for full detail.)
cd conservation dependent	Cessation of management would result in qualification for a threatened category within 5 years.
nt near threatened	Not qualifying for cd but close to qualifying for VU.
lc least concern	Not qualifying for cd or nt.

Figure 2. The Structure of the IUCN categories (IUCN 1994)



The species being assessed is allocated to the highest category determined by any one of five topics (A to E below). In the following analysis we assessed the woylie against the lowest of the Threatened classifications (Vulnerable). Had it met that classification we would have assessed it against the next (Endangered) etc.

A. Substantial past or projected future decreasing population trends.

For woylies to qualify as vulnerable there must have been a reduction in population size of at least 20% over the last 10 years or a projected reduction of that extent in the next 10 years. Table 3 summarises woylie status 20 years ago compared with now. Data to 1994 are detailed in Courtenay 1994; data since then have been supplied by people implementing the monitoring program established as Action 2 of the Recovery Plan.

Table 3. Comparison of *Bettongia penicillata* status 20 years ago with the present.

State	Location	area(ha)	Past Status (<21 yrs)	Status now
WA	Batalling	3,617	Presumed Extinct	Re-introduced 1983. TS 24% (July 1995)
WA	Boyagin	4,781	Presumed extinct.	Re-introduced 1992. TS 47% (Oct 1995) ³
WA	Dryandra	12,192	TS <1% (1975)	TS variable but consistently >50%
WA	Julimar	24,117	Presumed extinct	Re-introduced 1995; established
WA	Perup	37,640	3-10% (1974) ^{4,5}	TS 35% (Feb 1994) ⁶
SA	St. Peter Island	3,493	not naturally occurring	Introduced 1989; TS 53% (March 1995)
WA	Tutanning	2,369	TS 0% -6% (1984)	TS 13% (July 1995)
SA	Venus Bay	1,600	Presumed extinct	Re-Introduced 1994. Established
SA	Wedge Island	947	Not naturally occurring	Introduced 1983; TS 77% (June 1995)
SA	Yookamurra	1,100	Presumed extinct	Re-introduced 1991. Established.

* TS = Trap success expressed as a percentage.

The increase in the number of populations has resulted from translocations after fox (and, at Venus Bay Peninsula, cat) control. In WA the increase in population density (as measured by trap success) has occurred since fox control measures have been introduced.

The population at Yookamurra is contained within a fox-proof fence. The managers, Earth Sanctuaries, plan to maintain the population in a wild state within the fence. Introduced populations on two small SA islands with carrying capacity of <50 animals were recognised by the Recovery Team to be too small to maintain long-term, viable populations. One became extinct in early 1994. The other persists but will not be maintained if it declines.

Table 3 demonstrates a substantial increase in population density as well as the number of populations (area of occupancy) at sites identified in the Recovery Plan as key populations over the past 20 years, a substantial proportion of which has occurred in the last 10 years. Woylies do not qualify as Vulnerable under this category.

Besides sites identified in the Recovery Plan for protection or introduction of woylies there are a number of other relevant sites. In WA fox control has now been extended to 550,000 ha of jarrah/wandoo forest much of which is probably suitable habitat. Woylies have been translocated to ten sites within that area under another program (Operation Foxglove and Project 3.4 of the VBC CRC). That program will translocate woylies to another eight sites before the end of 1995. Providing feral predator control is maintained, all populations that are still below carrying capacity throughout the accessible habitat are likely to increase in density

³ data from West Boyagin recorded by Jackie Courtenay.

⁴ Boyicup. The forest block at Perup monitored by Christensen 1974-1981.

⁵ Data using cage traps (as in present monitoring program) and excluding additional pre-baited funnel traps.

⁶ Yendicup. The forest block at Perup monitored by Burrows 1989-1994

and area of occupancy in future. CALM is committed to protecting or expanding these populations.

B. Extent of occurrence and areas of occupancy (see appendix 3 for definitions).

To qualify as vulnerable a species will have an extent of occurrence of less than 20,000 km² or area of occupancy of less than 2000 km² and furthermore meet two out of three additional criteria. Woylies now have an extent of occurrence many times 20,000 km² extending from WA to SA. The extent of occurrence in WA alone exceeds 17,000 km². However the area of occupancy is difficult to determine in forested areas where populations are expanding in the shelter of fox control. Although it probably exceeds 2000 km² the additional requirements are considered.

(1) Populations are severely fragmented (no population is estimated to contain more than 1,000 mature individuals) or found at no more than ten locations. The Dryandra population is estimated at about 6,000 individuals (Jackie Courtenay, unpublished data). The Perup (including Kingston to Lake Muir) area contains a much larger population, Batalling supports several thousand individuals and there are more than 1000 on Wedge and St. Peter islands. There are ten populations (six in WA and four in SA) even recognising the Lake Muir-Perup-Kingston (>40 km across) as one population and excluding the small SA island population and the area covered by Operation Foxglove.

(2) The species continues to decline in any of the following:

- a) **Extent of occurrence** (It has been increasing in WA and SA. Table 3.)
- b) **Area of occupancy** (It has been increasing in WA and SA. Table 3.)
- c) **Area, extent or quality of habitat** (These factors are increasing/improving with extension of fox control in natural vegetation on State lands in WA and SA)
- d) **Number of locations or sub-populations** (They are projected to expand in WA until populations coalesce)
- e) **Number of mature individuals** (woylies breed in their first year. Therefore populations that have been increasing over recent years (Table 3) will contain increasing numbers of mature individuals in WA and SA.)

(3) Extreme fluctuations in any of the following:

- a) **Extent of occurrence** (Increasing in WA and stable in SA. Table 3.)
- b) **Area of occupancy** (Stable or increasing, depending on site, in WA and SA. Table 3.)
- c) **Number of locations or sub-populations.** (Increasing in WA and stable in SA. Table 3.)
- d) **Number of mature individuals** (Stable or increasing, depending on site, in WA and SA. Table 3.)

Woylies do not meet any of the additional characters. Thus they do not qualify as Vulnerable under this category.

C. Population size (for larger populations) and predicted decreasing trends.

For woylies to be assessed as Vulnerable this category requires that the total number of individuals is less than 10,000 **and either** there is an estimated continuing decline of at least 10% in 10 years **or** there is a continuing decline in the number of mature individuals or population structure (severe fragmentation or all mature animals in one sub-population).

The Dryandra population is estimated at about 6,000 individuals (Jackie Courtenay, unpublished data.). The Perup area (including Kingston to Lake Muir) contains a much larger population, Batalling supports several thousand individuals and there are more than 1,000 on both Wedge and St. Peter Islands. Furthermore the total number of mature individuals is increasing as WA populations spread with the extension of fox baiting and a continuing translocation program. Woylies do not qualify as Vulnerable under this category.

D. Population size (of smaller populations) irrespective of population trends.

To qualify as Vulnerable this category requires the population to be very small (<1,000 individuals) or the population to be acutely restricted in its area of occupancy (typically <100²km) or number of locations (typically <5). Data presented above clearly indicate that woylies can not be classified as vulnerable under this category.

E. Quantitative analysis showing probability of extinction in specified time units or generations. To qualify as Vulnerable this category requires a quantitative analysis showing probability of extinction is at least 10% within 100 years. No analysis has been undertaken for woylies. Given the population size and trends discussed above, a population viability analysis would be unlikely to show a significant probability of extinction. Assuming climatic change does not eliminate suitable habitat, current feral predator controls are sustained or improved and State lands which now support woylie populations are not alienated, and that there are adequate monitoring programs, there is no reason to believe factors operating at present will reverse the current trend of increasing populations and densities (where populations are still below carrying capacity). Thus woylies would not qualify as Vulnerable under this category.

Conclusion on the status of woylies as assessed by the IUCN criteria.

Woylies do not qualify as Vulnerable, the least critical of the Threatened group of categories (Figure 2 and IUCN 1994 at Appendix 3). However they would probably be Endangered or Critically Endangered if remnant populations had not been protected from fox predation and new populations established in the safety of feral predator control. Undoubtedly their status would revert to a Threatened category if active management, particularly of feral predators, were to be discontinued. Woylies are therefore unequivocally classified as "Lower Risk (Conservation Dependent)". Conservation Dependent taxa are those which are the focus of a continuing taxon-specific or habitat-conservation program, the cessation of which would result in the taxon qualifying for one of the threatened categories within five years.

3.2 Recovery Plan Criteria

The criteria set by the Recovery Team for successfully achieving the objectives are:

3.2.1 Western Australia

At least six populations of woylies, each occurring in areas of at least 1,500 ha of suitable habitat and each increasing in density (and area where there is contiguous suitable habitat) or plateaued at a trap-success rate greater than 7.5%.

In Western Australia the six primary sites selected by the Recovery Team for achieving this criterion are listed in Table 4 which also indicates recent trap success rates. At all sites except for Julimar, woylies occupy substantially more than 1,500 ha at densities that yield trap success rates substantially greater than 7.5%. (Table 4)

Woylies were not translocated to Julimar until early 1995 and the trap success rate has not reached 7.5%. Animals were released at two points. One group has established well but there was high predation of the other to begin with. Fox control has been intensified in that area and the prognosis is now good for woylies at Julimar.

It is difficult to provide precise area data and trap success data for the forest site at Batalling because woylies are still spreading into contiguous suitable habitat. The population of woylies in the Perup region is actually considerably larger than indicated in Tables 3 and 4. The trap success data in Table 4 is from the proposed Perup Nature Reserve, about 37,640 ha. Woylies are also abundant in Kingston and Warrup Forests up to 25 km west of Perup and have been caught in the intervening Corbal and Dwalgan Forests (16% and 7% trap success respectively). They have also been caught in low

numbers in several forest areas at least 15 km south of Perup along the Muir Highway between Tone Forest and Lake Muir (Courtenay 1994). Thus woylies probably occur over an area of at least 60,000 ha in this region but in variable densities.

Table 4. Area, trap success and notes on six sites recognised as key sites by the Recovery Team in Western Australia.

Site	Trap	Area (ha)	Notes
Batalling	24%	3,617	33,565 ha now baited. Woylie density varies as they spread from the original Batalling site.
Boyagin	47%	4,781	Data from West Boyagin but woylies are present in both Blocks of this reserve.
Dryandra	>50%	12,192	Population estimated about 6000 woylies. This has been the source of animals sent to SA
Julimar	New	24,117	Approx. 16,000 ha of additional, contiguous, fox-baited forest on Commonwealth land to the north.
Perup	35%	37,640	Excludes areas outside proposed Perup NR, Eg. Kingston and Lake Muir where there are woylies.
Tutanning	13%	2,369	69 of 150 traps caught other species and were at least partially unavailable to woylies.

It should be noted that interpretation of trap success (TS) becomes increasingly difficult as populations of fauna recover. This is illustrated by data from Tutanning. In July 1995 fifty traps were set over three nights to give 150 trap nights. Table 5 presents the results.

Table 5. Trap data for the routine woylie monitoring transect at Tutanning in mid 1995. (Numbers in parenthesis exclude animals recaptured during the trap session.)

Date	Traps set	Woylie	Possum	Quenda	Bird
31/07/95	50	6(6)	22(22)	2	1
01/08/95	50	8(7)	14(12)	4	2
02/08/95	50	6(3)	19(15)	5	0
TOTAL	150	20(16)	55(49)	11	3

Woylie trap success is -

- 10.6% using all woylie individuals but excluding recaptures during the session
- 13.3% using all woylie captures
- 24.6% using all woylie captures and assuming all traps that caught other species were unavailable to woylies.

In presenting trap success data we have used total woylie captures because some early data did not differentiate new from recaptured animals during any one trapping session. Our assumption that all traps were available means that, in many instances, the data is conservative.

Clarification of the status of the woylie in conservation reserves and State Forest of the south-west of WA.

The discovery of a sound woylie population at Kingston Forest and a road kill near Lake Muir were among the factors prompting the revision of the first edition of the Recovery Plan. Courtenay (1994) surveyed for woylies in forests between Perup and Kingston and also between Perup and Lake Muir. She found woylies in all but one of the areas she surveyed as far south as the Muir Highway although trap rates were low in areas south of Perup. This suggests that woylies are probably present in varying numbers from Kingston to Lake Muir. (see above for more detail)

Establishment of experiments to determine the effects of timber harvesting (at Kingston Forest) and fuel-reduction prescribed burning (at Batalling Forest) on woylies and commitment in a Wildlife Management Program to modify forest management prescriptions to ensure compatibility with maintaining woylie populations.

The discovery of woylies at Kingston was made during a pre-logging fauna survey. There were also other threatened mammals present. These species occupied un-logged forest as well as forest logged about six years previously. Logging was postponed to allow time to set up experiments to quantify the impact of operational timber harvesting on fauna in the jarrah forest. Information from the experiment will be used to determine whether it is necessary to modify management prescriptions so that the species like woylies can recolonise all suitable forest habitat irrespective of tenure or use but under cover of fox control.

The experiments have been set up. Pre-logging data has been collected. Logging took place this year (1995). Preliminary results indicate woylies were not seriously affected by the operation. The experiment will run its full, planned course and CALM will assess the suitability of the current prescriptions when the results are available. The results of the experiment will be published.

An experiment to assess the impact of prescribed fuel-reduction fire on woylies and other mammals has been set up at Batalling. Preliminary results indicate woylies were not seriously affected by the operation. The experiment will run its full, planned course and CALM will assess the suitability of the current prescriptions when the results are available. The results of the experiment will be published.

3.2.2 South Australia

Maintenance of two island populations, on Wedge and St Peter Islands.

Populations on Wedge and St. Peter Islands are thriving. Trap success rates have commonly exceeded 50%. David Groth and John Wetherall, Curtin University of Technology, assessed DNA profiles of animals from Wedge and St. Peter Islands compared with animals from Tutanning. They reported to the Recovery Team that the island stocks (0.80 band-sharing) had very limited genetic variability and considerably less than the Tutanning stock which, at 0.50 band-sharing, approached that "seen in a well maintained population of sheep or cattle". Therefore wild-caught woylies from Dryandra have been introduced to Wedge Island in an attempt to increase the genetic variability of that population. If successful this process will be extended to St. Peter Island.

Establishment of at least one mainland population in addition to the Yookamurra population.

On 5 April 1994, after extensive work to control feral predators and rabbits, wild-caught woylies from Dryandra were released at Venus Bay Conservation Park on Eyre Peninsula. The future of this reintroduction appears secure, with recent systematic trapping (September 1995) producing 33% trap success (20 captures from 60 trap nights) five of which were new (untagged) animals. No further losses of radio collared woylies to predators have occurred since the capture of a large male cat in March and seven of the 14 collared females were observed with large young at foot. In addition all females handled were found to have pouch young and weights of all animals continue to be above weight at release, reaffirming the suitability of habitat and availability of adequate food resources.

The population at Yookamurra persists. SADENR staff assist with monitoring. The status of genetic diversity of the Yookamurra population is probably similar to that of the SA island populations as it is derived from the same founder stock. Any decision to introduce wild-caught animals from elsewhere to broaden the genetic base will be for the managers to make. The SADENR will continue to assist with monitoring for the time being.

3.2.3. Both States

Establishment of monitoring programs (to include genetic diversity) and action plans to address any adverse trends detected.

In South Australia the annual monitoring of Wedge and St. Peter Islands will continue. Fixed transects have been established to ensure comparability of data from year to year. Intensive monitoring of the establishing Venus Bay population, including systematic trapping three times per year and on going radio tracking, will continue at least to the end of 1996 by research staff. SADENR will determine the responsible personnel and program for monitoring thereafter.

In Western Australia a monitoring program using standardised transects with trap locations permanently marked has been established (Courtenay 1994) and regular monitoring, at least annually will be undertaken by CALM staff responsible for the management of the areas occupied by each of the woylie populations. This will be added to as more populations are established by translocation or as woylies extend into new Districts under cover of CALM's program to control foxes in the south west of WA. Samples from all populations have been collected to provide base line data on the genetic variability of wild woylie populations.

3.3. Criteria under CALM Policy. CALM Policy Statement No. 33, Conservation of Threatened and Specially Protected Fauna in the Wild (endorsed 1991) provides the mechanism and criteria by which species are assessed for inclusion and removal from the Schedule of "fauna which is likely to become extinct or which is rare" pursuant to the Western Australian Wildlife Conservation Act.

It establishes a Threatened Fauna Scientific Advisory Committee to review and advise the Executive Director on all proposals to amend the schedule. An indigenous taxon may be recommended for inclusion on the list if it is -

- ***presumed to be extinct.*** The woylie is not presumed extinct.

- *in imminent danger of or threatened with extinction, ie. it is likely to decrease in numbers and possibly become extinct if factors causing its decline continue to operate.* The data presented here demonstrates that the woylie is increasing in numbers of populations and in the extent of all populations not yet at carrying capacity within areas of natural habitat of finite size.
- *dependant on or restricted to habitats that are vulnerable and/or subject to factors that may cause its decline.* This criterion is pertinent to situations such as salt encroachment threatening habitat. Although woylies could decline to extinction if fox control were to cease, there is an on-going commitment by CALM to maintain fox control in all areas occupied by woylies (which also contain other threatened fauna in need of protection from foxes). Given that commitment, habitat occupied by woylies is not vulnerable or subject to factors that may cause their decline. (See below)
- *very uncommon, even if widespread.* The woylie is now very common in several locations in the south west of Western Australia in addition to the populations in South Australia.

Policy Statement 33 provides for the Threatened Fauna Scientific Advisory Committee to recommend that a taxon be removed from the schedule where:

- *Recent zoological survey has shown that the taxon no longer meets the above criteria.*
- *The taxon is no longer threatened because it has been adequately protected by habitat protection and its numbers have increased beyond the danger point.* This point clarifies the third dot-point in the criteria for listing (above).

Policy Statement No. 33 also requires the Threatened Fauna Scientific Advisory Committee to prepare a "Reserve List" listing (among other categories) taxa that have recently been removed from the schedule of threatened fauna.

The Recovery Team considers that the woylie no longer meets the criteria for inclusion on the schedule of threatened fauna. It satisfies both requirements for removal from the schedule and should be placed on the Reserve List. The Recovery team recognises that the Policy will require the Executive Director to refer its recommendations (below) to the Threatened Fauna Scientific Advisory Committee for review.

3.4. Criteria under South Australian Legislation.

The South Australian National Parks and Wildlife Act requires assessment for declaration be in accordance with a species status within that State's borders, irrespective of its status elsewhere (unlike the WA and Commonwealth legislation). The Recovery Team has implemented a National Recovery Plan and its conclusions pertain to the global status of woylies. It is the prerogative of the South Australian Government to assess the status of the woylie within that State, but the Recovery Team draws its conclusions to the attention of the SA Government and would be pleased to see its status reviewed in South Australia.

3.5. Criteria under Commonwealth Legislation.

The Endangered Species Protection Act lists Endangered and Vulnerable native species on Schedule 1 Parts 1 and 2 respectively. It defines a species as endangered if -

- a) *it is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or*
- b) *its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction; or*
- c) *it might already be extinct, but is not presumed extinct.*

It defines a species as vulnerable if, *within the next 25 years, the species is likely to become endangered unless the circumstances and factors affecting its abundance, survival or evolutionary development cease to operate.*

In the areas it now inhabits the principal threat has been predation. That threat has been sufficiently controlled to allow substantial increases in population density as well as area of occupancy. Translocations have increased the number of populations and will continue to do so. The increases which will be sustainable as long as foxes are controlled mean that the woylie no longer meets criteria as Endangered or Vulnerable.

4. Recommendations.

1. We recommend to the Chief Executive Officers of CALM and ANCA and to ANZECC that our conclusions are conveyed to their Ministers together with a recommendation that *Bettongia penicillata* be downgraded:

- **under the Commonwealth Endangered Species Protection Act, by deletion from Schedule 1, "Listed Species".**
- **under the Western Australian Wildlife Conservation Act, removal from listing as "fauna which is likely to become extinct or which is rare" and addition to the Reserve List as defined by Policy Statement 33.**

And we recommend to the Chief Executive of SADENR that in South Australia its conservation status within the State be reviewed.

2. CALM and SADENR write or review monitoring and management programs to ensure that the management necessary to maintain woylies as Conservation Dependent species is implemented and effective. The plans should:

- **provide for further improvement in the conservation status of woylies and**
- **commit to action to address any significant decline detected by the monitoring programs.**

References.

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Appendix 1. Current membership of the Recovery Team.

Current membership of the Recovery Team is:

- Tony Start (CALM, Chair)
- David Armstrong (SADENR Scientist)
- Andrew Burbidge (CALM, Western Australian Threatened Species and Communities Unit)
- Sally Stephens (ANCA Endangered Species Unit)
- Brian Macmahon (CALM Wheatbelt Region)
- Bob Hagan (CALM Southern Forest Region)
- Kim Williams (CALM Central Forest Region)
- Keith Morris (CALM Science & Information)
- Graham Liddelow (CALM Science & Information, Manjimup)

Two other people have been regular contributors at meetings:

- Ray Nias (WWFA)
- Jackie Courtenay (Edith Cowan University)

Appendix 2. Summary from recovery plan.

Appendix 3. *IUCN Red List categories: Version 2.2.* 1994. Species Survival Commission of the IUCN. Gland, Switzerland.

**WOYLIE (*BETTONGIA PENICILLATA OGILBYI*):
A REVIEW OF ITS STATUS IN DECEMBER 1995.**

SUPPLEMENT: THE STATUS OF WOYLIES IN 1990.

**By A.N. Start, and A.A. Burbidge for the Woylie Recovery Team.
January 1996**

1. The Purpose of this review.

The Woylie Recovery Plan required the Recovery Team to "Review the conservation status of the woylie, using internationally accepted criteria, and recommend changes if necessary" at the conclusion of its program of recovery actions in December 1995 (Start et al. 1995a). That review was undertaken (Start et al. 1995b) using the criteria defined by the IUCN for classifying the conservation status of species (IUCN 1994). The Recovery Team found that the woylie did not qualify as **Threatened** but did qualify as **Lower Risk(Conservation Dependent)**. These categories are defined in Appendix 1. The Recovery Team made the following recommendations.

*1. We recommend to the Chief Executive Officers of CALM and ANCA and to ANZECC that our conclusions are conveyed to their Ministers together with a recommendation that *Bettongia penicillata* be downgraded:*

- *under the Commonwealth Endangered Species Protection Act, by deletion from Schedule 1, "Listed Species".*
- *under the Western Australian Wildlife Conservation Act, removal from listing as "fauna which is likely to become extinct or which is rare" and addition to the Reserve List as defined by Policy Statement 33.*

And we recommend to the Chief Executive Officer of SADENR that in South Australia its conservation status within the State be reviewed.

2. CALM and SADENR write or review monitoring and management programs to ensure that the management necessary to maintain woylies as Conservation Dependent species is implemented and effective. The plans should:

- *provide for further improvement in the conservation status of woylies and*
- *commit to action to address any significant decline detected by the monitoring programs.*

In addition to defining criteria for classification of species the IUCN document states *There are rules to govern the movement of taxa between categories. These are as follows: (A) A taxon may be moved from a category of higher threat to a category of lower threat if none of the criteria of the higher category has been met for 5 years or more --* (the other rules are not relevant here). In the woylie's case the subject has a short generation time and a rapid recovery rate when protected from adverse factors such as predation. New populations are readily established from translocated stock and woylies are now secure in conservation reserves where there is an on-going commitment to fox control (a key factor).

Furthermore there are commitments to on-going monitoring and State and Commonwealth legislation would require re-listing in a **Threatened** category if its status again declines. In

view of those factors and given that its status will be under review routinely through the monitoring program, the Recovery Team recommended re-classification immediately and not pending yet another review in five years time.

It must be understood that the IUCN recommendations were not published until 1994 and that they were not available five years ago for use in classifying woylies. Nevertheless we thought it would be useful to examine the status of woylies five years ago. We have used the current IUCN criteria to retrospectively assess the conservation status of the woylie as it would have been in 1990, i.e. five years before the Recovery Team recommended that the species be removed from the threatened species lists.

2. The Status of woylies in 1990 assessed by current International Criteria.

The IUCN Red List Categories Version 2.2 (IUCN 1994) details the criteria that are currently used to classify the conservation status of species. A copy was attached as Appendix 3 to the Recovery Team Review (Start *et al* 1995b). It uses five independent topics to allocate the conservation status of a species to one of the categories outlined in Appendix 1.

The species being assessed is allocated to the highest category determined by any one of five topics (A to E below). In the following analysis we assessed the woylie against the lowest of the **Threatened** classifications (**Vulnerable**). Had it met that classification we would have assessed it against the next (**Endangered**) etc. This was the method used by Start *et al.* (1995b)

A. Substantial past or projected future decreasing population trends.

For woylies to qualify as vulnerable there must have been a reduction in population size of at least 20% over the last 10 years or a projected reduction of that extent in the next 10 years. Table 1 summarises woylie status in 1980 compared with December 1990, five years prior to the review.

Table 1. *Bettongia penicillata* status in 1980 and in December 1990.

Location	Status in 1980	Status in December 1990
Batalling	Presumed Extinct	Re-introduced 1983. Small but established new population.
Dryandra	TS 0% in 1975. No data for 1980 ¹	TS variable but mean 16% in baited area in 1989. Data not available for December 1990.
Perup	TS 24.8% ²	TS variable eg. 39.5% in Dec 1989; 62% April 1990 ³
St. Peter Island	not naturally occurring	Introduced 1989; established new population
Tutanning	TS mean 2.7% (1984) ⁴	TS mean 21.5% 1989. (data not available for 1990)
Wedge Island	Not naturally occurring	Introduced 1983; well established new population

* TS = Trap success expressed as a percentage.

¹ None could be trapped though woylies must have been present in low numbers in 1975. Baiting commenced 1982 in a small part of Dryandra.

² Boyicup. The forest block at Perup monitored by Christensen 1974-1981. Data including cage traps (as in present monitoring program) and pre-baited funnel traps.

³ Yendicup. The forest block at Perup monitored by Burrows 1989-1994. Cage traps only.

⁴ No data available pre 1984 when fox baiting began.

Introduced populations on two additional small SA islands with carrying capacity of <50 animals were recognised by the Recovery Team to be too small to remain viable in the long-term. (One became extinct in early 1994.)

There is no evidence of a net deterioration in the size or number of populations between 1980 and 1990. Instead there were improvements in both factors. At Dryandra and Tutanning the increase in population density (as measured by trap success) had occurred since fox control measures were introduced and at Perup since habitat management and some fox control had been implemented. Although the improvement was not as dramatic as it has been in five years since 1990, the IUCN criterion of a reduction of at least 20% in the decade preceding 1990 clearly had not happened. As the prospect of recovery after 1990 improved with the endorsement of the first Recovery Plan (Hall *et al.* 1991) there were no grounds for anticipating a decline in the succeeding ten years. Indeed improvements in the last five years (as detailed in Start *et al.* 1995b) have vindicated the optimism for improvement after 1990.

Woylies would not have qualified as **Vulnerable** under this category in 1990.

B. Extent of occurrence and areas of occupancy (see IUCN 1994 for definitions).

To qualify as **Vulnerable** a species will have an extent of occurrence of less than 20,000 km² or area of occupancy of less than 2000 km² and furthermore meet two out of three additional criteria. In 1990 woylies had an extent of occurrence many times 20,000 km² extending from WA to SA. However the area of occupancy is difficult to determine in areas where populations were expanding in the shelter of fox control and so the additional requirements are considered.

(1) Populations are severely fragmented (no population is estimated to contain more than 1,000 mature individuals) or found at no more than ten locations. The Dryandra population is estimated at about 6,000 individuals (1994, Jackie Courtenay, unpublished data). Trap success rates in 1990 (mean = 16% in baited areas and half that in unbaited areas) suggest that in that year there were probably more than 1000 individuals. The Perup (including Kingston to Lake Muir) contains a much larger population which has persisted without regular fox control over much of the area. It too would have contained more than 1000 individuals.

(2) The species continues to decline in any of the following:

- a) **Extent of occurrence** but it had been extended from sw WA to SA.
- b) **Area of occupancy** but it had been increasing with introductions in WA and SA.
- c) **Area, extent or quality of habitat** but these were increasing/improving with expansion of fox control in WA and translocations to SA islands and Batalling in WA.
- d) **Number of locations or sub-populations** but these had increased in WA and SA.
- e) **Number of mature individuals.** Woylies breed in their first year. Therefore populations that had been increasing prior to 1990 would have contained increasing numbers of mature individuals in WA and SA.

(3) Extreme fluctuations in any of the following:

- a) **Extent of occurrence** but this was increasing with translocation to SA islands.
- b) **Area of occupancy** but it was stable or increasing, depending on site, in WA and SA.
- c) **Number of locations or sub-populations** but it had increased in WA and SA.

d) *Number of mature individuals* but this would have stabilised or increased, depending on site, in WA and SA.

Woylies did not meet any of the additional characters. Thus they would not have qualified as **Vulnerable** under this category in 1990.

C. Population size (for larger populations) and predicted decreasing trends.

For woylies to be assessed as **Vulnerable** this category requires that the total number of individuals is less than 10,000 **and either** there is a predicted continuing decline of at least 10% in 10 years **or** there is a continuing decline in the number of mature individuals or population structure (severe fragmentation or all mature animals in one sub-population).

Although it is not possible to estimate the total number of woylies in 1980 and 1990 it has been shown above that woylie populations had improved, not declined in the decade preceding 1990. Furthermore there was a good prospect over the decade from 1990 for increases in the number of mature individuals in populations and an associated expectation of improvement in the fragmented nature of habitat. These would be the outcomes of actions spelled out in the Recovery Plan. Progress since 1990 shows that these were realistic expectations.

Woylies did not meet either of the additional characters. Thus they would not have qualified as **Vulnerable** under this criterion in 1990.

D. Population size (of smaller populations) irrespective of population trends.

To qualify as **Vulnerable** this category requires the total population to be very small (<1,000 individuals) or the population to be acutely restricted in its area of occupancy (typically <100km² = 10,000 ha) or number of locations (typically <5).

Table 1 identifies six locations at which woylies were present in 1990. At Dryandra they occupied an area exceeding 12,000 ha and Perup comprises an area of 37,640 ha but it has since been found that woylies extended up to 25km west of Perup to Kingston Forest and 15 km south to near Lake Muir. Populations at Dryandra and Perup would have exceeded 1,000 individuals.

Woylies would not have been classified as **Vulnerable** under this category in 1990.

E. Quantitative analysis showing probability of extinction in specified time units or generations. To qualify as **Vulnerable** by this category a quantitative analysis must show a probability of extinction of at least 10% within 100 years. No analysis was undertaken for woylies in 1990. However by then the key factor (fox predation) in the decline of woylies in sw WA had been identified and successfully addressed and translocation had been shown to be an effective means of establishing new populations. The status of woylies had already improved and a recovery plan which built on the factors that had produced the improvements was being written. (It was endorsed and funded). The principal recovery actions were to be fox control and increasing the number of populations in WA and SA through translocation. Monitoring was also an essential component. Given these factors, a population viability analysis would be have been unlikely to show a significant probability of extinction

Thus, even though no quantitative analysis has been done, woylies would probably not have qualified as **Vulnerable** under this category in 1990.

3. Conclusion on the status of woylies as assessed by the IUCN criteria.

Woylies would not have qualified as **Vulnerable**, the least critical of the **Threatened** group of categories if assessed in 1990 by the currently accepted criteria (promulgated by the IUCN in 1994). They would have been classified as **Lower Risk (Conservation Dependent)**. Never the less they were much less secure than they are now. This is illustrated by comparison of Table I with Appendix 2 (Tables 3 and 4 from Start *et al.* 1995b).

We do not believe that the IUCN document intended a moratorium on re-classification for five years from publication of the criteria. Rather we believe that in adopting the new criteria, it is sensible to re-evaluate species by them and, if appropriate, adjust their conservation classification. In the case of woylies the species has met the criteria for **Lower Risk (Conservation Dependent)** for at least five years anyway and its status continues to improve.

We still firmly believe that the recommendations of the Recovery Team are sound in this case and that to postpone reclassification of woylies pending a further review in five years time is unnecessarily bureaucratic, is not the intention of the IUCN system, will debase the credibility of the classification **Threatened** when a species clearly no longer meets the criteria and will divert resources and attention from much more critically threatened species.

References.

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APPENDIX 1.

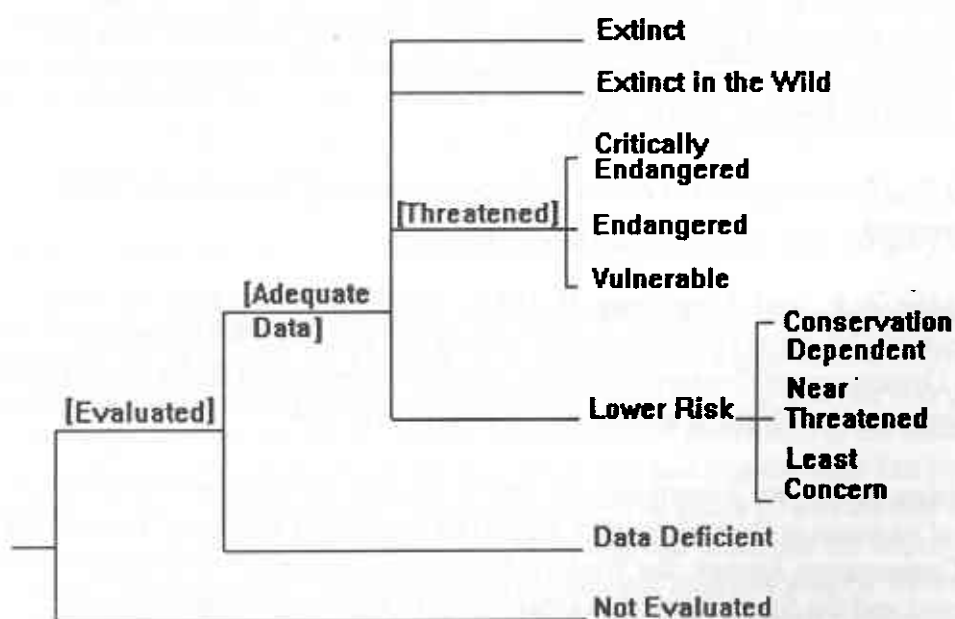
Definitions of the categories used in the current IUCN Red Lists

CATEGORY	SUMMARY EXPLANATION (see Appendix 3 for full detail.)
EX Extinct	No reasonable doubt the last one has died
EW Extinct in the wild	Survives but not wild in its natural range
CR Critically endangered	Extremely high risk of extinction in the wild in the immediate future
EN Endangered	Not CR but very high risk of extinction in near future
VU Vulnerable	Not EN but high risk of extinction in mid-term future
LR Lower Risk	None of the above nor DD but warrants monitoring
DD Data Deficient	Insufficient data to classify
NE Not Evaluated	Not yet assessed against the criteria

The category Lower Risk has three sub-categories. They are

SUB-CATEGORY	SUMMARY EXPLANATION (see Appendix 3 for full detail.)
cd conservation dependent	Cessation of management would result in qualification for a threatened category within 5 years.
nt near threatened	Not qualifying for cd but close to qualifying for VU.
lc least concern	Not qualifying for cd or nt.

The Structure of the IUCN categories (IUCN 1994)



APPENDIX 2.

Table 3. Comparison of *Bettongia penicillata* status 20 years ago with the present. (from Start et al. 1995b).

State	Location	area(ha)	Past Status (<21 yrs)	Status now
WA	Batalling	3,617	Presumed Extinct	Re-introduced 1983. TS 24% (July 1995)
WA	Boyagin	4,781	Presumed extinct.	Re-introduced 1992. TS 47% (Oct 1995)
WA	Dryandra	12,192	TS <1% (1975)	TS variable but consistently >50%
WA	Julimar	24,117	Presumed extinct	Re-introduced 1995; established
WA	Perup	37,640	3-10% (1974) ⁵	TS 35% (Feb 1994) ⁶
SA	St. Peter Island	3,493	not naturally occurring	Introduced 1989; TS 53% (March 1995)
WA	Tutanning	2,369	TS 0% -6% (1984)	TS 13% (July 1995)
SA	Venus Bay	1,600	Presumed extinct	Re-Introduced 1994. Established
SA	Wedge Island	947	Not naturally occurring	Introduced 1983; TS 77% (June 1995)
SA	Yookamurra	1,100	Presumed extinct	Re-introduced 1991. Established.

* TS = Trap success expressed as a percentage.

Table 4. Area, trap success and notes on six sites recognised as key sites by the Recovery Team in Western Australia. (from Start et al. 1995b).

Site	Trap	Area (ha)	Notes
Batalling	24%	3,617	33,565 ha now baited. Woylie density varies as they spread from the original Batalling site.
Boyagin	47%	4,781	Data from West Boyagin but woylies are present in both Blocks of this reserve.
Dryandra	>50%	12,192	Population estimated about 6000 woylies. This has been the source of animals sent to SA
Julimar	New	24,117	Approx. 16,000 ha of additional, contiguous, fox-baited forest on Commonwealth land to the north.
Perup	35%	37,640	Excludes areas outside proposed Perup NR, Eg. Kingston and Lake Muir where there are woylies.
Tutanning	13%	2,369	69 of 150 traps caught other species and were at least partially unavailable to woylies.

⁵Boycup. The forest block at Perup monitored by Christensen 1974-1981. Data including cage traps (as in present monitoring program) and pre-baited funnel traps.

⁶Yendicup. The forest block at Perup monitored by Burrows 1989-1994. Cage traps only.