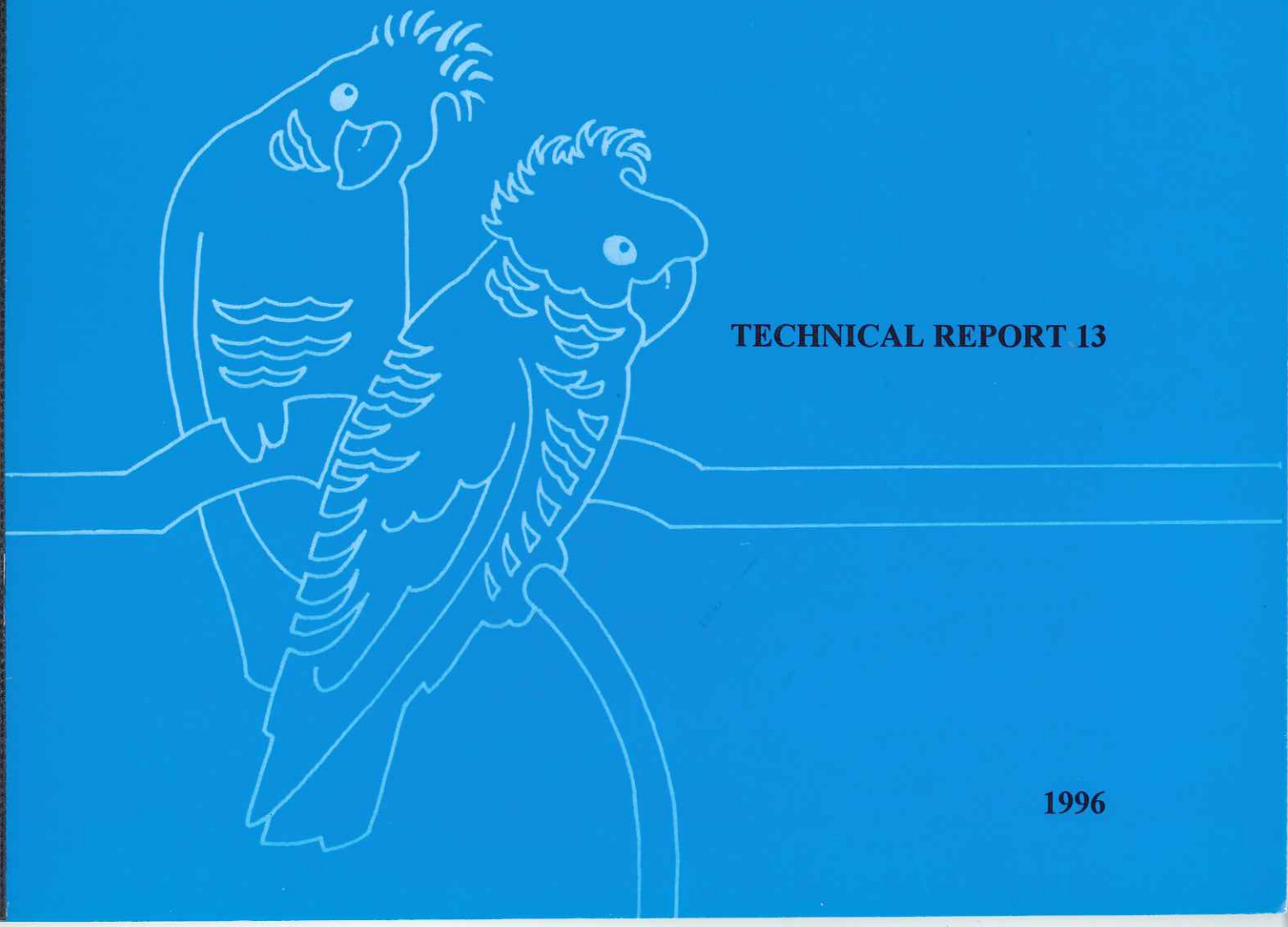
ACT PARKS and CONSERVATION SERVICE

STATUS OF THE BRUSH-TAILED ROCK-WALLABY *PETROGALE PENICILLATA* IN THE AUSTRALIAN CAPITAL TERRITORY

Peter Ormay



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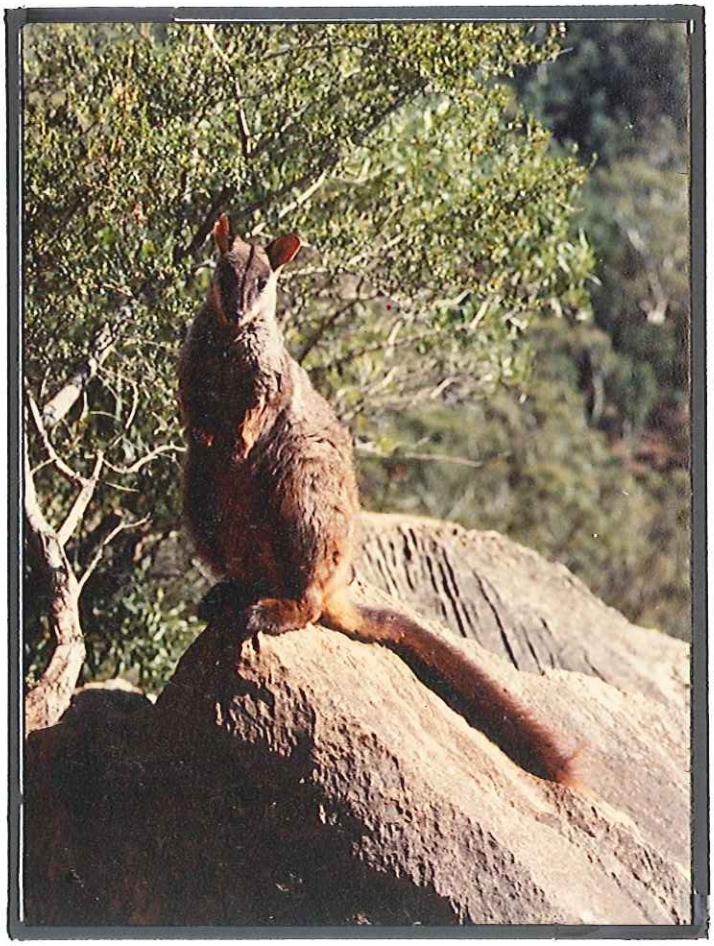

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The photo under acknowledgements was taken at Jenolan Caves in the enclosure by the author

STATUS OF THE BRUSH-TAILED ROCK-WALLABY *PETROGALE PENICILLATA* IN THE AUSTRALIAN CAPITAL TERRITORY

ABSTRACT

During 1982, 1985 and 1994 the southern ACT was searched for brush-tailed rock-wallabies. No evidence of their present existence was found although remains of brush-tailed rock-wallabies were found at five sites. The last record of a rock wallaby seen in the ACT was in 1959 in the present Tidbinbilla Nature Reserve. Evidence from research in other areas of Australia indicates that fox predation was the main cause for the demise of rock-wallabies and this predation probably occurred in the ACT also. It is therefore not considered feasible to reintroduce brush-tailed rock-wallabies into the wild in the ACT while foxes continue to exist in numbers which threaten their survival.

1.0 INTRODUCTION

The discovery of recent remains of brush-tailed rock-wallabies before 1982 and in early 1982 at two locations in the ACT by CSIRO Division of Wildlife staff (M. Braysher pers.comm.) led to this survey of the status of the species in the ACT. The objective of the study was to determine if brush-tailed rock-wallabies, *Petrogale penicillata,* still occur in the ACT, to locate sites formerly inhabitated by them and to assess the suitability of those sites for their possible reintroduction.

2.0 BIOLOGY

2.1 Distribution and status

The brush-tailed rock-wallaby is a small macropod with an average body weight of 7.2kg for males and 5.2kg for females (see appendix 1). It is found throughout a broad but disjointed range in eastern Australia (Figure 1), from Nanango in southern Queensland through eastern NSW and the ACT to Buchan and the Grampian Ranges in Victoria (Maynes and Sharman in Strahan, 1983).

Brush-tailed rock-wallabies are locally common throughout the central and northern part of their range. Some of the present known colonies are at the Upper Richmond River, Upper Clarence River, Mount Kaputar National Park, Goulburn River (Upper Hunter River) and Widden Brook (Upper Hunter River) (Short, 1982). They are in serious decline at Jenolan Caves, Kangaroo Valley, Snowy River (50 km N. of Buchan) (Norris and Belcher 1986) and the Grampians in Western Victoria (Australian Biological Research Group Pty. Ltd. 1986) and appear to be extinct in the Bungonia Gorge area (Short and Milkovits, 1990, Wong, 1993). The nearest colonies to the ACT are at Yalwal 100 km to the ENE (Wong 1993) and near Mt. Cobberas No. 1 in the Suggan Buggan area of Victoria 140 km to the SSW (Norris and Belcher,1986) (Figure 2).

Outside Australia there are introduced populations on Motutapu Island, Kawau Island and Rangitoto Island in New Zealand (Batchelor, 1980) and Oahu Island Hawaii (Lazell, *et al* 1986). The origin of the Kawau Island population is unknown. Their chromosomes do not match those of any existing Australian population (R. Close, pers. comm.).

Brush-tailed rock-wallabies are listed as nationally "vulnerable" and as "threatened" in NSW (National Parks and Wildlife Act 1974) because they are locally extinct in many areas of their former range on the western slopes and plains and on the southern tablelands (Short 1989). In the Snowy River area (Butchers Hill to Suggan Buggan, east Gippsland Victoria and just north

of the border in NSW) they have disappeared from 17 of the 22 known sites since 1954 (Norris and Belcher, 1986; Wakefield 1971).

Marlow (1958) mapped two locations in the ACT for brush-tailed rock-wallabies but did not mention the sites in his text and the basis for these records is unknown. No bones or skin could be found in any museum nor reference located in any field notebook to support his records (J. Calaby, pers. comm. 1991).

A nomination for the brush-tailed rock-wallaby was submitted to the ACT Flora and Fauna Committee in January 1996 to consider declaring it as "endangered".

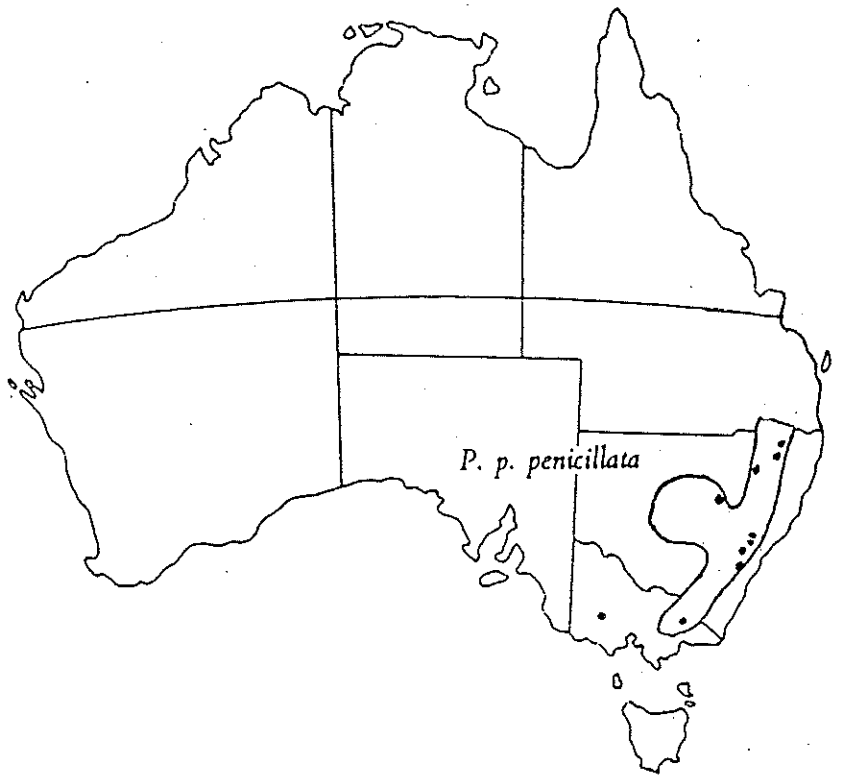

Figure 1. The range and known colonies of brush-tailed rock-wallabies *Petrogale penicillata* (last 20 years) (After Strahan 1983).

2.2 Behaviour and habitat

Lim (in Lim *et al.*, 1981) noted that rock-wallabies exist as individuals or mother-young pairs, rather than as integrated social groups, while Joblin (1983) found that in northern New South Wales females defended a refuge site from other females and once the young is too big to be carried in the pouch the mother leaves it in her rock shelter. The availability of such a shelter was linked to successful breeding (Joblin 1983).

In the Goulburn River area of NSW, Short (in Lim *et al.*, 1981) found that a male and three females had overlapping home ranges of approximately 15ha each. On Motutapu Island, New Zealand the mean home range was considerably smaller at 0.58 ha with a maximum distance of 624 m from the den. The difference in range may be attributed to the differece in climate. Motutapu Island, located 3 km east of Auckland (latitude 36 degrees 47 minutes south) has a relatively lush temperate coastal climate with a regular rainfall while the Goulburn River area, on the central tablelands of NSW (latitude 32 degrees 20 minutes south) has a much drier

climate and is subject to occasional droughts. Brush-tailed rock-wallabies compete with sheep for pasture on Motutapu Island but the competition (from the graziers' point of view) is not regarded as serious. However, regular shooting is carried out because of the erosion they cause on coastal cliffs by digging dens under living pohutakawa trees (Batchelor 1980).

The feeding range of brush-tailed rock-wallabies in the ACT was probably similar to those in the Goulburn River area. Brush-tailed rock-wallabies living in the early 1950s at Gibraltar Rocks in the present Tidbinbilla Nature Reserve would have been in contact with sheep as Gibraltar Rocks were within 50 m of partially cleared land and within 400 m of almost completely cleared land (from 1944 and 1968 airphotos viewed). At Wallaby Rocks they were surrounded by cleared land and would have been in contact with sheep.

Rock-wallabies are found in a wide range of habitats, including rainforest and semi-arid country. However, in south-eastern Australia the species is now mainly restricted to areas where there are suitable rocky outcrops and cliffs (Short, 1982). Preferred sites have a larger number of caves, sheltered ledges and steep access routes, usually via "chimneys" from cliff tops.

"Chimneys" are vertical openings in rocks with two, three or four walls 0.5 to one metre apart. Rock-wallabies go up or down chimneys by bounding zig-zag fashion between opposite walls. Occupied cliffs or outcrops invariably have a northerly aspect and receive sun for much of the day (Short, 1982).

Short (1980) found that by day brush-tailed rock-wallabies shelter on north facing cliff faces, emerging in the evening and at night to feed below and along the rocky ridges.

Le Souef and Burrell (1926) referring to rock-wallabies generally said that "unless thoroughly alarmed the wallabies' sense of self-preservation is not high. If in a cave where it cannot see the intruder it allows a close approach, and so can easily be shot or even taken by hand. Owing to this fact, and the depredations of the fox the eastern species (the brush-tailed rock-wallaby) is scarce where it was once very numerous". They also mentioned that "when hotly pursued the rock-wallaby will make for the tree at top speed, and without hesitation spring as high as possible up the trunk, then finally gain a fork or a large limb."

According to Bill Cotter an old time resident of the Michelago who had a run around Horse Gully Hut, rock-wallabies were quiet, inquisitive animals that were easily caught when they came to investigate a smokey fire lit for the purpose (G. Hirth, pers. comm.). Wakefield (1954) also stated that they had an inquisitive nature and could often be seen peering down from rock ledges if one intruded into their haunts.

It appears that brush-tailed rock-wallabies' willingness to leap into a tree when hotly persued, their reluctance to leave their rock shelter once chased into it, and their inquisitive nature would have made them vulnerable to shooting.

3.0 METHODS

A survey of suitable habitat for rock-wallabies in the ACT was undertaken by the author during 1982, 1985 and 1994. Familiarisation with the species and its habitat was gained by observing a colony at Jenolan Caves in NSW. There the rock-wallabies polish and stain rock surfaces and deposit large amounts of distinctively shaped dung (Plate 1) in and around occupied caves and rock shelters. A rock-wallaby skeleton was brought back for comparison with bones found locally. Skulls held in the Australian National Wildlife Collection at the CSIRO Division of Wildlife and Ecology were inspected. Legoland, an ACT site on Orroral Ridge known to have supported brush-tailed rock-wallabies, was then visited to familiarise the author with former known local habitat, and bones and old droppings were collected.

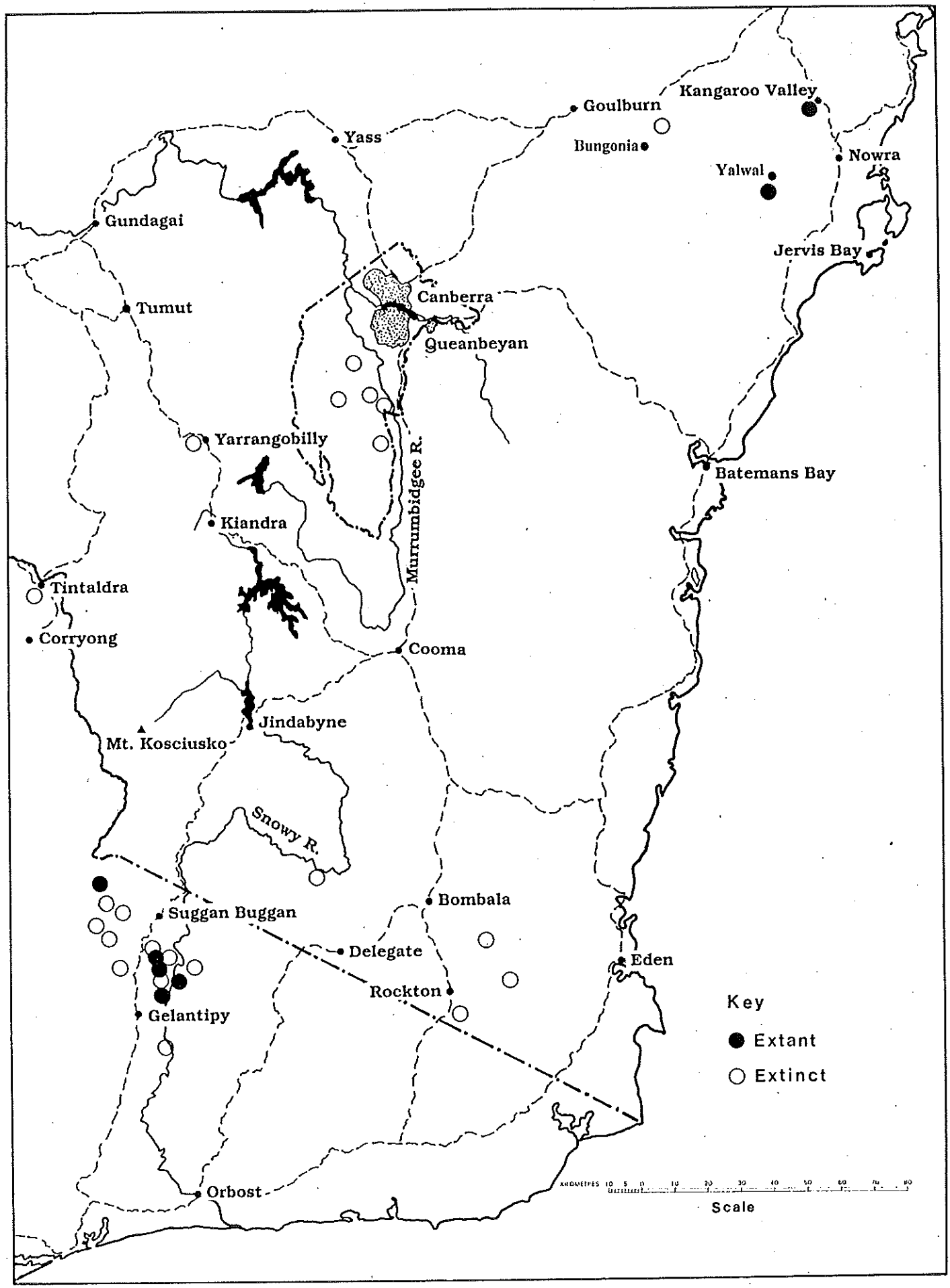

Figure 2 STATUS OF ROCK-WALLABIES IN S.E. AUSTRALIA

Long-time ACT residents who had seen rock-wallabies in the ACT years ago and people who were believed to have made recent sightings were interviewed and their recollections are included in appendix 2.

Airphotos of the areas of these sightings and adjacent hills were examined first using a mirror stereoscope. Likely looking cliffs and rock stacks located on the airphotos were then visited on foot. Airphotos of the rest of the ACT from where there were no anecdotal reports of rock-wallaby sightings were similarly examined next and all likely looking sites visited. Areas where no likely looking rock stacks or cliffs were found on airphotos but where long-time residents had reported seeing rock-wallabies were also searched on foot.

Caves containing rock-wallaby bones and/or lots of the typically shaped droppings on ledges or in nooks and crannies around them were recorded as formerly occupied sites. Appendix 3 lists sites searched for signs of rock-wallabies.

The weights of rock-wallabies, wallaroos, kangaroos, some other macropods, foxes and cats were gleaned from Strahan, (1988) and other sources for a better understanding of their relative sizes and are included in Appendix 1.

4.0 RESULTS

4.1 Formerly occupied sites

Eddie Green who grew up in the present Tidbinbilla Nature Reserve and knew rock-wallabies well from his childhood, remembers seeing them at Wallaby Rocks as he was building the track up past Wallaby Rocks to Gibraltar Gap in 1959 (E. Green pers. comm.). No recent sign of brush-tailed rock-wallabies was found during the survey. However an unconfirmed sighting of a brush-tailed rock-wallaby was made by Connolly (1995) near Honeysuckle Creek.

New sites that were formerly occupied by rock-wallabies were found at Honeysuckle Crag and Gibraltar Rocks. Less suitable sites, with minor caves or rock shelters and some old droppings but not copious amounts, were found at two sites near Mt McKeahnie, on an unnamed hill between Booroomba Station and Booroomba Rocks and on an unnamed hill between Bushfold Flats and Booroomba Rocks. For grid references and other site data see Appendix 3.

The cliffs and rocky slopes north and west of Tidbinbilla Mountain were not thoroughly searched as the area was known to contain lots of goats and no rock-wallabies had ever been reported from the vicinity.

Rock-wallabies used to range far and wide, well away from the rock stacks and ledges that were their permanent homes. This view was supported by Wakefield (1961) and a skull collected from the Kambah Pool area 8 km NE of Gibraltar Rocks held in the Australian National Wildlife Collection at the CSIRO Division of Wildlife and Ecology. They were regularly seen on the lower slopes of Mount Tennent, near Glencoe, Wallaby Rocks at Tidbinbilla Nature Reserve and on the northern part of the Clear Range as indicated by anecdotal records.

The Clear Range is over 33 km long and although airphotos were extensively searched no likely looking cliffs or rock stacks could be found. However because of several anecdotal reports of rock-wallabies on the Clear Range many of these unlikely looking sites were searched on the ground. These were on the northern, central as well as the southern end of the range and comprised mainly of exposed bedrock with only small surface rocks and no protected caves or shelters. No structure resembling Legoland or Gibraltar Rocks was found on the Clear Range.

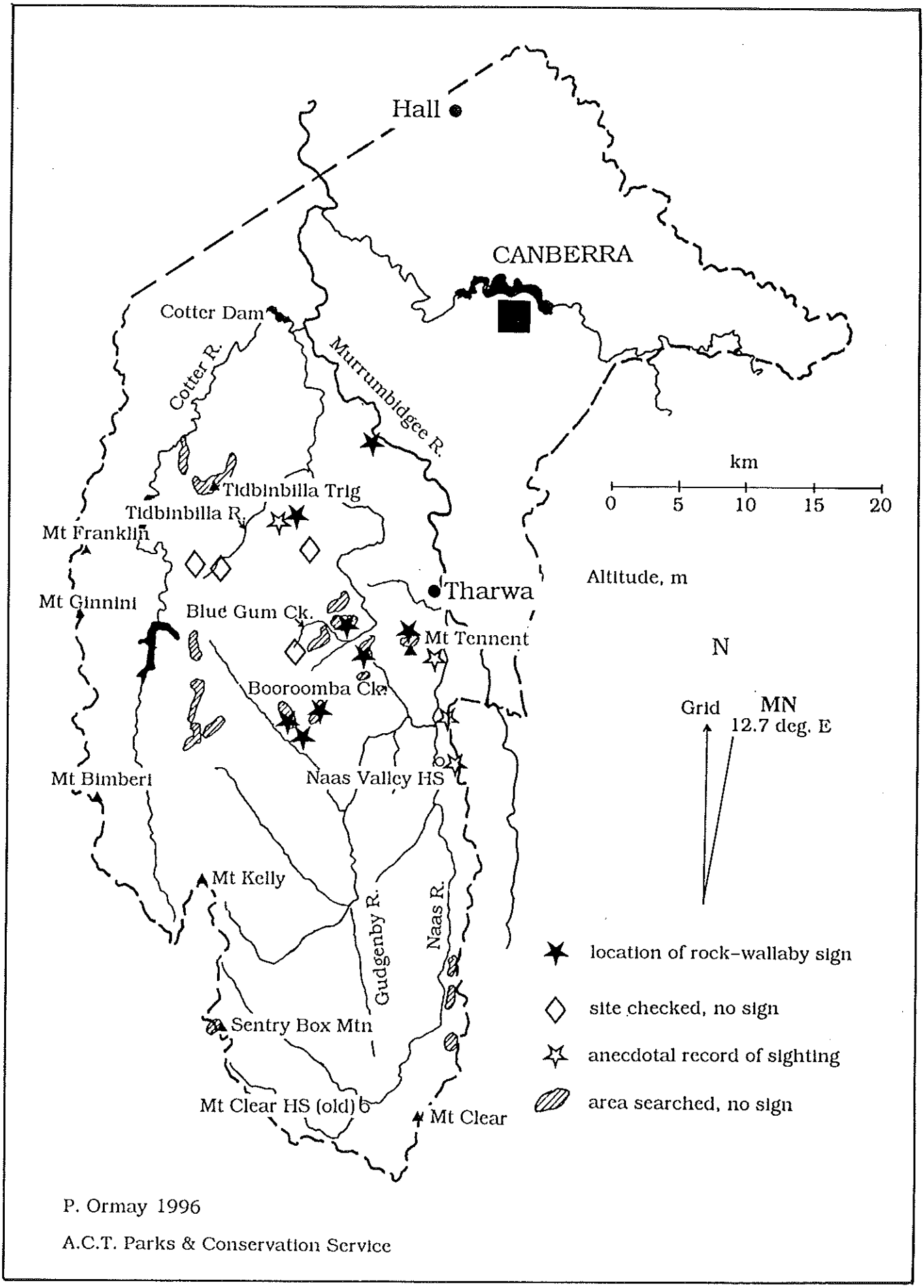

Figure 3. EVIDENCE OF FORMER ROCK-WALLABY PRESENCE A.C.T.

4.2 Suitability of sites

Dr Jeff Short in a personal communication said that none of the sites he has seen in the ACT is good rock-wallaby habitat. The sites do not offer the same protection from predators as those in New South Wales, where rock wallabies are extant. Of the ACT sites with which he was familiar, he considered none to be good habitat for rock-wallabies, however the Legoland site (White Witch) scored higher than The Belfry.

Gibraltar Rocks is a much bigger rocky outcrop with more extensive caves and ledges than either of the above sites and appears to be a better site. However none of the caves or ledges in Gibraltar Rocks would offer protection from foxes. Ann Connolly (1995), who applied a mathematical formula to the measurements of some sites in the ACT formerly occupied by rock-wallabies and some extant NSW sites, found that although sites posses common attributes, the accessible nature of the majority of ledges and caves at ACT sites to predators makes them unsuitable for use by rock-wallabies.

It appears that over the years since the introduction of the fox and the cat and other environmental changes such as land clearing, the range of the brush-tailed rock-wallaby in south eastern Australia has contracted to cliffs, caves and ledges where it is safe from these predators (Short, 1982). No such predator safe habitat was found during in the ACT in this survey.

Plate 1 Droppings of *P. penicillata* from Honeysuckle Crags near the Honeysuckle Creek Tracking Station site, Namadgi National Park, A.C.T.

4.3 Bones and droppings

A tooth row, bones and droppings were found at the White Witch in Legoland, a complete skeleton and droppings were found at the Belfry and droppings at Tower Rocks and Mushroom Rocks (all on the Orroral Ridge) prior to the survey documented in this report (Jeff Short pers. comm.). A skull, was also collected prior to this survey from the west side of the Murrumbidgee River at Kambah Pool.

Two skulls and other bones from at least six skeletons from Gibraltar Rocks in Tidbinbilla Nature Reserve found in this survey were positively identified as brush-tailed rock-wallabies. It is not possible to date such recent remains (John Calaby, pers. comm.). Old droppings were found at four other sites during this survey (Appendix 1) but were not positively identified. Positive identification can be done using hair found in the droppings. Rock-wallaby droppings can be confused with those of the wallaroo *Macropus robustus*. However copious amounts of droppings or droppings on ledges or in crevices around ledges in caves protected from the elements as found at the White Witch, the Belfry, Honeysuckle Crag and Gibraltar Rocks is conclusive. At that time there were copious amounts of droppings in a cave adjacent to a climb called the White Witch. Behind one ledge there would have been enough to have filled five 9 litre buckets. On a visit in July 1994 those droppings had fallen through a hole to exposed rocks 5m below but some could still be found behind other ledges. The earlier presence of brush-tailed rock-wallabies at the Belfry and Gibraltar Rocks is supported by bone remains that were positively identified as those of rock-wallabies.

Connolly (1995) reported collection of a fresh macropod dropping where she had observed a small macropod about 1km SW of the former Honeysuckle Creek Tracking Station. The dropping contained a hair that was identified by Barbara Triggs as 99% certain to be rock-wallaby. The location is within 2km of the White Witch, the Belfry and Honeysuckle Crag where some very old rock-wallaby droppings were found earlier.

Plate 2. Skull of *P. penicillata* from Jenolan Caves in the Australian National Wildlife Collection at the CSIRO Division of Wildlife and Ecology Gungahlin.

Graham Todkill an employee at Namadgi National Park found some old rock-wallaby droppings in early 1995 (confirmed by B. Triggs) on the north side of Mt Tennent (T. MacDonald, Ranger pers. comm.).

4.4 Anecdotal records

Granville Crawford's grandmother who grew up at "Ingledene" (Grid 896 606) used to walk to school to Naas with other children ca 1880 and got into trouble repeatedly for being late after chasing rock-wallabies (G.Crawford, pers. comm.). The children would have headed south from "Ingledene" and crossed the Clear Range at Grid 882 588 where they probably encountered the rock-wallabies 1.5km south-west of "The Angle". The "Naas School" was located (approximate Grid 860 582) about 200m east of the bridge and present flying fox over the Gudgenby River near "Naas" homestead (Laurie Tong, pers. comm.).

According to Ted Tong (Laurie Tong's father) rock-wallabies used to hop up into a couple of huge apple box trees *Eucalyptus bridgesiana* to hide at Champagne Flats (Grid 872 635) at the foot of Mount Tennent, when they could hear the cart approaching. "You could see their tails hanging down like bell ropes which would give them away" (G.Crawford, pers. comm.).

The last time and place Laurie Tong remembers seeing rock-wallabies (there were nine of them) was in 1953 on the west slope of the Clear Range (Grid 884 552) on the hillside 1.5 km east of "Naas Valley" house. He used to ride down a spur there and would clap his hands to startle them. They used to feed on the north side of the spur (Grid 884 553) and when disturbed would head south across the spur to the shelter of some rocks just east of the junction of two creeks (Grid 884 551). The rock-wallaby population declined rapidly in the late 1950s after myxomatosis went through the area (L.Tong, pers. comm.).

Interestingly, neither the ACT Bush Fire Council Annual Report 1985-86 with an historical section from 1939-86, nor ANU Forestry (1973) indicate any fires in the area in the 1950s.

"Wallaby Rocks" at Tidbinbilla Nature Reserve, were named by his grandfather after the rock-wallabies that frequented them (E. Green, pers. comm.). They are located 300m upslope SSE from the residence on the Gibraltar Fire Trail (Grid 753 744). An Aboriginal painting of a wallaby is located in these rocks (Bulbeck and Boot, 1991) but is now unrecognisable.

Granville Crawford, who grew up at "Glencoe" recalled seeing a hole in the ground near a gorge just east of the house (approximate Grid 883 531) in the early 1950's where a large pitfall trap had been years before. His grandfather told him the trap had a cantilevered lid and used to catch kangaroos, euros and wallabies. "It used to operate constantly and fill up sometimes so that no more could fall in" (G. Crawford, pers. comm.). The site was visited during the survey and the hillsides and gullies searched but no suitable cliffs or caves nor any evidence of a pitfall trap was found. No rock-wallabies had been seen there for over 45 years even though Glencoe Homestead had been occupied continuously during that time. (See also Appendix 2).

5.0 DISCUSSION

5.1 General

Results indicate that rock-wallabies once occurred on rocky outcrops, hills, ridges and cliffs in the ACT on the Clear Range, Mt. McKeahnie area, Orroral Ridge (on the north side of Orroral Valley), Booroomba Rocks to Mt. Tennent area and Gibraltar Rocks in the present Tidbinbilla Nature Reserve.

Legoland and Gibraltar Rocks where bones and/or copious amounts of rock-wallaby droppings were found, have caves and ledges that are considered by the author to be the best

sites in the ACT. Access to them however, is not protected by steep routes or chimneys and they are accessible to foxes. Connolly (1995) also found that the majority of ledges and caves at formerly occupied sites in the ACT are accessible. The author, who is not a rock climber, managed to climb into them without risking life and limb. Neither Le Souef and Burrell (1926), nor Short (1982), would have identified such easily accessible sites as suitable for rock-wallabies. John Calaby, (pers. comm.) considered the ACT as marginal habitat for rock-wallabies.

The occurrence in the early years of this century of rock-wallabies at "Champagne Flats", a grassy area without rocky outcrops, on the lower slopes of Mount Tennent about 1.5km north of "Ioma" and as far as the Kambah Pool area, indicate a very healthy population was formerly present with surplus individuals spread widely in less suitable sites. None of these locations was identified as suitable habitat to be visited during this survey. This view was supported by Wakefield (1961) when he wrote: "these animals used to range widely, well away from any cliff system, through the undulating lightly forested parts of the Murrindal district". He was referring to the numerous bones of brush-tailed rock-wallabies found in a sink hole a considerable distance from what he considered suitable habitat.

Wallaby Rocks in the present Tidbinbilla Nature Reserve is a small rocky outcrop that would offer little protection from predators. It may have been inhabited by surplus rock-wallabies originating from Gibraltar Rocks 1.4 km to the east.

5.2 Goats

Goats were mentioned as possible competitors of brush-tailed rock-wallabies for food and shelter (Wakefield 1971 and Short 1989) as they sometimes occur in the same habitat. Dawson and Ellis (1979) found considerable overlap between the diet of the yellow-footed rock-wallabies *Petrogale xanthopus* and goats. No similar study appears to have been carried out for the brush-tailed rock-wallaby, but it is reasonable to assume that an overlap in food preference would occur and that a severe infestation of goats could a have detrimental effect on rock-wallabies. A high goat population could also force rock-wallabies further away from their safe shelters to feed and expose them to more predation.

In the ACT goats appear to be localised on the Clear Range, Booth Range and Billy Range (B. Terrill and R. Watchorn, pers. comm.). Another population in the Tidbinbilla Mountain to Camels Hump area appears to have been successfully eradicated during the 1970s and early 1980s (R. Watchorn and P. Hann, pers. comm.). Small numbers of goats also occurred on the lower south-west slopes of Mt Tennent but were shot out years ago (H. Read pers. comm.) and three lived around Gibraltar Rocks at Tidbinbilla from 1945 to 1960 (E. Green pers. comm.).

The Clear Range is over 33 km long, but goats were not seen over the northern end where the rock-wallabies were seen up to the early 1950's (L.Tong, pers. comm.). The three goats at Gibraltar Rocks were only seen down as far as Wallaby Rocks once or twice from 1945 to 1960 while the rock-wallabies were down there all the time (E. Green, pers. comm.). Goats are not known to have ever occurred on the Orroral Ridge (B. Terrill, pers. comm.) where most of the physical evidence of the former occurrence of rock-wallabies was found.

It is concluded that it is likely that competition between goats and brush-tailed rock-wallabies in the ACT is of minor importance in the decline of rock-wallabies.

5.3 Cats

Dietary studies of cats from south-eastern Australia do not indicate that cats are predators of even small macropods in that area (Coman and Brunner, 1973; Jones and Coman, 1981; Triggs *et al.* 1984). Thus while cats may be a very occasional opportunistic predator of small

macropods, significant impact on macropod populations is probably confined to special situations, for example being confined to an island with a very limited number of prey (the spectacled hare-wallaby, *Lagorchestes conspicillatus* on the Monte Bello Islands, Burbidge, 1983; Burbidge and Johnson, 1983 in Robertshaw and Harden 1989) or small isolated populations on the mainland.

Spencer, (1991) documented a case of predation by a single feral cat on an isolated colony of rock-wallabies, *Petrogale assimilis,* at "Black Rock" in tropical North Queensland, 240 km NW of Townsville. The colony was the subject of a four-year behaviour and feeding ecology study and dwindled from a minimum of 83 adults to 26 adults between July 1986 and June 1990. During that time eighteen sightings were made of a cat, and a cat was disturbed eating a juvenile rock-wallaby on two occasions. Six other partly eaten rock-wallaby carcasses (three juvenile, one sub adult and two 4 kg adult males) also were found. From the pattern in which the carcasses were consumed, it appeared as if they were all the victim of the same cat. One wallaby ear tag was identified in a cat scat. The cat was not caught and marked so could not be identified positively. There was a prolonged drought in the area during the time and the decline of the population may have been a combined effect of predation and drought (Spencer, 1991).

5.4 **Foxes**

Predation by foxes is most often cited as the reason for the decline of rock-wallabies (Le Souef and Burrell, 1926; Wakefield, 1954; Short, 1982; Kinnear *et al.*, 1984 and Eric Rolls, 1964). Rolls (1964) stated that "The fox is an excellent climber. The rock-wallaby's only protection is the inaccessibility of the cave he lives in: Once chased to his cave he will not leave it. The fox merely climbs down and takes him there with ease".

Foxes are well known to kill prey up to their own weight in size (ANPWS, 1991). Their average weight is 6.4 kg. Batchelor (1988) found that the average weight of female brush-tailed rock-wallabies on Motutapu Island was 5.2 kg with a minimum weight of 3.75 kg. Young rock-wallabies are well within the prey size for foxes and newly emerged young would be even more vulnerable. Kinnear *et al.*, (1988) found that in at least two of their five study sites predation by foxes was directed at juvenile rock-wallabies.

Foxes are excellent climbers, well able to follow rock-wallabies into their retreats where they were safe from their natural predators such as dingoes and wedge-tailed eagles.

In Western Australia the fox, though suspected of causing rarity and extinction for a long time, was demonstrated finally through poisoning campaigns to be critical for the survival of remnant populations of rock-wallaby, (species not mentioned but probably *Petrogale lateralis lateralis,* Newsome, unpublished workshop notes). The most indicting evidence against foxes comes from work on Depuch Island off North West WA near Dampier (Kinnear *et al.*, 1984). In 1962, Dr Ride, former director of the Western Australian Museum, found the numbers of black-footed rock-wallabies *(Petrogale lateralis lateralis)* to be numerous and plenty of fox tracks and fox droppings containing fur and bone fragments. He commented "it seems that foxes have not been successful in reducing the rock-wallaby population to a low level." Twenty years later Kinnear *et al.*,(1984) visited the island and found the rock-wallabies had gone. The foxes were still there, foraging in the intertidal zone.

A four year controlled experiment was carried out from 1983 to 1986 inclusive in the central wheatbelt of Western Australia involving five colonies of the black-footed rock-wallaby. In this experiment three colonies were left untreated to "control the experiment" while the other two were repeatedly poisoned for foxes. Two of the control colonies declined by 14 per cent and 85 per cent. The latter had only one rock-wallaby left. The third control colony increased by 29 per cent. The two colonies subjected to fox control increased by 138 per cent and 223 per cent (Kinnear *et al.*, 1988) indicating that fox control is essential for the continued survival of the rock-wallabies there.

The brush-tailed rock-wallaby population in the two hectare enclosure at Jenolan Caves increased from around 40 individuals in 1982 to 80+ in 1988 and included some very old animals (P. Cully, pers. comm.). They were all released in 1988 but the population dwindled away due to predation by foxes, cats and possibly Powerfull Owls on the young rock-wallabies as was indicated by pieces of skin and other remains found. The adults appeared safe but young about two to three weeks out of the pouch were vulnerable. Some animals have been placed back into the enclosure in case the local free living population became extinct and there were 13 in the enclosure in November 1996 (P. Cully, pers. comm.).

Considering the average feeding range of brush-tailed rock-wallabies is about 15 ha they would have to come out of their protected caves and ledges to feed. This would expose them regularly to predation. In times of drought they would have to venture further particularly if the paucity of food is compounded by competition by goats, sheep and/or rabbits making the rock-wallaby more vulnerable to predation.

The survival of rock-wallabies at Wallaby Rocks in the present Tidbinbilla Nature Reserve until 1959 may have been indirectly due to the predator control efforts of graziers to protect their sheep from fox predation (E. Green, pers. comm.).

5.5 **Myxomatosis**

Rabbits, *Oryctolagus cuniculus,* were introduced into Australia in 1858 and spread rapidly. By 1880 their threat to agriculture was realised and thousands of kilometers of rabbit-proof fences were erected to try and stop their spread but by 1890 the rabbit population in the southern half of southeastern Australia was out of control.

In 1950 myxomatosis was successfully released into the rabbit population in the Murray Valley and spread along the river systems of eastern Australia to cover large areas of New South Wales and Queensland by the autumn of 1951. By 1954 the distribution of myxomatosis was coextensive with the distribution of rabbits (Walton and Richardson, 1988). The spread of myxomatosis coincided with the disappearance of the rock-wallabies from the Clear Range.

Laurie Tong in a personal communication suggested that foxes eliminated the rock-wallabies from the Clear Range when myxomatosis wiped most of the rabbits out. It is quite likely that increased predation pressure by foxes, when most of the rabbits died, tolled the death knell of the rock-wallabies in areas where they were not protected by suitable habitat as described by Short (1982).

5.6 **Diseases**

Diseases are sometimes quoted as being a causal factor in the demise of wildlife populations. Diseases do not seem to be a problem with the captive brush-tailed rock-wallaby population at Jenolan Caves at low densities (P. Cully, pers. comm.) however in Victoria some problems have been experienced with diseases at very high densities of captive rock-wallabies (D.Middleton, pers. comm.).

Toxoplasmosis is a disease that causes blindness due to corneal opacity and has occasionally afflicted free-living and captive swamp wallabies, *Wallabia bicolor,* and red-necked wallabies, *Macropus rufogriseus,* in Tidbinbilla Nature Reserve. The disease has not been experienced in the captive rock-wallabies at TNR (N. Record, pers. comm.) and is considered unlikely to have contributed to the demise of the rock-wallabies in the ACT.

It is considered that diseases are unlikely to have been a causal factor in the widespread disappearance of rock-wallabies from large areas of south-eastern Australia.

5.7 Fires

Rock-wallaby behaviour during a severe bushfire is unknown. Retreating into their rock or cave shelters as they do in response to a human threat may also have survival value in the case of fire. Most of the caves and rock shelters where evidence of rock-wallabies was found, had very little combustible material in them and would not support a fire. Rock-wallabies are likely to have survived in there under most conditions, however under extreme fire conditions with a hot wind fanning a fire, hot air and thick smoke would penetrate into some of these shelters and may have killed at least some rock-wallabies.

In 1939 a fire came into the present Tidbinbilla Nature Reserve from the west and missed Rock Valley house, Birrigai (then known as Gibraltar), and Gibraltar Rocks but burnt Stauntons' and Dalanders' properties near the present ranger's cottage adjacent to the kangaroo enclosures. The houses were saved (E. Green, pers. comm.). According to the ACT Bush Fire Council's Annual Report 1985-86 the 1939 fire missed the Tidbinbilla Valley completely but burnt the Orroral Ridge where the Belfry, Tower Rocks, Legoland and Honeysuckle Crags are located. It is not known whether the rock-wallabies on Orroral Ridge died out before this fire as no living rock-wallabies have ever been reported from the area. There appear to have been no severe widespread fires on the Orroral Ridge or in the Tidbinbilla Valley since 1939.

L. Tong in a personal communication indicated that a severe bushfire swept through the Naas area and over the Clear range in the early 1950s and may have contributed to the demise of the rock-wallabies there, but no written record of severe fires in the Clear Range area in the 1940s or 1950s could be found.

It is concluded that bush fire does not appear to have been a factor in the demise of the rock-wallabies at Gibraltar Rocks.

5.8 Habitat modification

Habitat modification in the sense of grazing or clearing does not appear to have been a major factor in the ACT as most of the sites where physical evidence of rock-wallabies was found are well away from former or current grazing and have never been cleared such as Mt. McKeahnie, Booroomba Rocks, Legoland and the site between Bushfolds Flat and Booroomba Rocks. They appear to have survived the longest at Wallaby Rocks in Tidbinbilla Nature Reserve, an area grazed by sheep.

5.9 Poisons

Poisoning of rabbits with strychnine, a practice widespread in the 1940s and early 1950s, could have taken its toll on local populations of rock-wallabies. The bran used to carry the poison was attractive to wallabies and kangaroos (E. Green, pers. comm.) but is unlikely to have affected rock-wallabies living at remote sites such as Booroomba Rocks, Tower Rocks, The Belfry, Mt. McKeahnie and the site between Bushfolds Flat and Booroomba Rocks.

6.0 CONCLUSION

The discovery of sub fossil skulls, other bones and droppings of the brush-tailed rock-wallaby, *Petrogale penicillata,* at several sites indicates that they did occur in the ACT in recent times. However no evidence of their present existence was found and it is likely that the species is extinct in the ACT. Nevertheless, Connolly's possible sighting and the one

guard hair identified as highly likely to be brush-tailed rock-wallaby must not be overlooked and further work is proposed through the Australian Alps Liaison Committee's natural heritage program to conduct surveys in the Alps for brush-tailed rock-wallabies during 1996.

There have been consistent reports of their former occurrence in the Tidbinbilla – Naas area from people who grew up there in the 1930s and 1940s and lived there until the 1960s. Recollections of rock-wallabies "hopping up into trees and their tails hanging down like bell ropes" and consistent reports of their disappearance in the 1950s leaves little doubt that they did exist in the ACT prior to 1960.

Their demise in the ACT is considered to be due mainly to predation by foxes as a result of a lack of protective habitat such as "caves, sheltered ledges and steep routes, usually via "chimneys" from cliff tops as described by Short (1982)". The effects of predation by feral cats, severe bushfires, vulnerability to hunting and trapping, competition for food by goats, rabbits and sheep, competition for shelter by goats and diseases such as toxoplasmosis are considered to have been of minor importance.

As evidence indicates that the fox was the main cause for the demise of brush-tailed rock-wallabies in the ACT it is not considered feasible to reintroduce them into the wild in the ACT while foxes exist there in anything but very low numbers. The ACT is considered marginal habitat for the brush-tailed rock-wallaby (J. Calaby pers. comm.) and this makes predator control even more critical should the species be reintrduced into the wild in the ACT Connolly (1995).

7.0 POSTSCRIPT

7.1 Captive Rock-wallabies at Tidbinbilla Nature Reserve

In October 1985 one male and two female brush-tailed rock-wallabies were introduced into an enclosure in Tidbinbilla Nature Reserve from Healesville Sanctuary, Victoria, primarily for interpretation and education purposes. They were two sisters and one half brother. In July 1991 there were seven in the enclosure and six had died since 1985 including the original male and one female. A male was sent to Melbourne Zoo in 1988 and two females were sent to Healesville in 1993. A new male was received from Healesville in 1994 but was euthanised due to a medical condition early the following year. By mid 1995 they had increased to approximately 24 but were still of the same stock; that is derived from Kawau Island, New Zealand stock via Healesville (from Tidbinbilla Nature Reserve records).

The use of this stock for reintroductions needs to be carefully considered in the context of introducing non local genes and ensuring that no local population exists.

7.2 1996 Search in Namadgi National Park

A fortnights searching in September 1996 in Namadgi National Park by Jim Reside and Raymon Martin of the Victorian Deprtment of Natural Resources and Environment recorded several new sites with rock-wallaby bones and droppings but no evidence of an extant population. The survey was conducted under a joint Victorian, NSW and ACT Australian Alps agreement project.

According to Jim Reside there are probably less than 40 left in the Victorian Alps where they are thinly spread across the six small colonies containing the only wild populations in south-east Australia. The species is ill-equipped for survival in post settlement Australia. The female doesn't keep the young in the pouch long but "stashes it away" in a rock crevice while she is away foraging, leaving it vulnerable to predators.

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9.0 INTERVIEWS:

Dr Robert Close. University of New South Wales Telephone interview.

Mr Granville Crawford. Grew up at "Glencoe", born ca 1927 and worked Glencoe for his grandfather after leaving school until the 1950s.

Mr Peter Cully. Ranger, Jenolan Caves NSW.

Mr Eddie Green. Born 1933, grew up at "Rock Valley" house now in Tidbinbilla Nature Reserve and left the valley in 1961 but kept returning until 1965.

Mr Ernie Holland. Ranger, Jenolan Caves. NSW.

Mr Steven Opper. Ranger, Jenolan Caves. NSW.

Mr Neil Reckord. Acting Manager, Tidbinbilla Nature Reserve. ACT.

Mr Laurie Tong. Born 1936, grew up at "Naas" Grid 855582 near the present bridge and flying fox over the Gudgenby River.

Mr David Middleton. Healsville Sanctuary. Victoria.

10.0 APPENDIX 1

Weights (kg) of some macropods and introduced predators from Strahan H. (1988) & some other sources.

	Males			Ave wt both Sexes	Females		
	Max	Ave	Min		Max	Ave	Min
Eastern grey kangaroo *Macropus giganteus*	66	35	4	26.5	32	18	3.5
Western grey kangaroo *Macropus fuliginosus*	53.5	28	3	22	27.5	16	4.5
Antilopine wallaroo *Macropus antilopinus*	49	39.5	30	29	20	18	16
Common wallaroo *Macropus robustus*	46.5	27	7	21.3	25	15.6	6.25
Agile wallaby *Macropus agilis*	27	21.5	16	16.8	15	12	9
Red-necked wallaby *Macropus rufogriseus*	26	20	15	15.5	15	11	7
Swamp wallaby *Wallabia bicolor*	20.5	16.5	12.3	15	15.4	13	10.3
Black-striped wallaby *Macropus dorsalis*	20	18	16	11	6	7.5	6.5
Brush-tailed rock-wallaby *Petrogale penicillata penicillata*	*7.6	*7.2	*5.6	*6.2		*5.2	*3.75
Tammar *Macropus eugenii*	10		6	7.5	6	5.5	4
Tasmanian pademelon *Thylogale billardierii*	12	7	3.8	5.5	10	3.9	2.4
Red-necked pademelon *Thylogale thetis*	9.1	7	2.5	5.4	8.3	3.8	1.8
Northern nailtail wallaby *Onychogalea unduifera*	9	7.5	6	6.7	7	5.8	4.5
Fox *Vulpes vulpes*	8.3	6.5	4.7	6.1	6.8	5.7	4.5
Red-legged pademelon *Thylogale stigmatica*	6.8	5.1	3.7	4.7	4.5	4.2	4.1
Black-footed Rock-wallaby *Petrogale lateralis lateralis*				4.6			

Feral cat *Felis catus*	6.2	5	3.8	4.3	4.4	3.52	2.5
Bridled nailtail wallaby *Onychogalea fraenata*	6	5.5	5	5	5	4.5	4
Parma wallaby *Macropus parva*	5.9	5	4.1	4.5	4.8	4	3.2
Unadorned rock–wallaby *Petrogale inornata assimilis*				4.3			
Spectacled hare–wallaby *Lagorchestes conspicillatus*		4.5		3		1.6	
Nabarlek *Peradorcus concinna*	1.5	1.3	1.05	1.3	1.5	1.3	1.05

* Weights of *P. p. pennicillata* from Motutapu I. N.Z. Batchelor (1988). No weights could be found for animals studied in Australia.

11.0 APPENDIX 2

11.1 Recollections of Rock-wallaby sighting in the ACT.

None since 1960:- Grid References from Nat. Map 1:100,000 ACT. and Central Mapping Authority of NSW Map 1 : 25,000 Topographic Series

Grid Ref. Site Location Interviewee and Comments

873 633 Champagne Flats Granville Crawford
Ted Tong (Laurie Tong's father) told Granville about rock-wallabies that used to hop up into a couple of huge apple box trees *Eucalyptus bridgesiana* to hide in at Champagne Flats at the foot of Mount Tennent when they could hear the cart approaching. "You could see their tails hanging down like bell ropes which would give them away."

876 533 Glencoe Granville Crawford
Rock-wallabies lived in a gorge just east of the house in the early 1950s. His grand father told him there used to be a trap in the gorge with a cantilevered lid which operated constantly occasionally filling up so that no more could fit in. Could not recall how many animals the trap held. It caught other species of wallabies, Wallaroos and Kangaroos as well and the skins were used for rugs. There is just a hole there now about 20yards down from where the fence crosses the creek. According to Granville his brother David Crawford, now living in Campbell an ACT suburb, would know the location of the trap. It could not be located during the search.

Naas area Granville Crawford
According to Granville "someone had got a rock-wallaby to replace a skin in a rug in the 1950s" but would not reveal who it was so that the skin could be positively identified through hair analysis because he felt that "It would not do anyone any good – they (the rock-wallabies) were there alright".

882 588 Clear Range Granville Crawford & Laurie Tong
Granville's grandmother Bertha ``Bertie" Dyball who grew up at "Ingledene" grid 896 606 and used to walk to school with other children to "Naas" got into trouble repeatedly for being late after chasing rock-wallabies. According to Laurie Tong they would have headed south from "Ingledene" and crossed the Clear Range 1.5 km SW of "The Angle" grid 882 588 then headed WSW to the school at grid 860 582 about 200 m east of the present bridge and flying fox near "Naas" on the Gudgenby River. The school was in the present Travelling Stock Reserve near an old pine tree. The pine tree is now dead but still standing in November 1996 (my own observation).

753 744 Wallaby Rocks TNR Eddie Green
According to Eddie Green rock-wallabies used to frequent Wallaby Rocks about 200 m SSE of the Ranger's house adjacent to the Gibraltar Fire Trail. The last time that he definitely remembers seeing them was in 1959 as he was building the fire trail up to Gibraltar Gap at the time. He thinks the reason that the rock-wallabies survived there so long was that they used thistle roots to poison rabbits while other land holders used bran which was attractive to wallabies and 'roos. The thistle roots were cut into half inch long pieces and poisoned with strychnine. It was Eddie's job to walk along in front of his father with a hoe and chip holes in the ground while his father dropped a bait in each hole and kicked soil over it.

Eddie Green (cont.)

There were no major bush fires in the Tidbinbilla Valley except in 1939. This fire did not come into the front of the valley but Stauntons' and Dalanders' at the bird feeding area were completely burnt out but the houses were saved. Booroomba Station was also burnt out. Eddie's brother had raised the alarm at 1.00 pm with "dad there's smoke coming over the hill" and the fire had reached Michelago by that night. Eddie Green remembers the fire well as he was 6 years old and terrified. According to the ACT Bush Fire Council Annual Report 1985–86 this fire missed the Tidbinbilla Valley completely.

884 553 to 884 551 Naas Valley Laurie Tong

The last rock–wallabies that Laurie Tong saw, there were 9 of them, was in 1953 on the hillside 1.5 km east of "Naas Valley". He used to ride down a spur there and would clap his hands to startle them. They used to feed on the north side of the spur at grid 884 553 and when disturbed would head south across the spur to the shelter of some rocks at grid 884 550 just east of the junction of two creeks. He grew up in the Naas Valley.

877 533 Glencoe Granville Crawford

Granville remembers Spur–winged Plovers (Masked Lapwing) were a common sight on Glencoe and often heard their familiar calls at night but did not see any young ones until he carried out a fox poisoning program for a couple of month in the early 1950s. He picked up over 50 fox carcasses in that time. In the following spring he saw the first plover chicks there for years (G. Crawford, 1991, pers. comm. August)

12.0 APPENDIX 3

12.1 Locations of search sites and earlier records with grid references.

Survey date	Grid reference	Site location	Comments
12-08-68	82-80-	Kambah Pool area collection. Site not visited in this survey	Skull in CSIRO Wildlife & Ecology
Early 1982 or before	773573-760599	"Legoland"(White Witch) "Mushroom Rock" "Tower Rock" "The Belfry" all on Orroral Ridge	Jeff Short found traces at these sites plus and a skull and partial skeleton at "The Belfry" (P.Fullagar pers comm.) CSIRO Wildlife & Ecology records.
Pre 1982	800625-810636	Booroomba Rocks	Jeff Short found no evidence of rock-wallabies or suitable habitat in the area (P.Fullagar pers comm.)
20-04-82	762584	"Legoland"(White Witch) on Orroral Ridge	Bones plus copious amount of sub fossil droppings found in cave among large granite tors.
18-05-82	718585-705573	South side of Cotter Hut road	No sign, no caves with ledges.
24-05-82	689587-690612	Cotter Hut road to Mt McKeahnie	Sub fossil droppings at 694595 and 699607 under granite tors
01-06-82	695568-686561	Cotter Hut road south side	No sign, possibly suitable at 686561.
16-06-82	766741	Gibraltar Rocks in Tidbinbilla Nature Reserve	6 partial skeletons plus sub-fossil droppings found in caves under large granite tors
24-06-82	694654-696636	Corin road to un-named mountain Mt McKeahnie area (Little McKeahnie)	No sign
06-07-82	782642-781655	2 km NW of Booroomba Rocks	No sign.
08-07-82	777717	1 km east of Woods Reserve	No sign, no caves with ledges.
26-07-82	849649-856650	North side of Mt Tennent	No sign, no caves with ledges.
28-07-82	804662-795660	South of Booroomba Station	No sign, no caves with ledges.

03-08-82	804684-795675	South of Booroomba Station	No sign
05-08-82	809662-804657	South of Booroomba Station	Sub fossil droppings found at 809662
11-08-82	820637-822646	Between Bushfolds Flat and Booroomba Rocks	Sub fossil droppings found at 820667
13-08-82	753744	Wallaby Rocks in Tidbinbilla Nature Reserve	No sign, granite tors with no caves or ledges.
13-08-82	692706	Fishing Gap area in Tidbinbilla Nature Reserve	No sign, granite tors with no caves or ledges
17-08-82	815619-820622	Deadmans Hill 2 km SE of Booroomba Rocks	No sign
25-08-82	766637	2 km NW of Booroomba Rocks	No sign, granite tors with no caves or ledges
26-08-82	770640-783649-781653	2 km NW of Booroomba Rocks	No sign, granite tors with no caves or ledges
31-08-82	796594	1 km SE of Honeysuckle Creek Tracking Station	No sign
2-09-82	762584-759596	Orroral Ridge 3km WSW of Honeysuckle Ck T.S.	N to NNW of "White Witch". No recent sign
06-09-82	710703	Off Fishing Gap Trail Tidbinbilla Nature Reserve	No sign, granite tors with no caves or ledges
14-09-82	690590-698606-691611-698618	Corin Hut road to McKeahnie	No sign (other than those found 24-5-82), granite tors with no caves or ledges
22-09-82	884387-888400	Clear Range south end.	No sign, granite slopes with no caves or ledges
24-09-82	883363-885377	Clear Range south end	No sign, some granite slopes, no caves or ledges
01-10-82	779557-787549	1.5 km east of Orroral Tracking Station	No sign, spectacular granite tor stack, no caves or ledges
05-10-82	888330-888330 890340-881340	Clear Range east of Horse Gully Hut	No sign, some granite slopes, no caves or ledges
07-10-82	713344-704341	"Sentry Box" and 800 m to the WSW	No sign, site seems suitable but moist-any dung may have decomposed-many Bogong moth remains.
19-10-85	718780-692770	"The Pimple" 1 km north of Tidbinbilla Mtn.	No sign, goats in the area controlled since before 1977

01-11-85	682800-684777	2.5 km WNW of Tidbinbilla Peak	Extensive cliffs, no sign found but area not properly searched. Goats in area since early 1930s. but eradicated 1970s to early 1980s
21-02-94	850571-847563-855565-856572	Billy Range, North end 1.5k S. of "Naas" H.S.	Anecdotal record. No sign. No rock stacks no caves or ledges
22-02-94	882531-886531-885537-881536	Clear Range, North end near "Glencoe" H.S.	Anecdotal records. No sign. No cliffs or rock stacks with caves or ledges.
25-02-94	879553-885557-887544-885551-881548	Clear Range, North end, gullies and hillsides east of "Naas Valley" H.S.	Anecdotal records. No sign. No cliffs or rock stacks with caves or ledges.
04-03-94	876565-883565-883560-880562-876560	Clear Range, North end, gullies and hillsides 1km NE of "Naas Valley" H.S.	Anecdotal records. No sign. No cliffs or rock stacks with caves or ledges
29-03-94	773573	"The Belfry" on Orroral Ridge	Sub-fossil droppings found in cave under granite tors.
29-03-94	761583	"Legoland"(White Witch) on Orroral Ridge	Most of the sub-fossil droppings found in 1982 had disappeared
19-04-94	874594-879592-882585-880584-880590-874590	Clear Range, North end, gullies and hillsides 2.3km ENE of "Naas" H.S.	No sign. No cliffs or rock stacks with caves or ledges.
28-04-94	766741	Gibraltar Rocks in Tidbinbilla Nature reserve	Sub-fossil droppings-copious amounts found in extensive caves in large granite tor stack.
16-08-94	778584-784590	Honeysuckle Crag	Sub fossil droppings found on floor and ledge under granite tors.
1995	859656	Mt Tennent 40 to 50m below bridge on the Bicentenial Walking Trail	Sub-fossil droppings found in rock shelter by G. Todkill.

There is also a sub-fossil skull from the Yarrangobilly area in the CSIRO Wildlife & Ecology collection.

Notes

Grid references = Australian Map Grid reference or AMG as used on the 1:100,000 1:50,000 and 1:25,000 map scales.

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