

3 RESULTS AND DISCUSSION

3.1 OVERVIEW

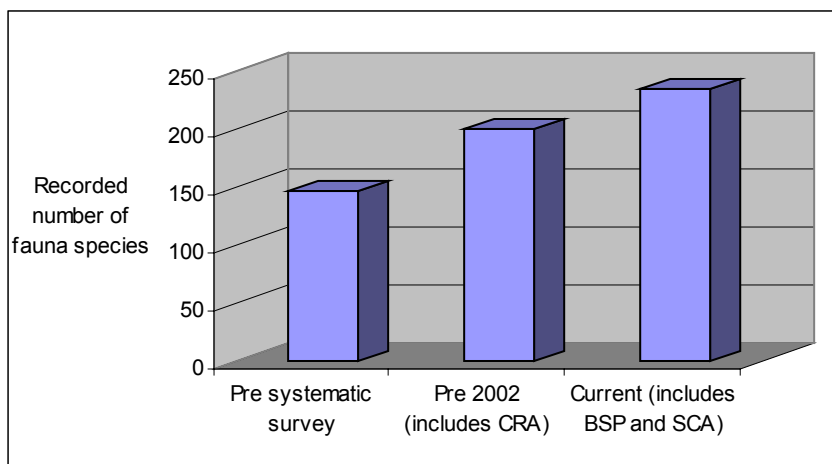
DEC has established and surveyed over 140 systematic fauna survey sites within Kanangra-Boyd NP between 1997 and 2004. These sites cover the range of dominant habitats and landscapes present within the park, and have been surveyed during both summer and winter months. In addition to these surveys, Birds Australia and the Australian Museum have contributed significantly to the number of fauna records for the park, as have numerous DEC staff, scientific researchers, and dedicated members of the public.

Two hundred and thirty-five terrestrial vertebrate fauna species have been recorded within Kanangra-Boyd NP. This result makes Kanangra-Boyd NP the sixth richest reserve for vertebrate fauna within the Central Directorate (NPWS 2003b). Seventeen species that are listed as threatened on the NSW Threatened Species Conservation Act (1995) (TSC Act) have been recorded within the boundaries of park, however there is uncertainty surrounding some of these records, as discussed below. Twelve introduced fauna species have been recorded within the park to date, including eleven ground mammals and one bird. Forty-one additional species have been recorded within a five-kilometre radius of the park boundary (Appendix B), some of which have the potential to also occur within the park. This includes four additional threatened species, which will be discussed further below.

A complete species list for all fauna groups is provided in Appendix B. The richness of vertebrate fauna within the park can be attributed to the high diversity of habitats, including heathlands, karst systems, rock outcrops and walls, swamps, river flats, rainforests, wet and dry sclerophyll forests and woodlands, together with the influence of both montane sub-alpine and low altitude coastal environments.

The value of systematic fauna survey is apparent in the contribution it has made to the knowledge of fauna within the reserve and the building of a species inventory. The CRA surveys, undertaken between 1997 and 1998, added 48 species to the list of known fauna within the park. The SCA Special Area and Biodiversity Survey Priorities (BSP) fauna surveys, undertaken between 2002 and 2004, have added a further 39 species to the park database. Figure 1 graphs the increase in the known number of fauna species within the reserve over time, as a result of dedicated systematic fauna survey.

Figure 1: Number of terrestrial vertebrate fauna species recorded within Kanangra-Boyd National Park following systematic fauna survey.



3.2 TAXONOMIC ISSUES

There are several taxonomic issues surrounding some of the species that inhabit Kanangra-Boyd NP. This section aims to identify these issues and discuss how they may effect our knowledge and the identification of species that are recorded to inhabit the park.

3.2.1 Green Stream Frog

The Green Stream Frogs, previously all known as *Litoria phyllochroa*, are small, light green tree frogs common in flowing creeks of the NSW coast and ranges. A recent taxonomic revision of the Green Stream Frog group led to the definition of a 'new' species, *Litoria nudidigita* (Donnellan *et al.* 1999), previously known in the literature as the southern call-race of *L. phyllochroa* (Anstis 2002). *Litoria nudidigita* can be distinguished from *L. phyllochroa* by the distinctive mating call as well as small physical differences. *Litoria nudidigita* was described from southern Gippsland in Victoria and is known to occur from Stanwell Park south to Victoria (Anstis 2002). The known range of *L. phyllochroa* (previously known as the northern call-race) extends from Wollongong to northern NSW. The distribution of *L. nudidigita* and *L. phyllochroa* is known to overlap in the Illawarra (NPWS 2002a). This overlap and uncertainty about the distribution boundaries of the two species calls into question the reliability of identification of pre-2003 records of this species complex within Kanangra-Boyd NP.

Two of the Kanangra-Boyd NP records of Green Stream Frog from 1999 were recorded at Kanangra Brook Falls as the southern call race, and therefore would currently be classified as *Litoria nudidigita* (A. White pers. comm.). In December 2003, *L. nudidigita* was heard calling at two locations on the Boyd Plateau, while in January 2004 *Litoria phyllochroa* was identified calling at Colong Caves. This result indicates that the species distribution overlaps within the park, which is an important zoogeographic finding. The distribution of current records suggests that *L. nudidigita* occurs on the plateau, and *L. phyllochroa* in the deeply incised gully systems, however more work is required to confirm this pattern.

3.2.2 Warm- and Cool-temperate Water-skinks

The Warm-temperate Water-skink (*Eulamprus heatwolei*) and Cool-temperate Water-skink (*E. tympanum*) both occur within Kanangra-Boyd NP. Genetic studies have confirmed the presence of both species, which live in sympatry at some sites (D. O'Connor pers. comm.). These species are usually distinguished by the following characteristics: *E. heatwolei* has a white throat and a yellow belly, while *E. tympanum* has a cream-white belly; *E. tympanum* has a series of broad black longitudinal lines on the throat, extending onto the belly while *E. heatwolei* has a clean throat, often also with dark flecks on the belly; *E. tympanum* generally has fewer dark flecks on the head, and a generally darker body. In January 2004, some *Eulamprus* were captured on the Uni Rover trail that exhibited characteristics of both species, having strong dark flecking on the throat and belly and yellow bellies. One of these individuals was taken to the Australian Museum for identification, where it was labelled as *E. heatwolei*. This specimen has been lodged with the museum and may be accessed in the future should further question about the lizards identification arise or a taxonomic review of the species occur.

3.2.3 Mountain Brushtail Possum

Recent work on the Mountain Brushtail Possum (*Trichosurus caninus*) has identified it to be two species (Lindenmayer *et al.* 2002). The species revision paper proposes the southern of the two species, from Victoria to southern NSW, be given the scientific name *Trichosurus cunninghami*, while the northern of the two species, ranging from central New South Wales north, retain the name *T. caninus*. The paper does not, however, clearly define a boundary between the two species. Since its publication, trapping has identified animals in the Kangaroo Valley as *T. cunninghami* (D. Lindenmayer pers. comm.). Differentiation of the species in the field is difficult without capturing the animal or having experience in identifying both species. Uncertainty currently surrounds the identity of the Mountain Brushtail Possums within Kanangra-Boyd NP. However, the animals encountered during the 2003-2004 surveys have been classified and lodged in the Atlas of NSW Wildlife as *T. caninus*, pending further distribution information and creation of a Wildlife Atlas code for the new species.

3.3 DIURNAL BIRDS

A total of 124 diurnal bird species have been recorded within Kanangra-Boyd NP. This includes the Glossy Black-cockatoo (*Calyptorhynchus lathami*), which is listed as vulnerable under the TSC Act, and will be discussed further in Section 5 below. The Brown Treecreeper (south eastern subspecies) (*Climacteris picumnus victoriae*), also listed as vulnerable, has been recorded once within the park, at the junction of Wheengee Whungee Creek and Christys Creek in 1993. However, this single record is not supported by the extensive DEC fauna survey effort within the park. The nearest definite record occurs three kilometres to the east of the park on Scotts Main Range.

Of conservation significance is the presence of a number of bird species that are thought to be in decline in NSW, though they are not yet listed under the TSC Act or the Environmental Protection and Biodiversity Conservation Act (1999) (EPBC Act). The Varied Sittella (*Daphoenositta chrysoptera*, recorded at six locations in the park), Eastern Shrike-tit (*Falcunculus frontatus*, five locations), Rufous Whistler (*Pachycephala rufiventris*, 24 locations) and Eastern Yellow Robin (*Eopsaltria australis*, 41 locations) are part of a group of birds that have been identified as declining in the NSW Wheat-Sheep Belt (Reid 1999). Of the group identified by Reid (1999) these species are the least restricted to woodland habitats, and have each been recorded both on and off the Boyd Plateau. A recent review of bird records across the nation identified numerous species that appear to have declined in numbers in recent years (Barrett *et al.* 2003).



Plate 5: Scarlet Robin ©Peter Ekert

Of the species identified, the following occur within Kanangra-Boyd (followed by the number of locations at which they have been observed): Flame Robin (*Petroica phoenicea*, 17); Spotted Quail-thrush (*Cinlosoma punctatum*, 22); Red-browed Treecreeper (*Climacteris erythroptera*, 15); Gang-gang Cockatoo (*Callocephalon fimbriatum*, 33); White-winged Chough (*Corcorax melanorhamphos*, 11); and Rockwarbler (*Origma solitaria*, 6). It is thought that the Scarlet Robin (*Petroica boodang*, 14) (Plate 5) has declined in the east of its range, including within the Sydney Basin and South Eastern Highlands Bioregions (Barrett *et al.* 2003). Kanangra-Boyd NP, together with the neighbouring Blue Mountains NP and Warragamba Special Area, play an important role in the conservation of these species and their habitats.

The composition and richness of bird species within Kanangra-Boyd is a reflection of the diversity of habitat types present within the park. Species that are characteristic of sub-alpine montane environments (such as the Flame Robin), of moist sclerophyll forest (such as Red-browed Treecreeper), of lowland woodlands (such as Willie Wagtail (*Rhipidura leucophrys*)), of lowland rainforest (such as Brown Gerygone (*Gerygone mouki*)) and of heath (such as Southern Emu-wren (*Stipiturus malachurus*)) are all accommodated within the park. The location of the park at the boundary of two Bioregions allows species that are typical of the Sydney Basin, as well as some species typical of the South Eastern Highlands to occur, further increasing the richness of birds.

Ninety-five of the diurnal bird species were recorded during systematic twenty-minute diurnal bird surveys, including seven species that have only been recorded using this technique. The most widespread diurnal bird species in the park is the White-throated Treecreeper (*Cormobates leucophaeus*), which was recorded at 81 out of 83 systematic bird survey sites. The next most widespread species were the Grey Shrike-thrush (*Colluricincla harmonica*), Yellow-faced Honeyeater (*Lichenostomus chrysops*), Striated Thornbill (*Acanthiza lineata*) and White-browed Scrubwren (*Sericornis citreogularis*).

Honeyeaters are also indicative of the diversity of bird species within the park, with sixteen species recorded. These include (in descending order of the number of times they have been recorded) Yellow-faced Honeyeater, White-naped Honeyeater (*Meliphaga lunata*), Eastern Spinebill (*Acanthorhynchus tenuirostris*), Bell Miner (*Manorina melanophrys*), Red Wattlebird (*Anthochaera carunculata*), White-eared Honeyeater (*Lichenostomus leucotis*), New Holland Honeyeater (*Phylidonyris novaehollandiae*), Lewin's Honeyeater (*Meliphaga lewinii*), Brown-headed Honeyeater

(*Melithreptus brevirostris*), Noisy Miner (*Manorina melanocephala*), Little Wattlebird (*Anthochaera chrysoptera*), Fuscous Honeyeater (*L. fuscus*), White-cheeked Honeyeater (*P. nigra*) and Crescent Honeyeater (*P. pyrrhoptera*). The latter two species have only been recorded once within the park.

Cockatoos (family Cacatuidae) and parrots (family Psittacidae) are both represented in the reserve, with four and five species respectively. This includes the widespread and abundant Crimson Rosella (*Platycercus elegans*), and the charismatic Yellow-tailed Black-cockatoo (*Calyptorhynchus funereus*) and Gang-gang Cockatoo. As mentioned above, of specific conservation importance is the number of Glossy Black-cockatoos located within the park. These birds have been seen or heard fifteen times within the park, while evidence of their presence in the form of chewed *Allocasuarina* cones, has been recorded a further ten times.

Birds of prey are a diverse group within the park, with nine species recorded to date, though abundance is generally low. The most commonly recorded is the Wedge-tailed Eagle (*Aquila audax*), which has been seen soaring over the landscape surrounding the Kowmung and Jenolan Rivers and on the Boyd Plateau. Nankeen Kestrel (*Falco cenchroides*) has been observed at three locations on the Boyd Plateau, near Whalania Heights. Brown Falcons (*Falco berigora*) and Peregrine Falcons (*F. peregrinus*) have each been observed at two locations in the south western section of the park. Three Peregrine Falcons (a pair and a single) were observed from the Gangerang Range, when the systematic survey team undertook the walk to Mt. Cloudmaker in December 2003. The Brown Falcons were observed from Gingra Range and Scotts Main Range in 2002. The remaining five birds of prey, Brown Goshawk (*Accipiter fasciatus*), Collared Sparrowhawk (*A. cirrocephalus*), Little Eagle (*Hieraaetus morphnoides*), Black-shouldered Kite (*Elanus axillaris*) and Australian Hobby (*Falco longipennis*), have each been recorded once on the Boyd Plateau. The Collared Sparrowhawk was observed during a systematic bird survey in December 2003 in the steep Brown Barrel gully between Echo Head and Seymour Top. A number of these birds of prey, including Brown and Peregrine Falcon are thought to be in decline in various parts of the nation (Barrett *et al.* 2003), thus protection of their habitat within Kanangra-Boyd and the surrounding region is important.

3.4 NOCTURNAL BIRDS

Eight species of nocturnal bird have been recorded within the park to date. This includes five owls, the Southern Boobook (*Ninox boobook*), and Barn (*Tyto alba*), Sooty, Powerful and Barking Owls, the latter three of which are listed as vulnerable on the TSC Act. The single Barking Owl recorded from the park was heard in October 1998 on Kanangra Road, west of Mt. Whitely. A Sooty Owl roosting site exists at Colong Caves, and the species has also been observed on the Kowmung River south of Roots Ridge. The analysis of a Sooty Owl pellet collected at this site in 1997 revealed the presence of Common Ringtail Possum (*Pseudocheirus peregrinus*), Greater Glider (*Petauroides volans*), Rabbit (*Oryctolagus cuniculus*), Sugar Glider (*Petaurus breviceps*), Bush Rat (*Rattus fuscipes*) and Black Rat (*R. rattus*) in the owls diet (DEC 2004a). Powerful Owls are more widespread within the park, being observed at nine separate locations. A ninth species of nocturnal bird, the Masked Owl (listed as vulnerable on the TSC Act) has been observed 800 metres to the south of the park, on Back Swamps Creek, south of Mount Moogan. This individual was heard calling in January 2004. As this species have a large home range, it is likely that the owl uses Kanangra-Boyd NP as part of its foraging habitat, and that other individuals also occur within the park, at least on an occasional basis. The threatened owls will be discussed further in Section 5 of this report.

Though not known to occur within the park before systematic surveys were undertaken, Australian Owlet-nightjars (*Aegotheles cristatus*) are relatively common, having been recorded 30 times during systematic surveys and fourteen times opportunistically. By



Plate 6: Tawny Frogmouth ©David O'Connor

contrast, the White-throated Nightjar (*Eurostopodus mystacalis*) is relatively uncommon, having been recorded at only four systematic survey sites and twice opportunistically. Both the Southern Boobook and Tawny Frogmouth (*Podargus strigoides*) (Plate 6) are widespread and abundant within the park, each having been observed within a variety of vegetation types. Barn Owl has only been recorded in two locations within the park, once on Black Range and once where the Uni Rover Trail crosses the Kowmung River. The nine species of nocturnal bird listed here includes every species likely to be recorded in the greater Sydney Basin.

3.5 ARBOREAL MAMMALS

Seven species of arboreal mammal have been recorded within the park during systematic surveys. Of particular conservation importance is the occurrence of Squirrel (*Petaurus norfolcensis*) and Yellow-bellied (*P. australis*) Gliders within the park, which are both listed as vulnerable on the TSC Act. The Yellow-bellied Glider has been recorded on seven occasions in the park, while the Squirrel Glider has been observed once and recorded from hair in predator scats on two occasions. Two records exist within the park boundary for an eighth species of arboreal mammal: the Koala (*Phascolarctos cinereus*). The first record consists of remains identified from within a Dingo/Dog scat collected at Moorara Boss in 1988 (M. Jones pers. comm.). The second record is of scratchings on a Eucalypt tree (at the junction of Gingra Range and Roots Ridge track) which “may be that of a Koala”, observed in April 2002. Koalas have not been seen or heard on any other occasion within the park. However, in May 2004 two individuals were observed approximately 700 metres north of the park boundary, at the gauging station north of the junction of Gingra Creek and the Kowmung River. This sighting suggests that Koalas almost certainly occur within the park, probably in relatively low numbers. These threatened species will be discussed further in Section 5 below.

The most abundant and frequently encountered species of arboreal mammal in the park is the Greater Glider. This large glider was observed during 27 of the 44 systematic site spotlight surveys, as well as during nocturnal call playback surveys, transect spotlighting, in predator scats and numerous times opportunistically. These gliders have been recorded within all of the vegetation types where systematic spotlighting was undertaken, with the exception of Mallee Heath and River Oak Forest. The gliders are most frequently recorded, however, in the taller Montane Sheltered Forests, such as those that occur on the Boyd Plateau, where tree hollows are in good supply. The Sugar Glider is also abundant in the park, frequently detected by its distinctive yapping call. These gliders are more often encountered in the gully systems in the north and south east of the park and only rarely on the plateau.

The Common Ringtail Possum is widespread throughout the park, though generally less abundant, having been observed on 27 occasions. This small possum has most often been recorded in tall Montane Sheltered Forests, but is also present within woodland, dry rainforest and heath-mallee. Both Common (*Trichosurus vulpecula*) and Mountain Brushtail Possums are also present within the park. Common Brushtail Possums are relatively widespread in the ridge and gully systems in the north and south east of the park (22 recorded), but have not been recorded on the Boyd Plateau. In contrast, Mountain Brushtail Possums are less frequently encountered (six recorded), but have been observed on both the plateau as well as on ridgetops in the north and south east of the park.

3.6 BATS

The immense importance of comprehensive, systematic survey for little-studied groups such as the microbats is clearly indicated by the fact that only two species of microbat were known to occur within the park prior to the DEC systematic fauna surveys. Fourteen species of insectivorous microbat are now known to occur within the park (Appendix B). This includes four species that are listed as vulnerable on the TSC Act: the Large-eared Pied Bat (*Chalinolobus dwyeri*, also listed as vulnerable on the EPBC Act); Greater Broad-nosed Bat (*Scoteanax rueppellii*); Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Eastern Bent-wing Bat, which will each be discussed further in Section 5. A fifteenth species of microbat possibly occurs within the park; the Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*) also listed as vulnerable on the TSC Act. Like the White-striped Freetail-bat (*Nyctinomus australis*), the echolocation call of this high-flying species can be detected by the human ear. One individual was possibly heard flying over a site on the Mumbedah Fire Road during a spotlighting survey in January 2004, however a definite identification could not be obtained. The species has not been recorded elsewhere within a five kilometre radius of the park boundary. The species is migratory, only occurring in southern Australia between January and June (Churchill 1998). This migratory habit, in combination with its high-flying foraging technique, makes the species more

difficult to detect than smaller, more sedentary bat species. It is likely that parts of Kanangra-Boyd form habitat for this species during the late summer and autumn.

The Grey-headed Flying-fox (*Pteropus poliocephalus*), listed as vulnerable on both the TSC Act and EPBC Act, has not been seen or heard within the park, either opportunistically or during systematic surveys. However, in 1986 the species was identified from hair within a Dog/Dingo scat found on Kanangra Road. It is not known whether the Dingo/Dog consumed the Flying-fox from within the park or not. The closest spatially accurate record for the species is sixteen kilometres to the east of the park, in the Kedumba River Valley in Blue Mountains NP. The Grey-headed Flying-fox is a highly visible and well-known species, suggesting that they are unlikely to avoid detection if they regularly occurred within the park in significant numbers. The Grey-headed Flying-fox does, however, move opportunistically over large distances across the landscape, taking advantage of large-scale flowering events. It is therefore possible that Kanangra-Boyd NP is occasionally used by the species, and provides an important contribution to the diversity of habitats on which this species depends.

The Eastern Freetail-bat (*Mormopterus norfolkensis*), listed as vulnerable on the TSC Act has been recorded by its ultrasonic call one and a half kilometres to the east of the park on Scotts Main Range. Relatively little is known about this species, but the fact that they are rarely captured in harp traps suggests that they are high-flying individuals, likely to cover a large area when foraging. It is highly likely, therefore, that the species also occurs within Kanangra-Boyd NP. The species will therefore be discussed further in Section 5.

Generally, the smaller microbats are the most frequently encountered within the park, including members of the *Vespadelus* genus, the *Nyctophilus* genus (Plate 7), and the Chocolate Wattled Bat (*Chalinolobus morio*). This observation may be an artefact of the sampling technique, however, as these bats tend to fly below the tree canopy and are therefore more readily captured in harp traps. These species primarily roost in trees, in hollows and under bark, meaning that they have less restricted habitat than cave-dwelling species. Bats of the *Vespadelus* genus are very abundant in the park, and can often be seen at dusk flying rapidly along roads or



coming in to drink from creeks and other water bodies. The most frequently encountered species during the surveys was the Southern Forest Bat (*V. regulus*; captured 164 times and in 50 per cent of harp traps) while the most widespread was the Large Forest Bat (*V. darlingtoni*; captured 146 times and in 100 per cent of harp traps). The Little Forest Bat (*V. vulturinus*) is also abundant, captured 57 times in harp traps during the surveys. These bats have primarily been located along ridge-lines in the northern half of the park, however, this result may be a reflection of the positioning of harp traps (traps are difficult to place in steep gullies or at any significant distance from the road due to their size and weight, as well as their reliance on visible bat fly-ways). A review of the distribution of microbat records across the Blue Mountains and Kanangra region revealed that both the Southern Forest Bat, Large Forest Bat and Chocolate Wattled Bat have been captured most frequently above 600 metres in altitude, while the Little Forest Bat has been captured most frequently below 600 metres (DEC 2004a).

The presence of larger members of the tree-roosting microchiropteran bat group is indicated by a smaller number of captures in harp traps, as well as by ultrasonic call detection. Species that fly below the canopy, including Gould's Wattled Bat (*Chalinolobus gouldii*) and the Eastern Broad-nosed Bat (*Scotorepens orion*) are often captured in traps, while species that usually fly above the canopy, including Greater Broad-nosed Bat, Eastern False Pipistrelle and particularly the White-striped Free-tail Bat are infrequently captured. This indicates the importance of using a variety of techniques to effectively sample bats within an area.

The karst systems within Kanangra-Boyd NP and neighbouring areas support a relatively high abundance and diversity of cave-dwelling bat species. The most frequently observed of these is the Eastern Bent-wing Bat. This species has been recorded at eight locations in the park, and a roost site exists at Colong Caves. The roost is thought to house over 1000 bats of this species, and is thus highly significant to the continued survival of the species in the region. The Eastern Horseshoe-bat is

also known to roost at Colong Caves, while the Large-eared Pied Bat has been identified from echolocation calls at the cave entrances (Hoye 2001).

3.7 NATIVE GROUND MAMMALS

Ground mammals are difficult to sample adequately, as they either require a large, labour intensive trapping effort (eg. Dasyurid and *Rattus* species), are large bodied, wide-ranging habitat-generalists (eg. Wombats, wallabies, kangaroos), or they prefer inaccessible and precarious habitats (eg. Brush-tailed Rock-wallabies). Hence, due to time constraints, fewer sites were able to be sampled for ground mammals than the other fauna groups. The majority of records for large ground mammals, such as Wombats and macropods, have come from opportunistic sightings, while the majority of small ground mammal records have come from predator scat analyses. A small amount of hair tube transects and Elliott trapping has been undertaken, revealing the presence of Bush and Swamp (*Rattus lutreolus*) Rats and Brown (*Antechinus stuartii*) and Dusky (*A. swainsonii*) Antechinus in the park.

Five species of macropod are known to occur within the park. Of particular significance is the occurrence of the Brush-tailed Rock-wallaby, which is listed as endangered on the TSC Act. The first record of this animal within the park in the Atlas of NSW Wildlife specimen collected west of Kowmung Gap in 1987. An individual was then observed at Cathedral Rocks, near Church Creek Caves, in 1989. This species will be discussed further in Section 5 below. The most frequently encountered macropod within the park is the Red-necked Wallaby (*Macropus rufogriseus*), which has commonly been recorded along roads in the central and northern sections of the park and on Dennis Ridge, north of Scotts Main Range. The Swamp Wallaby (*Wallabia bicolor*) is also widespread and abundant in the park, with the majority of records coming from opportunistic sightings along roads in the north of the park and on Scotts Main Range. The Eastern Grey Kangaroo (*Macropus giganteus*) is less common in the park, with records concentrated on the Boyd Plateau, in cleared land near Whalanian Heights and along the Boyd River Fire Trail. The Common Wallaroo (*Macropus robustus*) has been recorded at two locations, each on steep gully slopes in the north of the park.

The Spotted-tailed Quoll, listed as vulnerable on the TSC Act, has been observed recently at several locations within the park. Cage trapping failed to detect the species on the Boyd Plateau, yet individuals have been seen within the last year at Sally Camp Creek, on the Kowmung River Fire Trail and at Mount Krungle Bungle (M. Jones pers. comm.). Potential habitat for the species is widespread within the park, and prey species, such as Greater Glider, are abundant. This elusive species is likely to be widespread within the park, though at low density, as will be discussed further in section 5.

Common Wombats (*Vombatus ursinus*) have been recorded over fifty times within the park, evidenced by direct observation, burrow entrances, or their characteristic prominently placed scats. These large marsupials have been observed in all areas where systematic surveys have been undertaken, and in all vegetation types where surveys have been undertaken with the exception of Dry Gorge Slopes Forest, River Oak Forest, and Jenolan River Heath Forest.

Two species of monotreme occur within the park, the Short-beaked Echidna (*Tachyglossus aculeatus*) (Plate 8) and the Platypus (*Ornithorhynchus anatinus*). These animals were observed opportunistically during the systematic fauna survey field trips, as they were not directly targeted by any of the systematic survey techniques. Platypus were observed at two locations on the Kowmung River, on the eastern boundary of the park, in February 2003. It is likely that the animals occur elsewhere along the river, as well as in the Coxs River. Echidnas are relatively widespread within the park, and likely to be quite common. Eight individuals have been recorded within the park, on the Boyd Plateau as well as in the gully and ridge systems in the east, south and west of the park.



Plate 8: Short-beaked Echidna at Rocky Tops ©David O'Connor

Knowledge of the distribution and abundance of small terrestrial mammal species within the park is limited. In addition to the species recorded by systematic techniques (Bush and Swamp Rats, Brown and Dusky Antechinus), the Common Dunnart (*Sminthopsis murina*), was observed opportunistically on Cronje Mountain during CRA fauna surveys in 1998. This is an important record, as only ten records of this species occur within the boundaries of the Katoomba and Burratorang 1:100000 map sheets and this species is rarely captured in Elliott traps. Small mammals are likely to be abundant throughout the park, with the pattern of density and species assemblage dependent on vegetation structure and landscape features.

In 2003, Dingoes (*Canis lupus dingo*) were recorded at the eastern extremity of park on Scotts Main Range. The animals observed appeared morphologically to be Dingo, however the degree of the animals' purity would only be confirmed by genetic testing. High numbers of Dingoes have also recently been recorded along the lower Kowmung River by a field officer (M. Jones pers. comm.). A research project on Dingoes across the Warragamba Special Area will commence shortly, which aims to tease out the distribution of Dingoes in comparison to Dogs across the region (B. Purcell pers. comm.). Currently, most records on the Atlas of NSW Wildlife are entered as Dingo/Dog, and the distribution of these records is presented in Map 4.

3.8 REPTILES

The diversity of landscapes within the park provides a variety of habitats for reptiles that facilitates the occurrence of a diverse mix of species, including low altitude species, high altitude specialists, litter dwelling species and water-loving species. A total of 35 species of reptile have been recorded within the park to date, including two species of gecko, two dragons, one monitor, twenty-two skinks and seven snakes. None of these reptiles are listed as threatened under state or federal legislation, however some of the records provide important new information on species ranges and habitats.

All of the gecko records are located towards the edge of the park, in the incised valley system that occurs in the east and south of the park. Neither of the geckos inhabit montane or sub-alpine environments, and hence do not occur above 800 metres in altitude within the park. Lesueur's Velvet Gecko (*Oedura lesueurii*) has been recorded on Scotts Main Range and by the banks of the Coxs River. The Broad-tailed Gecko (*Phyllurus platurus*) has been recorded on the escarpment edge west of Kooragang Mountain and twice in the vicinity of Colong Caves, where cracks and crevices in bedrock provide appropriate shelter sites for the species.

The Mountain Heath Dragon (*Tympanocryptis diemensis*) is relatively common within the park, occurring both on and off the plateau. The majority of records for this species have come from opportunistic sightings made during systematic survey field trips, as well as records made during diurnal herpetofauna searches. Numerous individuals were observed by the field surveyors who undertook the Gangerang Trail walk to Mt. Cloudmaker in December 2003. The species has also been observed in the areas of Whalania, Tuglow Caves, Rocky Top, Boyd Crossing, Black Range and the northern Uni Rover trail. This small dragon has most commonly been recorded in Montane Sandstone Dry Shrub Forests, followed by Montane Sheltered Forest, and once each in Mallee Heath and Jenolan River Heath Forest on Granite.

Lace Monitors (*Varanus varius*) have not been recorded on the Boyd Plateau, but are relatively widespread in the north and east of the park, with eleven location records on the Atlas. This large goanna is a habitat generalist with a large home range, and has hence been recorded in a wide variety of habitat types, including Dry Rainforest, Montane Sandstone Dry Shrub Forest and Grassy Red Gum-Box-Ironbark Woodland and Cleared Land.

Kanangra-Boyd NP accommodates a suite of skinks typical of the south eastern NSW coastal high country. Above 800 metres in altitude, the reptile fauna is dominated by skinks that prefer the grassy open forests and woodlands of montane sub-alpine environments. This includes the species (in order of abundance) Tussock Cool-skink (*Pseudemoia entrecasteauxii*), Trunk-climbing Cool-skink (*Pseudemoia spenceri*), Southern Forest Cool-skink (*Niveoscincus coventryi*) and Bold-striped Cool-skink (*Bassiana duperreyi*). This species assemblage is concentrated on the Boyd Plateau, with additional records just south of Black Range and along the Murrain Range, along the southern boundary of the park. Lizards of the *Egernia* genus (*E. saxatilis intermedia*, *E. cunninghamii* and *E. whitii*), primarily occur in the centre of the park, where they prefer high rocky habitats, such as that which occurs at Rocky Tops on the Boyd Plateau. The Blotched Bluetongue (*Tiliqua nigrolutea*) also has a preference for high altitude habitats, occurring above 800 metres on the Boyd Plateau.

The diversity of topography and vegetation types within the park supports a diversity of water skinks, including Warm-temperate Water-skink, Cool-temperate Water-skink, Eastern Water-skink (*Eulamprus quoyii*) and Bar-sided Forest-skink (*E. tenuis*) (listed in order of recorded abundance). The first two of these species are generally high altitude species. Within Kanangra-Boyd the Cool-temperate Water-skink has only been recorded above 800 metres in elevation on the Boyd Plateau, within the Moist Sheltered Narrow-leaved Peppermint and Brown Barrel Forests. Warm-temperate Water-skinks have been recorded once below 600 metres and 96 times above 600 metres in elevation. The remaining two Water-skink species prefer low altitude habitats, occurring within the gully systems at the northern, eastern and southern extremities of the park. Also occurring within this dramatic landscape are Red-throated Skinks (*Bassiana platynota*), which particularly inhabit the ridge-tops and steep slopes, Copper-tailed Ctenotus (*Ctenotus taeniolatus*), Sunskinks (*Lampropholis delicata* and *L. guichenoti*), and Weasel Shadeskinks (*Saproscincus mustelinus*).

Seven species of snake have been recorded within the park, of which the Red-bellied Black Snake (*Pseudechis porphyriacus*) is the most common. This snake occurs in a diverse range of environments, from River Oak Forest along the Kowmung River to Box-Ironbark Woodland on Sassafras Creek to the Montane Sheltered Forests on the Boyd Plateau. The Eastern Brown Snake (*Pseudonaja textilis*) has been recorded at five locations within the park, also in a diverse range of vegetation types both on and off the plateau. The Highlands Copperhead (*Austrelaps ramsayi*) prefers montane environments; within Kanangra-Boyd it has only been recorded above 800 metres in altitude, on the Boyd Plateau within Montane Sheltered Forests and Tablelands Snow Gum Woodland. The Mainland Tiger Snake (*Notechis scutatus*) (Plate 9) also occupies the Boyd Plateau, as well as ridgetops and plateaux in the southern half of the park (all five records of this species occur above 600 metres). The occurrence of these latter two species within the park has conservation significance, as they are thought to be in decline in NSW (R. Wellington pers. comm.). The White-lipped Snake (*Drysdalia coronoides*) has been recorded three times in Mallee Heath at Kanangra Tops. The remaining snake species, Golden Crowned Snake (*Cacophis squamulosus*) and Mustard-bellied Snake (*Drysdalia rhodogaster*), have each been recorded only once within the park.



Plate 9: Mainland Tiger Snake on the Boyd Plateau © DEC

There is potential for additional reptile species to occur within the park, particularly animals with a cryptic habit that are difficult to detect, such as Blind Snakes (*Ramphotyphlops spp.*) and nocturnal snakes. There is also the potential for Rosenberg's Goanna to inhabit the park, which is listed as vulnerable on the TSC Act. One individual of this species has been observed within a five-kilometre radius of the park, between Scotts Main Range and Tonalli Range in December 2002. This species will be discussed further in Section 5 below.

3.9 FROGS

The success of frog surveys is largely dependent on the immediate weather, season and recent climatic conditions. Unfortunately, in the lead up to and during the 2002-2004 systematic survey period, survey conditions were unusually dry, providing poor conditions for conducting frog surveys. Hence minimal systematic frog surveys were able to be carried out, and frogs were primarily recorded opportunistically and during other systematic survey techniques such as site spotlighting, diurnal herpetofauna searches and nocturnal call playback. Conditions were wetter during the CRA, allowing limited systematic frog survey to be undertaken.

A total of eighteen frog species have been recorded within Kanangra-Boyd NP. This includes three species listed on the TSC Act: Booroolong Frog (*Litoria booroolongensis*); Giant Burrowing Frog (*Heleioporus australiacus*) and Littlejohn's Tree Frog (*L. littlejohni*), the latter two of which are also listed as vulnerable on the EPBC Act. The Booroolong Frog will be discussed further in section 5 of this report. The latter two frog species have not been recorded in the park since at least the 1950s and the records have a very low degree of spatial accuracy. It is considered unlikely that the Giant Burrowing Frog exists within the park, as suitable habitat is very limited. The closest recent record of the frog is almost twenty kilometres north east at Wentworth Creek (DEC 2004a). It is possible that the Littlejohn's Tree Frog once occurred within the park. Across its range, the frog appears to be restricted to moist forest, sandstone woodland and heath communities at mid to high altitude (NSW Scientific Committee 2000a), which do occur within the park. The neighbouring Blue Mountains National Park contains one of only thirteen known extant locations of the species in NSW (NSW Scientific Committee 2000a). In recent years, however, the species' prevalence and abundance within its range have declined significantly (NSW Scientific Committee 2000a), bringing into severe doubt whether the species persists in the park.

In the summer of 1999-2000, DEC commissioned targeted surveys for frogs of the *Mixophyes* genus across the Blue Mountains region. The surveys failed to confirm the persistence of any of the *Mixophyes* species within the park. The Stuttering Frog (*Mixophyes balbus*), which is listed as endangered on the TSC Act, is known to occur within a five kilometre radius of the park, however, from a specimen collected in 1974 at Jenolan Caves, and a recently discovered population near Mt. Werong in Blue Mountains NP. There is a chance that this species persists within the park, within the inaccessible gullies in the south and north east of the park.

A key threatening process affecting all four of these threatened frogs is chytrid fungus (chytridiomycosis, *Batrachochytrium dendrobatidis*), listed as a key threatening process on the TSC Act. This fatal disease particularly affects high altitude frog populations (greater than 400 metres) and stream-breeding frog species such as Booroolong Frog, Giant Burrowing Frog and Stuttering Frog (NSW Scientific Committee 2003a). Chytrid fungus has recently been detected in the Stuttering Frog population at Mt. Werong (DEC 2004b), suggesting that the disease is likely to also occur within Kanangra-Boyd. Chytrid fungus spreads rapidly and can cause drastic declines on reaching an amphibian population. Further survey of frogs and the threatening processes acting upon them within Kanangra-Boyd NP should be a high priority. As the majority of potential habitat for a number of the threatened frog species is extremely difficult to access by car or on foot, the conservation status of frogs in the park could only be comprehensively assessed by extensive and intensive targeted survey effort.

The most commonly recorded frog in the park is the Common Eastern Froglet (*Crinia signifera*), which has been observed at forty locations in a variety of water bodies, from swamps to creeks, and within a range of vegetation types, from Dry Rainforest and Montane Sheltered Forest to Montane Sandstone Dry Shrub Forest and Mallee Heath. The second most frequently recorded frog within the park is Bibron's Toadlet (*Pseudophryne bibronii*), which has been seen or heard calling at over twenty locations, most commonly within Montane Sheltered Forests and Mallee Heath. Within the park, Bibron's Toadlet has only once been recorded below 800 metres in altitude. It is widely hypothesised that the Bibron's Toadlet that occurs in highland areas, including Kanangra-Boyd NP, is a different form to the frog that occurs at lowlands in the Sydney Basin. The highland form of Bibron's Toadlet has yellow on the urostyle, red fringes around the dorsum papillae and a distinct call (A. White pers. comm.). There is widespread concern that the lowland form of Bibron's Toadlet is in decline, particularly within the Sydney Basin (R. Wellington pers. comm.), possibly due to loss of breeding habitat (A. White pers. comm.). The highland form of the species appears to be stable, however, with large numbers occurring in the Kanangra region (DEC 2004a).

Verreaux's Tree Frog (*Litoria verreauxii*), has also only been recorded above 800 metres in altitude within the park, most frequently on the Boyd Plateau. In contrast, Lesueur's Frog (*Litoria lesueuri*) is widespread, occurring on the Boyd Plateau and in the Kowmung and Cocks River Valleys. Peron's Tree Frog (*Litoria peronii*) has been recorded at five locations, four along permanent creek lines on the Boyd Plateau and one on the Cocks River. The Spotted Grass Frog (*Limnodynastes tasmaniensis*) prefers open grassy habitats, and has been recorded at four locations on the edge of cleared land at Whalanian Heights.

The identification of *Litoria nudidigita* in Kanangra-Boyd NP in December 2003 is an exciting find, as it constitutes a range extension for the species and contributes important information to the known distribution of the frog. An examination of old records indicated that at least some of the frogs identified as the southern call race of *Litoria phyllochroa* prior to 2003 were also *L. nudidigita* (A. White

pers. comm. for frogs at Kanangra Brook Falls). *Litoria phyllochroa* also occurs within the park, however, having been heard calling at Colong Caves in 2004. It would be valuable to undertake further frog surveys in appropriate weather conditions to ascertain the distribution of these two species within the park, as well as the distribution and abundance of other frog species that have only been recorded on a small number of occasions.

3.10 INTRODUCED SPECIES

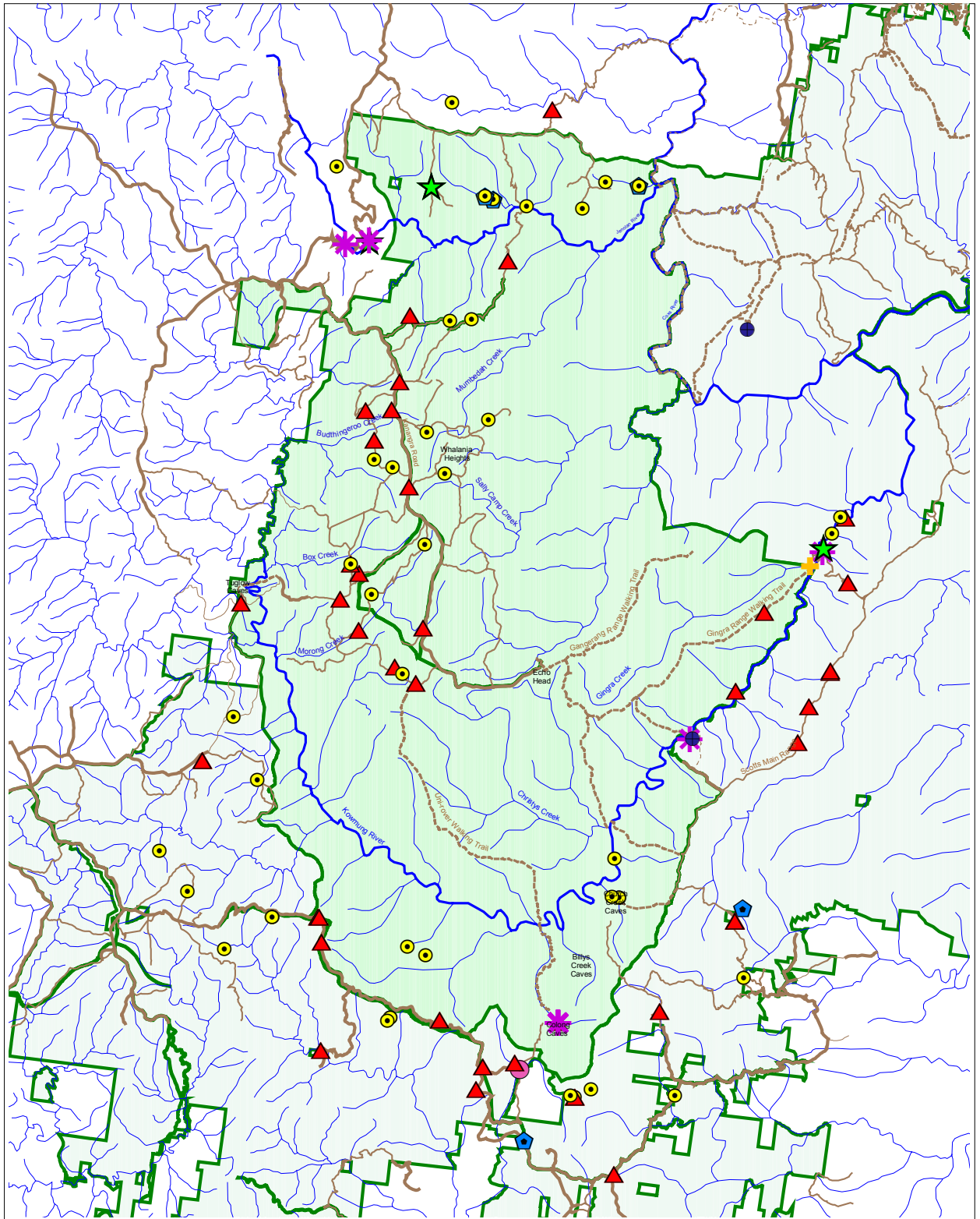
Eleven species of introduced ground mammals have been recorded within the park. This includes species that are well established and widespread (such as Fox and Pig) and species that have only been recorded in a few locations (such as Brown Hare (*Lepus capensis*) and House Mouse (*Mus musculus*)) and probably inhabit the park in low densities. The distribution of introduced mammal records within the park is presented in Map 3 and Map 4. As noted above, Dingo and Dog have been presented together in the distribution map, as until recently they could not be entered separately into the Atlas of NSW Wildlife, and it is difficult to ascertain the level of Dingo purity in the field.

The most commonly recorded introduced species within the park is the Rabbit, closely followed by the Fox. Both of these pest species have been regularly recorded on the Boyd Plateau, as well as along the southern and eastern boundaries of the park. The third most frequently recorded introduced species is the Pig, the occurrence of which is often evidenced by their characteristic tracks, scats and diggings. Pigs primarily occur in moist environments or along drainage lines, particularly in Montane Sheltered Forest, Dry Rainforest and River Oak Forest. On the Boyd Plateau, evidence of Pig activity is extremely dense and widespread.

Cats (*Felis catus*) and Goats (*Capra hircus*) have also been observed within the park, though in relatively low numbers. Goats have most frequently been recorded in the north of the park, on the steep slopes between Black Range and the Jenolan River, but have also been seen in the west, near the junction of Box Creek and the Kowmung River (M. Jones pers. comm.). Cats have been recorded at seven locations, including on the Boyd Plateau, Murruin Range, Scotts Main Range and the Kowmung River valley. Deer have recently been observed at increasing frequency within the park. Fallow Deer (*Dama dama*) have been observed in the north western corner of the park, and north of Batsh Camp off the Oberon-Colong Stock Route (M. Jones pers. comm.). Deer have been also been observed by bushwalkers on the Black Range, though the species identity in this area is uncertain (M. Jones pers. comm.).

These introduced species are likely to be having a significant negative impact on the native terrestrial flora and fauna of the park. Six of the species are listed, or are pending finalisation, as a Key Threatening Process on the TSC Act, as they are known to adversely affect threatened species and have the potential to cause other species to become threatened. The first five of the species below are also listed as a Key Threatening Process on the EPBC Act. The threats posed to native fauna by each animal are summarised as follows:

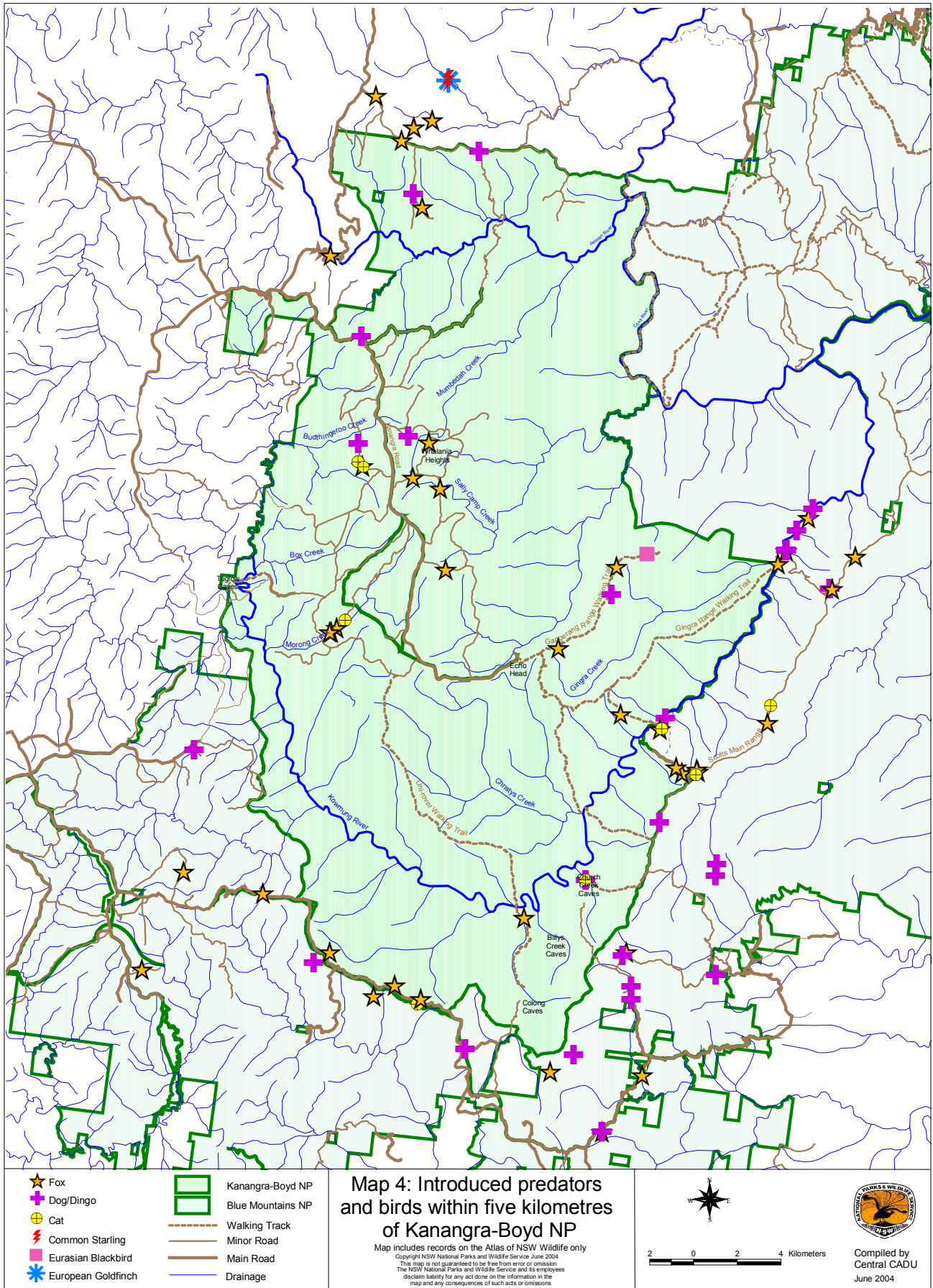
- Feral Rabbits impact negatively on native species via competition for resources, alteration of the structure and composition of vegetation, and land degradation (NSW Scientific Committee 2002).
- Predation by Foxes is a major threat to the survival of native Australian fauna, with non-flying mammals weighing between 35 and 5500 grams and ground-nesting birds at greatest risk. Fox predation has been implicated in limiting habitat choice and population size of a number of medium-sized marsupials (NSW Scientific Committee 1998c). The fact that Foxes prey upon native animals within the park is evident from scat analysis, as summarised in section 3.11 below.
- Feral Pigs compete for food resources with native fauna, actively predate upon native birds, reptiles, bird and reptile eggs, and frogs, spread disease and are capable of significant habitat degradation as a result of their behaviour and feeding habits (NSW Scientific Committee 2004a).
- Feral Goats were given a preliminary determination as a Key Threatening Process in June 2004. They cause habitat degradation and have the ability to significantly alter the habitat of native fauna. Goats may compete with native fauna for food, water and shelter (NSW Scientific Committee 2004b).
- Feral Cats threaten native fauna by direct predation. Cats are carnivorous and capable of killing vertebrates up to three kilograms. Preference is shown for mammals weighing less than 220 grams and birds less than 200 grams, but herpetofauna are also eaten (NSW Scientific Committee 2000b).



- Black Rat
- Brown Hare
- Goat
- House Mouse
- Deer
- European cattle
- Pig
- Rabbit
- Kanagra-Boyd NP
- Blue Mountains NP
- Walking Track
- Minor Road
- Main Road
- Drainage

Map 3: Introduced herbivores within five kilometres of Kanagra-Boyd NP
 Map includes records on the Atlas of NSW Wildlife only
 Copyright NSW National Parks and Wildlife Service June 2004
 This map is not guaranteed to be free from error or omission
 The NSW National Parks and Wildlife Service and its employees
 disclaim liability for any act done on the information in the
 map and any consequences of such acts or omissions

Compiled by
Central CADU
June 2004



- Deer cause environmental degradation through overgrazing, browsing, trampling, ring-barking, antler rubbing, dispersal of weeds, creation of trails, concentration of nutrients, exposing soils to and accelerating erosion (NSW Scientific Committee 2003c).

Clearly the potential for introduced predators and herbivores to significantly impact on native fauna in Kanangra-Boyd is of high conservation concern. Comprehensive targeted survey of the species, assessment of their impacts, followed by appropriate management actions, should remain a high priority for park management.

The introduced Black Rat has only been detected within Kanangra-Boyd NP by the identification of remains (hair and/or skeletal parts) in predator scats and cough pellets; once in a Sooty Owl cough pellet and once in a Fox scat, each in the south west of the park. The House Mouse has been directly observed at a single location within the park, on Warlock Ridge. These results indicate that introduced rodents occur deep within the park, even in areas with low disturbance, yet probably only at low densities. This is typical of moist undisturbed environments of the east coast. Research has suggested that introduced rodents rarely out-compete native mammals in a natural undisturbed environment (Fox *et al.* 2003).

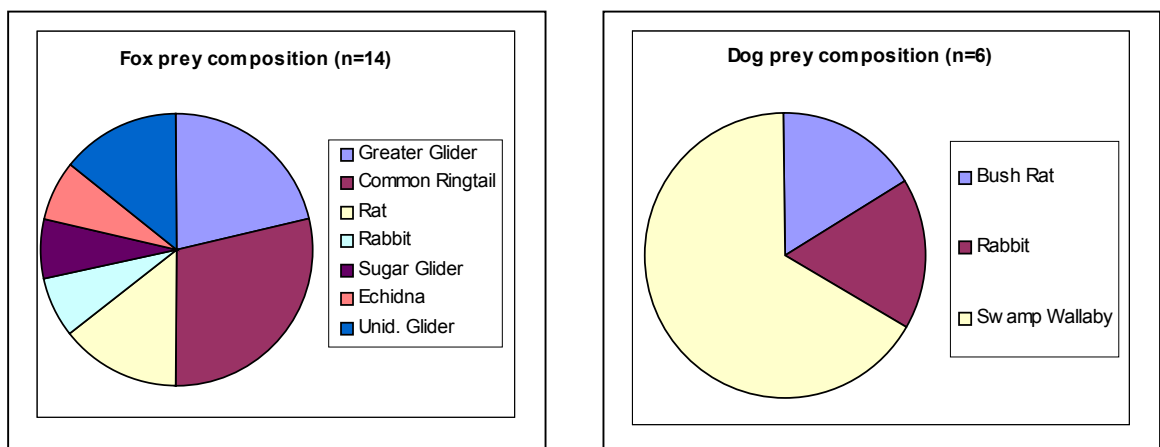
The only introduced bird to have been recorded within the park is the Eurasian Blackbird (*Turdus merula*), which has been observed once on Roar Knoll, west of Mt. Cloudmaker in December 2003. Since this species is present in such low numbers, it is unlikely to be having a significant impact on native fauna at this stage.

3.11 PREDATOR SCAT AND PELLETT ANALYSIS

Analysis of prey remains in predator scats and owl pellets is a valuable method of collecting information about animal species that are cryptic, and therefore difficult to observe without an intensive trapping program. The analysis of a Sooty Owl pellet collected at Colong Caves during the CRA fauna surveys revealed the presence of Bush and Black Rats, Common Ringtail Possum, Greater and Sugar Gliders and Rabbit remains. This contributes important information to the study of diet and feeding biology of these large threatened owls.

The analysis of Fox and Dingo/Dog scats yields interesting information about the vertebrate prey composition of the predator's diet (Figure 2). Interestingly, Rabbit remains were only identified from one of the Fox scats analysed, while possums and gliders made up the largest component of the Foxes' diet (Figure 2). Dogs/Dingoes tended to consume larger prey, with Swamp Wallabies making up the biggest component of their diet. Only limited conclusions can be drawn from these analyses due to the relatively low number of scats analysed. An analysis of predator scats across the region is being undertaken as part of the SCA fauna survey program, with the aim of yielding more comprehensive information about prey composition (DEC in prep.).

Figure 2: Vertebrate prey items (hair and skeletal remains) identified from Fox and Dingo/Dog scats.



3.12 LANDSCAPE SCALE PATTERNS IN FAUNA DISTRIBUTION

The vegetation of Kanangra-Boyd NP is broadly effected by two parameters – elevation and geology. The stark differences in altitude and geological history between the Boyd Plateau and the surrounding valley system has resulted in the park having two broad structural types of vegetation (see Section 1). The deeply incised landscape in the eastern and south eastern parts of the park is more reflective of the adjoining Sydney Basin Bioregion having lower altitude (below 800 metres above sea level) and sandstone influenced geologies. The vegetation in these areas comprises various Eucalypt woodlands and forests with a sclerophyllous shrubby understorey. In contrast, the Boyd Plateau in the north western half of the park is at higher elevations (800 metres above sea level) with more volcanic geologies (particularly granites). The vegetation on the Plateau is more typical of the South Eastern Highlands Bioregion with tussock grasses dominating under a woodland canopy or ferns dominating under a tall forest.

The distribution of fauna species across the park reflects this differentiation in habitat types, with a suite of species dramatically responding, either directly or indirectly, to altitudinal changes. The reptiles found at higher altitudes within the park, including Cool-temperate Water-skink, Black Crevice-skink (*Egernia saxatilis intermedia*), Blotched Bluetongue and Highlands Copperhead have been discussed in Section 3.8. These species are likely to be responding variously to habitat changes (such as the occurrence of tussock grasses (for *Pseudemoia* spp.) and the presence of exfoliating granite (Black Crevice-skink) on the plateau) and temperature differences (for example, Highlands Copperhead is one of the few snakes in Australia that can survive above the snowline). A complimentary suite of reptiles prefers the lower altitude habitats (see Section 3.8). Similarly, some mammals respond to altitude differences. For example, the Yellow-bellied Glider has a distinct association with Grey Gum and is abundant in the various Grey Gum woodlands and forests that occur along Scotts Main Range and in the north east of the park. The upper limit of Grey Gum appears to be 600 metres above sea level (D. Connolly pers. comm.), and hence neither the tree nor the Yellow-bellied Glider occur on the Boyd Plateau.

Some bird species appear to effectively replace each other in the two broad habitat areas. For example, the Satin Flycatcher (*Myiagra cyanoleuca*) appears to replace the more widespread Leaden Flycatcher (*M. rubecula*) on the Boyd Plateau. This reflects the situation in the ACT where the former species replaces the latter in closed habitats and is rare below 800 metres, while the Leaden is uncommon above 900 metres (Taylor and COG 1992). Similarly, the Glossy Black-cockatoo is only recorded in the eastern parts of the reserve, reflecting the higher abundance of *Allocasuarina* food species in these areas, whereas Yellow-tailed Black-cockatoos are more likely to be recorded in the cooler climes at higher altitudes. Other birds that seem to be more prevalent at higher altitudes are Flame Robin, Red-browed Treecreeper, Grey Currawong (*Strepera versicolor*), Little Raven (*Corvus mellori*) and Red Wattlebird. Some species that appear to be recorded more regularly at lower altitudes include Brown Gerygone, Lewin's Honeyeater, Bell Miner and to a lesser extent Yellow-faced Honeyeater, Superb Fairy-wren (*Malurus cyaneus*) and Wonga Pigeon (*Leucosarcia melanoleuca*). It must be remembered, however, that because most of records were collected during systematic surveys undertaken in spring, these patterns reflect habitat preferences only at this time of year. Some species, such as the Flame Robin, may move off the plateau in winter, or visa versa.

Many species do not appear to respond to changes in altitude. These include, for example, Brown Thornbill (*Acanthiza pusilla*), White-browed Scrubwren and Eastern Spinebill that utilise the sparser shrubs in the understorey, Superb Lyrebird (*Menura novaehollandiae*), Striated Thornbill and Eastern Whipbird (*Psophodes olivaceus*) that inhabit most types of moist forest and habitat generalists such as Laughing Kookaburra (*Dacelo novaeguineae*), Pied Currawong (*Strepera graculina*) and Southern Boobook. Some mammals and reptiles, such as the Common Wombat, Common Ringtail Possum and Red-necked Wallaby and Eastern Brown Snake also fall into this last category. Within the park, the distribution of



Plate 10: Roosting Eastern Bent-wing Bats ©Narawan Williams

these species would reflect habitat characteristics that are independent of the sub-alpine plateau/lower altitude incised gully gradient.

3.13 THE LIMESTONE KARST SYSTEM

The karst system within Kanangra-Boyd has high conservation value and contributes significantly to the fauna species richness of the reserve. Four sets of limestone caves are known to exist: Colong, Church Creek, Billys Creek and Tuglow. The caves sustain populations of obligate cave-roosting bats, including Eastern Bent-wing Bat (Plate 10), Eastern Horseshoe-bat, and Large-eared Pied Bat and are likely to also provide roost sites for bat species that can roost in either caves or tree hollows, such as Eastern False Pipistrelle and Chocolate Wattled Bat. None of the caves have yet been identified as maternity roosting sites. The caves also provide roost sites for bird species such as the Sooty Owl (see Section 5) and crevice shelter sites for reptiles such as the Broad-tailed Gecko.

4 FUTURE WORK

Every effort was made during the recent systematic fauna surveys to sample the full variety of habitat types and fauna groups within Kanangra-Boyd NP, and hence obtain a comprehensive picture of terrestrial vertebrate fauna within the park. The surveys were, however, subject to a number of constraints, leading to limitations and a recommendation that further work be undertaken within the area in coming years. Areas of endeavour that should be targeted in the future include:

- Systematic frog surveys using the nocturnal streamside search method described above. The surveys should be undertaken under appropriate weather conditions, that is on warm, humid nights in spring or early summer after an extended period of rain. This program should specifically endeavour to ascertain whether Booroolong Frogs, Giant Burrowing Frogs, Littlejohn's Tree Frogs and/or Stuttering Frogs persist within the park, and if so to assess their conservation status and threats to their continued survival. Gathering information on the relative distribution of the two species of Green Stream Frogs (*Litoria phyllochroa* and *L. nudidigita*) would also be valuable.
- Further systematic owl surveys using the nocturnal call playback method described above. The surveys should be undertaken between April and August, when owls are most likely to respond to the playback (DEC unpublished data). The Boyd Plateau should be targeted first.
- Continuation of the Brush-tailed Rock-wallaby surveys by the DEC Oberon office.
- Targeted surveys for Koalas in the east and south east sections of the park where Grey Gum and Forest Red Gum occur. These should be undertaken to confirm whether the species occurs within the park, and if so to estimate the species abundance and distribution.
- Further systematic surveys for small and medium sized ground mammals, including Spotted-tailed Quolls.
- Targeted surveys to ascertain the abundance and distribution of introduced fauna species in the park that are listed as being a Key Threatening Process. This should be accompanied by research into impacts that the species are having on native fauna, which should in turn guide management actions.
- Undertake all systematic survey techniques within vegetation types that remain undersampled. These vegetation types are Montane Slopes Dry Forests, Dry Gorge Slopes Forests and Grassy Red Gum-Box-Ironbark Woodlands. These habitats are very difficult to access and may require the use of a helicopter.
- Any systematic work undertaken in the future should be undertaken utilising the methods described in Section 2.3 and in NPWS (1997). Data entry into the BSS is the responsibility of the survey coordinator and time and resources for data entry should be included within the original survey proposal. This will ensure that the data is available to all staff and clients of DEC with accurate details and also the data to be included in any analysis of systematic data undertaken.