KILMORE EAST MURRINDINDI COMPLEX SOUTH FIRE

BURNED AREA EMERGENCY STABILIZATION PLAN

BIODIVERSITY - FAUNA ASSESSMENT

I. OBJECTIVES

- Assess the effects of fire and suppression actions to the Threatened and Endangered Species of Victoria, Australia under the Flora and Fauna Guarantee Act 1988 (FFG Act), and the Environment Protection and Biodiversity Conservation Act 1999
- Prescribe emergency stabilization and rehabilitation measures and/or monitoring and assess the effects of these actions to listed species and their designated habitat.

II. ISSUES

Impacts to Rare or Threatened Species- Seven listed species under the Flora and Fauna Guarantee Act 1988 (FFG Act), (Leadbeater's Possum [*Gymnobelideus leadbeateri*], Spotted tree-frog [*Litora spenceri*], Barred Galaxias [*Galaxias olidus* var. *fuscus*], Macquarie Perch (*Macquaria australasica*), Brush-tailed Phascogale [*Phascogale tapoatafa*], Powerful Owl *[Ninox strenua*]), Sooty Owl [*Tyto tenebricosa*], occur within the fire areas. Leadbeater's Possum, Barred Galaxias, and Macquarie Perch, are also listed nationally under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) within the fire area. Impacts to these species and their habitats from the fire, suppression actions, and proposed emergency stabilization actions are addressed.

III. OBSERVATIONS

The purpose of this Burned Area Emergency Response (BAER) Wildlife Assessment is to document the effects of the fire, suppression activities, proposed stabilization treatments, and potential post fire flooding and sediment delivery to listed threatened and endangered fauna species and their preferred habitats within the fire area. This assessment includes effects to species that occur on lands under the tenure of the Department of Sustainability and Environment, Parks Victoria, Goulburn Broken Water Catchment Management Authority, Goulburn Valley Water, Melbourne Water Corporation, and private ownership.

Species addressed for the Kilmore East-Murrindindi Complex South Fire include all listed species and designated habitats from the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Flora and Fauna Guarantee Act 1988 (FFG Act) with known populations within the fire perimeter. Numerous other sensitive species and habitats identified by these Acts have been documented within the fire areas. Although these species may have been potentially affected by the fires, the Code of Practice for Fire Management on Public Lands dictates that rare or threatened species or communities must be considered (Section 4.4.3). Further, the short time frame for field reconnaissance, analysis, and assessment precluded addressing less sensitive species. However, non-specification, general recommendations are made.

Background

The Kilmore East-Murrindindi Complex South Fire was reported on Saturday February 7, 2009. The fire started in two locations; Kilmore at approximately 1150 hours and the Murrindindi Mill, approximately 1500 hours. Strong northerly winds pushed the fires to the southeast towards Wandong, Kinglake, and Narbythong. A southerly change came through in late afternoon, pushing the fires in a northeasterly direction to Flowerdale, Glenburn and Marysville. The fires then merged in the Glenburn area. The fire continued to burn in a northeasterly direction into Rubicon, Taponga and Big rivers area. The area

included in this burned area assessment is 99831 hectares. The BAER analysis is made up to public land managed by Melbourne Water, Department of Sustainability and Environment, Parks Victoria, local government and private land. Breaks in the K-M South Complex analysis area were based on catchment boundaries. The northern and western side of the area was assessed by a separate incident management team, the Gasser BAER Team.

The terrain in the Killmore East-Murrindindi Complex South Fire varies from flat ground to steep area up to 30 degrees and some escarpments. Elevation varies from 100 meters to 1500 meters. The fire spread through a number of vegetation types. The main vegetation types are foothill mixed species forest at lower elevations to wet sclerophyll, alpine forest in the higher elevations.

Suppression tactics included, but were not limited to, dozer line, hand line, fixed wing fire bombers, helitac and backfires (syn. back-burns) and other suppression related damages to habitat. On-the-ground surveys were conducted in conjunction with other BAER disciplines and agency resource advisors to identify areas needing emergency stabilization and rehabilitation. Overall, the area burned within the Killmore East-Murrindindi Complex South Fire experienced an array of fire intensity, with contiguous areas of moderate to high fire intensity exceeding 40,000 ha. Most of the fire in the upper elevations includes a mosaic pattern of burned area interspersed with patches of unburned, while some of the lower elevations burned completely due to fine fuel loading including grass. There were some areas throughout the fire with moderate to high burn severity as well. The Kilmore East-Murrindindi Complex South Fire was contained on the southern portion at 1400 on March 14, 2009.

Vegetation

The Kilmore East Murrindindi Complex North Fire burned through a variety of habitat types. Dominant vegetation types, or Ecological Vegetation Classes (EVCs), are Damp Forest, Cool Temperate Rainforest, Mixed Forest, Wet Forest, Shrubby Dry Forest, and Grassy Dry Forest. Thirty-one EVCs were described for the South Fire. See the map in the EVC South assessment section for Hectares of Ecological Vegetation Classes on lands within the Kilmore East-Murrindindi Complex South Fire. Vegetation communities were impacted to varying degrees due to differential fire intensity (hereafter referred to as vegetation mortality) and soil burn severity. A description of vegetation communities and fire effects to plant species is provided in the BAER Biodiversity- Flora Assessment. Also see maps of fire intensity and soil burn severity as available in Appendix.

Reconnaissance Methodology and Results

Information used in this assessment was generated from review of relevant literature, recovery and management plans, GIS databases, and discussion with species experts from Department of Sustainability and Environment, Parks Victoria, and consulting biologists. Field reconnaissance consisted of on site inspection of known species occurrence sites and their preferred EVC types and habitat areas. Field visits to the Kilmore East Murrindindi Complex South Fire were conducted on several days during March 9 - 17, 2009. Field reconnaissance included Scott Lambert (BAER - Biologist - Botanist). Field notes were transcribed to Victoria DSE Incident Management Log and included in the BAER file provided to DSE, Parks Victoria, Melbourne Water Corporation, and Goulburn/Broken Water Catchments Management Authority, and Goulburn Valley Water.

The Department of Sustainability and Environment (DSE) and Department of Environment, Water, Heritage, and the Arts (DEWHA) has jurisdiction over the listed species within the area of the fire. Identification of known listed species occurrences and their preferred EVC types is crucial to accurately assessing fire affects. DSE and DEWHA maintain extensive GIS databases on listed species occurrence locations and species experts have identified

EVC's that are preferred by each species. Data was made available to the BAER Team for analysis and was supplemented by Action Statements from the FFG Act and data provided by species experts with ongoing research in the area. Carl Hardzinski, BAER GIS Specialist, collected and analyzed local spatial data throughout the assignment. Maps with threatened species occurrence locations, EVC's, Leadbeater's Possum reserves, Barred Galaxias streams, and vegetation mortality was generated from the above data sources.

This Fauna Assessment is a summary of fire effects to wildlife and their habitats. While the effects of the fires to the vegetation that makes up their habitats is discussed, a more thorough coverage of impacts to vegetation communities and watersheds can be found in the BAER Vegetation and BAER Catchments Assessments. These reports contain more detailed description of pre and post fire vegetation, post fire vegetation recovery estimates, impacts to threatened plant species, and run-off and debris flow estimates.

As stated above, the purpose of this assessment is to discuss the potential effects of the fire, suppression activities, and proposed emergency stabilization actions to State and/or Nationally threatened species and their habitats that occur within or immediately adjacent to the Kilmore East-Murrindindi Complex South Fire . Due to legislative mandates, time constraints, and the opinions of local species experts (J. Antrobus, F. Hames, and S. Smith, pers. comm.), effects to other wildlife species are not discussed in great detail. This assessment is not intended to definitively answer the many questions on fire effects to specific species that arise during a series of incidents such as the 2009 Kilmore East-Murrindindi Complex South Fire. The purpose of this assessment is to determine the need for immediate, emergency actions that may be necessary to prevent further negative effects to threatened species. The species discussed in this assessment have ranges that extend beyond the fire perimeters, it is important to include information at a larger scale and across land tenure boundaries when discussing potential impacts to species as a whole and the need for long-term rehabilitation.

Findings

Habitat Conditions

The fire has altered the landscape with regard to the habitat of fauna in a profound way. Immediately obvious is the gross loss of food and shelter resources to all fauna (including insect life). Many of the vertebrate fauna species that inhabit the burned area are dependant upon hollows in trees and in fallen timber for reproduction, cover, and food. These habitat elements on the ground and within streams facilitate biodiversity recovery and longer term persistence of viable animal populations. The loss of habitat in forest and woodland EVCs with overstory species that are rarely killed by wildfire can be expected to slowly recover habitat quality over the next decade. However, massive decline in the availability of hollows in living trees is anticipated in forest types where the overstory is largely killed by intense wildfire (primarily EVC's dominated by the ash eucalypts). This has local consequences for populations of a range of fauna where food resources and hollows must co-occur spatially and temporally. Such species include hollow dependent folivores, hollow dependent sap-feeding species, hollow dependent nectivores and insectivores, hollow dependent granivores, hollow dependant higher order predators, and those species that specialize on preying on these fauna.

In addition to concerns regarding the gross loss of habitat quality for many species groups due to the fire, the arrangement of the remaining habitat needs to be considered in future recovery, salvage, timber harvesting and fire pre-suppression activities. One of the major issues of concern due to the fire is the loss of habitat connectivity which will have negative affects on many species of fauna. Species such as the arboreal mammals which rarely go to ground and spend most of their life in the tree canopy require connectivity in the mid-story for movement and dispersal in order to re-colonize new sites. Fragmentation of unburned habitat patches due to the fire may also isolate populations, lead to increased competition and predation, and decrease reproductive output.

2009 Kilmore East-Murrindindi Complex South Fire Threatened Species List

Analysis of GIS databases, species occurrence maps, and consultation with species experts indicates that the fire perimeter contained threatened species occurrences. Occurrences of the Leadbeater's possum [*Gymnobelideus leadbeateri*], Barred Galaxias [*Galaxias olidus* var. *fuscus*], Macquarie Perch [*Macquaria australasica*], Powerful Owl *[Ninox strenua*], Sooty Owl [*Tyto tenebricosa*] , Brush-tailed Phascogale [*Phascogale tapoatafa*], Regent honeyeater [*Xanthomyza phrygia*], Spotted Tree Frog [*Litoria spenceri*], Broad-tooth Rat [*Mastacomys fuscus*], Spot-tailed Quoll (*Dasyurus maculatus maculatus*) and their habitats are within but not limited to the Kilmore East- Murrindindi Complex South Fire perimeter on DSE and Parks Victoria lands (see Fauna Maps in Appendix IV).

A species list was obtained on March 12, 2009 from Jo Antrobus, Parks Victoria. The list was generated for all species potentially occurring within fire perimeter or subject to fire effects outside the perimeters (e.g. non-native invasive flora and fauna). All information provided for the fire areas was reviewed and refined by Karen Lester (DSE), Merril Halley (DSE), and Jo Antrobus (Parks Victoria) to determine which species may occur within the fire areas and were in greatest need of fire impact assessment. The below list is for DSE, Parks Victoria and other public lands. The list was reviewed by and/or discussed with Richard Loyn (DSE), David Cheal (DSE), Ed McNabb (DSE) Steve Smith (DSE), and Fern Hames (DSE). The following listed species occur and have preferred EVC types within the fire area or were potentially affected by fire suppression actions on DSE/Parks Victoria lands. Therefore, the below species are the focus of the BAER Wildlife Assessment.

SPECIES	SCIENTIFIC NAME	LISTING STATUS
Leadbeater's possum	G*ymnobelideus leadbeateri*	Endangered (EN) EPBC and FFG listed
Barred Galaxias	*Galaxias olidus* var. *fuscus*	Endangered (EN) EPBC and FFG listed
Macquarie Perch	*Macquaria australasica*	Endangered (EN) EPBC and FFG listed
Sooty Owl	*Tyto tenebricosa*	vulnerable (v) FFG listed
Powerful Owl	*Ninox strenua*	vulnerable (v) FFG listed
Brush-tailed Phascogale	*Phascogale tapoatafa*	vulnerable (v) FFG listed

The following species have been identified as occurring inside the fire perimeter however, sightings were likely incidental, of individuals, only passing through the area, old records, or the fire area is at the edge of their range (E. McNabb, pers. comm.). These species were determined not to be significantly impacted by the fire due to low population abundances, negligible habitat loss, or we were unable to access their locations and habitat due to active fire line. Therefore these species will not be addressed in this assessment. This determination was made in consultation with Ed McNabb, Fern Hames, Steve Smith (DSE) and Joanne Antrobus (Parks Victoria).

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SPECIES	SCIENTIFIC NAME	LISTING STATUS	REASON FOR NOT ADDRESSING IN THIS DOCUMENT
Spotted Tree Frog	*Litoria spenceri*	Endangered (EN)	In fire area- Rubicon River – Big River; unable to

		Listed as threatened (L)	access habitat to complete assessment.
Common Dunnart	*Sminthopsis murina murina*	Vulnerable (Vu)	Kinglake population habitat is likely burnt.
Alpine Tree Frog	*Litoria verreauxii alpina*	Vulnerable (Vu)	Data deficient. Previously recorded in fire affected area
Regent Honeyeater	*Xanthomyza phrygia*	Critically Endangered (CR) Listed as threatened (L)	Outside of range, incidental use of the area, or negligible habitat loss
Broad-toothed Rat	*Mastacomys fuscus mordicus*	Data Deficient	Generally outside of range or incidental use of the area, some habitat loss. Known / formerly known population at Bellel Creek within fire perimeter near Lake Mountain.
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	Endangered (EN) Listed as threatened (L)	Population size in fire area unknown
Lace Monitor	*Varanus varius*	Vulnerable (V)	Population size in fire area unknown

Biological Assessment for Federally Listed Species

Direct effects as described in this report refer to mortality or disturbance that result in flushing, displacement, or harassment of the animal. Indirect effects refer to modification of habitat, effects to prey species, and changes in competition, and predation rates.

Leadbeater's Possum: Leadbeater's Possum (*Gymnobelideus leadbeateri*) is the only member of the genus Gymnobelideus and is restricted to mountain ash forests dominated by Mountain Ash (*Eucalyptus regnans*), Alpine Ash (*Eucalyptus delegatensis*) and Shining Gum (*Eucalyptus nitens*). Smaller, but significant, populations occur within sub-alpine woodland at Lake Mountain (Jelinek *et al*. 1995) and a disjunct population occurring in lowland Swamp Gum (*Eucalyptus camphora*) in Yellingbo Nature Conservation Reserve (Smales 1994).

Leadbeater's Possum (LBP) is a small (120 - 150g) arboreal species that rarely occurs on the ground. It is grey to greyish-brown above and paler below with a prominent dark mid-dorsal stripe. Unlike its relative, the sugar gilder, the LBP is distinguishable by the absences of a gilding membrane and has a club-shaped tail, broader near the tip than at the base (Smith 1980). The possum is totally dependant upon nesting tree hollows in large old trees and a thick understory that allows the possum to traverse throughout its home range and facilitates the dispersal of animals. Maximum population densities occur in regrowth forest (15-50 year) with more than six potential nest-trees per 3 ha and a biomass of *Acacia* spp. between 20-50% of stand basal area (Smith and Lindenmayer 1992).

LBP's live in small colonies of up to 8 individuals and construct a communal nest in the hollows of living or dead trees.

The most important components of the LBP's habitat are the nest tree abundance, vegetation structure and food availability. Leadbeater's possum habitat is declining due to logging practices, uncontrolled fire, lack of hollow recruitment, low population numbers, and potentially poor connectivity and coincidence of essential resources. In 1991 the Scientific Advisory Committee to the FFG Act determined that Leadbeater's Possums are:

significantly prone to future threats which are likely to result in extinction, and very rare in terms of abundance and or distribution

The species is recognized as threatened and endangered, listed under the FFG Act and EPBC Act. The survival of this animal in the wild is dependent on conservation measures undertaken in Victoria, specifically in the Central Highlands known core home range.

DIRECT FIRE EFFECTS: High intensity fire has affected many populations of Leadbeater's Possum in the eastern areas of the study area. All understory plants have been destroyed and many of the nesting trees are likely to have been killed. Nest boxes are used for monitoring of the population at Lake Mountain in the sub alpine woodland. Most of these nest boxes have been destroyed (23 out of 30 boxes destroyed, 5 badly damaged, 2 unburnt, J. Antrobus) and many animals were found dead during field reconnaissance. In March 2008 nest boxes in this area had an occupancy rate of approximately half of those occupied supported colonies. The populations in the area near Deep Creek and Lake Mountain (Rubicon – Big River Basin and the O'Shannessy – Armstrong Basin) have been the subject of extensive field observation over many years and as a consequence this area has most of the recorded observations of the species. Much of this area remains unburnt by recent fire events. Fourteen of 28 boxes were occupied in 2008, a maximum of 19 occupied in 2006. Conversely extensive areas of suitable habitat with limited field observations of Leadbeater's possum have been subjected to severe wildfire. At least 50% of the known habitat range has been burnt in 2009 (J. Antrobus, per. comm.).

INDIRECT FIRE EFFECTS: Indirectly, the fires degradation of habitat would likely have the greatest impact on the Leadbeater's Possum. The loss of cover would increase the chance of predation by red foxes, raptors and owls. Habitat fragmentation due to high intensity fire, tree felling during fire preparedness and fire suppression operations have significantly impacted their habitat. LBP territories are 1-3 hectares. Habitat degradation due to potential salvage logging operations will continue to be a major threat to the species, due to the loss of nest sites from hollow bearing trees and decreased mobility through forests.

The monitoring of LBP presence/absence and abundance in burned and unburned areas will enable resource staff to better ascertain the impacts of the fire on this species and its habitats. Immediate reinstatement of supplementary den sites, such as nest boxes, where lost and known to have been occupied should occur. In addition, the impact/interaction of salvage logging operations needs to be considered in any monitoring program.

Viable connections between existing LBP populations and reserve areas need to be maintained and encouraged in both the medium and long-term, based around the areas of unburnt forest. The Lake Mountain population was estimated at 100 – 300 animals by Parks Victoria. Currently only 4 animals are known to have survived the fire in 2009. Strict compliance to the Fire Salvage Harvesting Prescriptions (DSE 2008) needs to be enforced to ensure habitat continuity. Consideration should be given to the reduction of barriers for arboreal mammals along major tracks.

Table 3. Hectares of Leadbeater's Possum reserves by habitat/ EVC type and land tenure in the Kilmore east-Murrindindi Complex South fire.

EVC NAME	DSE Managed Public Land Tenure Hectares	Parks Victoria Tenure Hectares	Grand Total Hectares
Cool Temperate Rainforest	149	1,548	1,696
Damp Forest	68	206	273
Montane Damp Forest	24	98	122
Montane Riparian Forest	19	16	36
Montane Wet Forest	861	1,904	2,765
Riparian Forest	2	19	21

Shrubby Foothill Forest	3	30	34
Sub-alpine Treeless Mosaic	0	0	0
Sub-alpine Woodland	18	129	147
Wet Forest	185	4,646	4,831
GRAND TOTAL	1,329	8,597	9,926

Barred Galaxias: Barred Galaxias is endemic to Victoria and is known to occur in only 12 streams, all within the headwaters of the Goulburn River system. The Barred Galaxias (*Galaxias olidus* var. *fuscus*), a variety of the Mountain Galaxias is a small scaleless fish restricted to upland streams above 400m in elevation. It is often the only native fish present and spends its entire life cycle in freshwater. The Barred Galaxias has a bulbous head with a thicker caudal peduncle and an over all body coloration of orange –yellow base with 10 distinct wide black vertical bars on the sides of its body (Raadik 1993).

The Barred Galaxias has suffered a serious decline over most of its range and has become fragmented within its limited range (Raadik 1993). In 1991 the Scientific Advisory Committee determined that Barred Galaxias are:

- in a demonstrable state of decline that is likely to result in extinction;
- significantly prone to future threats which are likely to result in extinction;
- extremely rare in terms of abundance and distribution;
- in need of special conservation until research can be carried out on its taxonomic status.

The decline is due in part to the predation and competition of introduced brown and rainbow trout on all native populations of galaxias. The Barred Galaxias is a non-migrating species (Raadik 1993) and has little ability to circumvent large instream barriers. Thus, it rarely re-colonizes areas after local extirpations occur. Competition for stream habitat, spawning grounds, feeding positions, and diet are reasons for decline or loss of barred galaxias populations (Shirley 1991, Cadwallader *et al*. 1980, Cadwalladar and Backhouse 1983). Other issues of concern include forestry and mining activities, development of alpine ski resorts, the exotic viral disease epizootic haematopoietic necrosis (EHN), poaching and the colonization of the Upper Goulburn River by the Broad-finned Galaxias, which compete with the Barred Galaxias for resources.

DIRECT FIRE EFFECTS: The major direct immediate impacts to Barred Galaxias come from high water temperatures and ash and smoke impacts in waterways as the flame front passed. These impacts would reduce dissolved oxygen, and increase pH, nutrient loads (nitrogen and phosphorus), and temperatures which could result in fish die-offs. The level of die-off could range from small isolated pockets of fish to the elimination of populations in entire sections of streams. The ash reduces dissolved oxygen while the fine silt smothers gills and habitat. The heavier silt and gravel will settle out within the first kilometer while the fine ash and silt will travel for hundreds of kilometers down stream, and affect populations that might have re-colonized upstream populations (F. Hames, pers. comm.).

INDIRECT FIRE EFFECTS: Indirectly, the degradation of instream and surrounding habitats would likely have the greatest impact on Barred Galaxias. Because these fish are found at higher elevations in headwater streams, catastrophic stripping of soil and ash from surrounding catchments during rain storm events can filter sediment and ash into streams and smother eggs, pool habitats, and food sources. This would also result in longer term degradation to water quality parameters such as dissolved oxygen, pH, temperature, conductivity,

and nutrient load. Loss of riparian vegetation increases water temperatures and alters flow regimes caused by increase surface and ground water uptake by re-growth of plants. See Table 4 for the area within the K-M South Complex Fire in Barred Galaxias stream habitats. The degradation of their habitat plus the increase predation and competition from the non-native brown and rainbow trout can extirpate whole populations from high elevation streams. Salvage logging activities post fire can increase sediment loads in already degraded streams and reduce any remaining shade that may be available for reducing temperatures in streams. The Barred Galaxias is a non-migrating species (Raadik 1993) and has little ability to circumvent large instream barriers and rarely re-colonizes areas after local extirpation occurs. Regrowth of forest within the catchment will likely result in declining streamflows in the interim period.

All of the remaining 12 populations of Barred Galaxias are being monitored to determine the levels of pH, dissolved oxygen, conductivity, turbidity and temperature. Of those streams, ten have been surveyed and fish removed from eight due to poor water quality (P. Fairbrother, pers. comm.). Since these populations have no source population downstream, translocation until water quality improves is the only way to mitigate impacts of the fire.

Table 4. Hectares of Barred Galaxias habitat, by EVC and Land Tenure in the Kilmore East-Murrindindi Complex South Fire; including sites along Rubicon River, Royston, Little Rubicon R., Torbreck River, Taponga River, and Big River *

EVC NAME	DSE – Managed Public Land Tenure Hectares	Parks Victoria – Parks/reserves Hectares	Grand Total
Cool Temperate Rainforest	280	57	337
Damp Forest	62	0	62
Montane Damp Forest	103	44	148
Montane Riparian Thicket	129	29	158
Montane Wet Forest	1,463	234	1,698
Riparian Forest	3	0	3
Sub-alpine Treeless Mosaic	11	47	57
Sub-alpine Woodland	25	253	278
Wet Forest	285	216	500
Grand Total	2,361	880	3,241

* Within the fire perimeter, vegetation mortality could not be mapped due to heavy smoke and cloud cover blocking satellite image.

Macquarie Perch: Originally widespread throughout the Murray - Darling Basin, the Macquarie perch is now limited to a few streams in New South Wales, Victoria and Australian Capital Territory. Of the remaining 9 populations of Macquarie Perch in Victoria, 6 are in the Goulburn River water system, less than 1% of their previous range. Nationally the perch is listed as endangered and for state and territories as endangered and vulnerable.

Background: Macquarie Perch (*Macquaria australasica*) is a deep bodied perch, black to gray to green-brown in color and pale underneath. It has a blunt snout, large eyes and rounded tail and can grow to 50 centimeters and 3.5 kilograms a live to be 20 years of age.

Because they live longer, the perch can capitalize on good years where conditions for spawning and recruitment are best.

Not aggressive predators they mostly rely on aquatic insects or crustaceans for their diet. This diet is very similar to the non-native trout species which competes with Macquarie Perch for food. Where the Perch resides, along the bottom or mid-waters of slow-flowing rivers with deep holes, in the upper reaches of forested catchments with intact riparian vegetation, is being threatened. Due to the extensive years of drought the annual flow in the upper Murray region, the key habitat for the Macquaries Perch, is predicted to be reduced by up to 30%. Coupled with high temperatures, sedimentation, reduced water flows due irrigation uptake, dams, and weirs the movement of this native fish along waterways is restricted and is affecting the fish's survival.

DIRECT FIRE EFFECTS: The impacts to Macquarie Perch are similar to the Barred Galaxias, however most known perch locations were outside of the fire. Those found within the fire would have suffered from increased water temperatures, and ash and debris deposits into waterways as the flame front passed. These impacts would reduce dissolved oxygen, and increase pH, nutrient loads (nitrogen and phosphorus), and temperatures which could result in fish die- offs. The level of die-off could range from small isolated pockets of fish to the elimination of populations in entire sections of streams. The ash reduces dissolved oxygen while the fine silt smothers gills and habitat. The heaver silt and gravel will settle out within the first kilometer while the fine ash and silt will travel for hundreds of kilometers down stream, and effect populations that might have re-colonized upstream populations (F. Hames, pers. comm.).

INDIRECT FIRE EFFECTS: Indirectly, degradation of in stream and surrounding habitats as a result of the fires would likely have the greatest impact on Macquarie Perch. Because this species is found at lower elevations than the Barred Galaxias, much of the heavier sediments will have fallen out of streams before is reaches perch locations. Water quality will be significantly degraded by fine sediments and ash inputs into stream following rain events. Water quality parameters such as dissolved oxygen, pH, temperature, conductivity, and nutrient load could be impacted for an extended period. Those perch sites that are further downstream of the fire area will be impacted to a lesser extent. However, the size of the catchments effected will likely produce significant amounts of run-off

Loss of riparian vegetation increases water temperatures and alters flow regimes caused by increase surface and ground water uptake by re-growth of plants. The degradation of their habitat plus the increase predation and competition from the non-native brown and rainbow trout can extirpate whole populations from high elevation streams. Salvage logging activities post fire can increase sediment loads in already degraded streams and reduce any remaining shade that may be available for reducing temperatures in streams. The Macquarie Perch is a non-migrating species (Raadik 1993) and has little ability to circumvent large in stream barriers and rarely re-colonizes areas after local extirpation occurs.

Of the remaining 9 populations of Macquarie Perch in Victoria, 6 are in the Goulburn River system and are being monitored for pH, DO EC, turbidity and temperature above 15 degrees by DSE. Of those streams King Parrot Creek has been surveyed and had fish removed due to poor water quality, the other five streams all are due to be surveyed and have fish removed if water quality declines. The three remaining streams are apparently less threatened, but will be monitored and fish will be removed if water quality declines (F. Hames, pers. comm.). Since these populations have no source population downstream translocation until water quality improves is the only way to mitigate impacts of the fire.

Powerful Owl: The Powerful Owl (*Ninox strenua*) is the largest owl found in Australia and is restricted to the mainland. In Victoria, the powerful owl has been recorded from woodlands and forests across most of the State with the exception of the drier north-west and riverine Red Gum forests along the Murray River generally downstream of its confluence with the Ovens River (NRE 1998a). There are limited reliable data on population size or densities across its Victorian and Continental range. Throughout its range, the Powerful Owl generally favors dense gullies for roosting and breeding sites. It prefers older forests where large tree hollows provide nesting sites and arboreal prey items

are plentiful.

The Powerful Owl reaches sexual maturity at two years of age. Mating for the life of the partner (Schodde & Mason 1980, Debus & Chafer 1994) records indicate nesting takes place during the winter months. Two eggs are laid in a large hollow lined with wood debris between June and July and young fledge at 10-weeks of age. During February and March the young disperse and establish new territories.

The Powerful Owl is an opportunistic, nocturnal hunter that preys mainly on arboreal or semi arboreal marsupials. Birds, insects and some terrestrial mammals are taken with some being characteristic of open country, indicating that Powerful Owls may forage on forest margins.

Since European settlement 65% of Victoria's forest cover has been cleared (Woodgate & Black 1988). Only 5% of freehold land remains forested. This past permanent loss of habitat has likely led to an overall reduction in owl numbers and fragmentation of the original populations into a series of smaller populations. Further to this forest utilization has removed significant areas of forests within older growth stages.

The Powerful Owl is sedentary and lives alone or in pairs which occupy a permanent territory containing a number of roost sites and one or more nesting sites. Adult pairs appear to remain within one large home range all their lives. Home range calculations based on estimated dietary requirements put this figure at 400-1500 ha. Home ranges are likely to be smaller in forest supporting higher densities of prey. It is estimated that hollows suitable for owls do not form even in the fastest-growing eucalypts, until they are 150-200 years of age (Parnaby 1995). Of the observed nesting trees in Victoria populations about 50% were senescent and all ranged between 350-500 years of age (McNabb 1996, Ambrose 1982). Over much of its range, the lack of suitably large hollows is considered to be a limiting factor to successful breeding and population recruitment. The protection of known and active nesting areas is considered crucial for recruitment and persistence of local populations. In addition, prey density may be an important determinant in territory size and breeding success, particularly considering that only the male hunts during the breeding season.

The EVC's preferred by the Powerful Owl include the Herb-rich Foothill Forest, Mixed Forest and Shrubby Foothill Forest (E. McNabb, pers. comm.). Within the fire perimeter approximately 50% of these habitats have suffered greater than >50% vegetation loss. Insufficient data was available to provide further information.

DIRECT FIRE EFFECTS: Though this species has a relatively large home range and is highly mobile, it is nocturnal and was likely roosting during the initial fire runs. Those individuals not near edges of the fire perimeter, or larger blocks of unburned bush may have been overcome by the heat and smoke of the flaming front. Due to the lack of population numbers in the fire area, it is not possible to calculate an estimate of the number of individuals that may have perished.

INDIRECT FIRE EFFECTS: The most significant indirect fire impacts to this species focus on loss of cover to support prey species and the loss of large hollow trees. The loss of forage species either as a direct result of the fire or through the temporary loss of cover in burned areas could result in decreased survival and reproductive success for the owl. However, immediately following the fire owls may benefit from the loss of cover and experience increased foraging success on prey species that survived the fire. This benefit will be short lived as prey populations will not maintain levels without adequate cover and other required resources. The movement of non-native rabbits and small foraging mammals populations into the areas inhabited the owl may supplement their forage base until the under story recovers and tree crowns are restored. Individual owls could expand their home ranges if prey density is low.

The loss of large hollow bearing trees is also a negative indirect effect of the fire. It is hard to know the exact extent of losses as large trees may survive or remain standing. Large

hollows are used for breeding and roosting and are a critical habitat component for the owl. The lack of hollows may force owls off of territories in search of more suitable habitat. Depending on the number of owls in the area, dispersing owls will create intra-specific competition which could negatively impact both individuals. While fire may destroy some large hollow bearing trees, it also leads to the creation of them when large branches are burned out and trees are variously injured. Determining Powerful Owl presence and territory density within and adjacent to the fire area is crucial in assessing fire effects to this species. This information will allow managers to decide if further stabilization measures are warranted. Salvage logging post burn of large hollow bearing trees will further fragment Powerful Owl habitat and reduce dispersal opportunities and increase genetic isolation. The loss of hollow-bearing trees has been listed as a potentially threatening process under the Flora and Fauna Guarantee Act 1988 (SAC 1991). It is important to minimize any further losses of trees during road rehabilitation.

Sooty Owl: The Sooty Owl (*Tyto tenebricosa*) so named for its sooty black upper parts and less dark underparts flecked with white is listed as a threatened species. (Hollands 1991, Olsen 1994, Schodde & Mason 1997). The owl is endemic to Australia with a sub-population in eastern Victoria from near Melbourne, east and northeast to the border with New South Wales. Within that area the Sooty Owl is numerically rare (1-9 individuals per 100km). Elsewhere in Victoria it is absent or very rare (<1 individual per 100km).

The Sooty Owl is a medium-large dark owl with short round wings, a very short tail and huge forward facing black eyes in a rounded facial disc. In Victoria, the Sooty Owl occurs in closed forests (rainforest) and tall open-forests. Preferring old growth (>165 years) Mountain Ash than younger regrowth (40-80 years), (Loyn 1985: Milledge *et al*. 1991) with population densities declining from mixed old growth to thinned/logged mixed regrowth mature sites (Loyn *et al*. 2001).

Mating for life, the Sooty Owl is sedentary, strongly territorial, and has large forested areas as a home-range. It roosts in dense shrubby vegetation, tree-hollows, caves, and ledges or crevices on rock faces. Nesting in large tree-hollows or caves the owl may breed every year with autumn-winter and early spring peaks (Hyem 1979: Debus 1994). Laying only one clutch with two eggs in any breeding year and rarely raises more than one fledgling (Peake *et al*. in prep, Schoddle & Tidemann 1986). The owl feeds on a variety of animals from arboreal gilders and possums to scansorial mammals such as agile antechinus and introduced black rat, terrestrial mammals, birds and reptiles. This diet varies with locations and stand size of the forest.

The EVC's preferred by the Sooty Owl include the Cool Temperate Rainforest, Damp Forest, Montane Damp Forest, Montane Wet Forest and Wet Forest (E. McNabb, pers. comm.).

DIRECT FIRE EFFECTS: Though this species has a relatively large home range and is highly mobile, it is nocturnal and was likely roosting in the dense understory or trees during the initial fire runs. The sooty owl was approaching the peak of its reproductive season, therefore nesting sites and eggs may have been lost due to the fire.

Those individuals not near edges of the fire perimeter, or larger blocks of unburned bush may have been overcome by the heat and smoke of the flaming front. Due to the lack of breeding pair population numbers and their exact extent of habitat in the fire area, it is not possible to calculate an estimate of the number of individuals or nests that may have perished. There are relatively large blocks of Sooty Owl preferred EVCs that burned in a mosaic pattern. Unburned tracts within mosaics could have provided some refuge for individuals.

INDIRECT FIRE EFFECTS: The most significant indirect fire impacts to this species focus on loss of cover to support prey species and the loss of nesting and roosting areas of understory thickets and large hollow trees. The loss of forage species either as a direct result of the fire or through the temporary loss of cover in burned areas could result in

decreased survival and reproductive success for the Sooty Owl. However, immediately following the fire owls may benefit from the loss of cover and experience increased foraging success on prey species that survived the fire. This benefit will be short lived as prey populations will not maintain levels without adequate cover and other required resources. As mentioned above the movement of non-native rabbits and small foraging mammal populations into the areas inhabited by the owl may supplement their forage base until the understory recovers. Individual owls could expand their home ranges if prey density is low.

The loss of large hollow bearing trees is also a negative indirect effect of the fire. Large hollows are used for breeding and roosting and are a critical habitat component for the owl. The loss of hollow-bearing trees has been listed as a potentially threatening process under the Flora and Fauna Guarantee Act 1988 (SAC 1991). The lack of hollows may force owls off of territories in search of more suitable habitat. Depending on the number of owls in the area, dispersing owls will create intra-specific competition which could negatively impact both individuals. While fire may destroy some large hollow bearing trees, it also leads to the creation of them when large branches are burned out. Determining sooty owl breeding pair presence and territory density within and adjacent to the fire area is crucial in assessing fire effects to this species. This information will allow managers to decide if further stabilization measures are warranted. Salvage logging post burn of large hollow bearing trees will further fragment Sooty Owl habitat and reduce dispersal opportunities and increase genetic isolation.

Brush-tailed Phascogale: The Brush-tailed Phascogale (*Phascogale tapoatafa*), is a small, nocturnal, arboreal, carnivorous marsupial of the Family Dasyuridae. It is a uniform deep grey on the head, back and flanks, pale cream underneath with large naked ears and has a conspicuous, intensely black 'bottlebrush' tail up to 230 mm long.

It is found in a variety of treed habitats having a reliable annual rainfall between 500 and 2000 mm (Cuttle 1983) but prefers open dry foothill forest with little ground cover. In Victoria the Brush-tailed Phascogale's distribution is fragmented. The species occurs in the foothills to the east and north-east of Melbourne; central Victoria around Ballarat, Heathcote and Bendigo; north-eastern Victoria from Broadford to Wodonga; and far western Victoria from Mt Eccles to Apsley. Significant habitat for this species occurs in Kinglake National Park, which has been identified as a Priority Management Area for the species. There is an annual monitoring program at this site.

Brush-tailed Phascogales are primarily arboreal, and forage for their diet, which is predominantly large insects, spiders and centipedes, on the trunks and major branches of rough-barked trees and fallen logs. Eucalypt nectar may be taken when ironbarks or boxes are flowering (Traill and Coates 1993). Brush-tailed Phascogales nest in as many as 30 different sites each year. Nests may be in hollows in dead or live trees, or in tree stumps. Nursery nests require large, secure cavities with small openings; competition for these cavities from other species is often intense. Where natural hollows are scarce, Brush-tailed Phascogales will use nest boxes as shelter and nursery sites (Soderquist *et al.*1996).

DIRECT FIRE EFFECTS: High intensity fire has affected the known population of Phascogales within Kinglake National Park. A number of nesting trees are likely to have been killed and all understory plants have been destroyed. This area is part of an annual monitoring transect for the species and is considered one of the priority management areas for the species across Victoria. Immediate fire effects are reduction in food availability, loss of all understorey and canopy vegetation and increased predation risk.

INDIRECT FIRE EFFECTS: Indirectly, the fire degradation of habitat will likely have the greatest impact on the Brush-tailed Phascogale, with loss of hollow bearing trees. The loss of cover will also increase the chance of predation by red foxes, raptors and owls.

The monitoring of Brush-tailed Phascogales presence/absence and abundance in burned areas will enable resource staff to better ascertain the impacts of the fire on this species

and its habitats. Consider supplement den sites, such as nest boxes, where loss of nest sites has occurred.

Viable connections between existing Brush-tailed Phascogale populations, particularly the Kinglake – Warrandyte link need to be maintained and improved in both the medium and long-term. The link could be improved by revegetation of what was area of farmland, now managed by Parks Victoria.

OTHER SPECIES OF CONCERN

A host of other sensitive species and those with no special status occur within or adjacent to the fire perimeter, or downstream of burned catchments. Analysis into the effects of the fires, suppression impacts, and emergency stabilization treatments to these species is beyond the scope of this BAER Wildlife Assessment. Time constraints, legislative mandates, and the opinions of local species experts guided the decision making of the BAER team in assessing wildlife resources affected by the fires. While the potential impact of the fire on populations of these species is high, there are other non-threatened species with similar habitat requirements that may have been more severely impacted even though they are comparatively more abundant (e.g. Yellow-bellied Gliders and Greater Gliders). Local concerns were expressed about the impacts to sensitive species that may have been affected by the fires; further study should be conducted to more accurately describe fire effects. Agencies with jurisdiction over these species should work to assess fire effects in both the short and long term.

The information below summarizes how individual groups of species that rely on similar habitat components (e.g. hollow bearing trees) may have been affected by the fire.

In addition to effects to threatened species discussed above, the 2009 Kilmore East-Murrindindi Complex South Fire is likely to have caused severe impacts to populations of other fauna groups, especially those species that are either arboreal, sedentary, and ground dwelling (or combinations of these attributes). While the fire may have provided a beneficial short term impact for some species, most are likely to sustain adverse impacts in the months following the fire due to loss of cover and prey species, increased predation and competition, and decreased water quality. Extensive areas of forest habitat have been significantly impacted, however the fire will also promote the development of hollows in dead standing (stags) and living trees. Hollow bearing trees are a critical habitat component for numerous fauna species.

The following is an assessment of other fauna species which may occur in the fire area as identified from the Atlas of Victorian Wildlife (AVW) database. It should be noted that some of the species included in the database may be due to incidental sightings. For some species the fire area may be at the edge of their range or along migration routes. The scope of the assessment and reporting process was limited due to time and information constraints.

The Victorian Fauna Database (VFD) was used to determine the response to fire of species recorded within the fire perimeter based on conservation status, specific habitat dependencies, behavior, breeding season, and diet. Fully or partially hollow dependent species were considered at high risk of mortality where fire has destroyed hollow bearing trees. That risk is compounded where other habitat elements (primarily understory plants) and required food resources are absent. For individuals that have survived the direct impact of the fire and immediate post-fire predation, the risk is expected to diminish slowly until habitat regeneration is advanced.

Table 5. Other species of concern (threatened species discussed in previous sections) impacted by the fires based on habitat needs and life history characteristics. Grouping based on analysis of VFD records.	
Species that are nocturnal and totally dependent on tree hollows for shelter	Yellow-bellied Glider, Southern Boobook, Sugar Glider, Feathertail Glider, Greater Glider, Australian Owlet-nightjar, Chocolate Wattled Bat, Gould's Long-eared Bat, Gould's Wattled Bat, Large Forest Bat, Little Forest Bat, Southern Forest Bat, White-striped Freetail Bat, Eastern False Pipistrelle, Lesser Long-eared Bat, Common Brushtail Possum, Mountain Brushtail Possum
Key prey species for higher order carnivores that are likely to be significantly less abundant 1-5 years post-fire. (Determined using an estimation of the relative abundance of these prey = more than 2% of all Victorian records for each key prey species being found in fire area).	Yellow-bellied Glider, Sugar Glider, McCoy's Skink, Dusky Antechinus, Garden Skink, Coventry's Skink, Common Ringtail Possum, Mountain Brushtail Possum, Greater Glider, Agile Antechinus, Bush Rat, Broad toothed Rat
Insectivores that may suffer from depletion of terrestrial insects for several weeks or months post-fire.	Southern Brown Bandicoot, Swamp Skink, White-footed Dunnart, Common Bent-wing Bat, Eastern Horseshoe Bat,
Carnivores likely to be advantaged in the immediate post-fire environment by the increased amount of carrion.	Lace Goanna, Australian Raven, Black Kite, Brown Falcon, Blotched Blue-tongued Lizard, Common Blue-tongued Lizard, Wedge-tailed Eagle, Whistling Kite, Spotted Quoll
Nectar and pollen eaters likely to suffer significantly by loss of preferred food resources for 2-3 years post-fire.	Common Possums, Gliders, Parrots and Lorrikeets, and Honeyeater species.
Threatened or rare herbivores likely to suffer from general loss of vegetation until significant rainfall.	Hardhead, Musk Duck
Forest dwelling March breeders that may not breed in the fire area this year	Southern Toadlet, Common Dunnart,
Fish and other estuarine animals considered at high risk from post-fire pollution of waterways	Broad-finned Galaxias, Mountain Galaxias, Harpactacoid Copepod, Murray Spiny Cray,

IV. RECOMMENDATIONS

Based on the results of the above observations:

A. Fire Suppression Repair

Rehabilitation of dozer tracks and handline within the interior of the fire area should be conducted as soon as possible to prevent further habitat degradation. In addition to general track rehabilitation, sensitive flora, fauna, and cultural areas should be identified and rehabilitated using appropriate techniques. These sites may require more delicate techniques such as hand work, rather than the use of heavy equipment in order to avoid further damage to resources. Local resource advisors should overlay dozer tracks, hand tool lines, fire retardant lines, and areas of heavy tree felling once mapping is completed with layers describing known sensitive flora, fauna, and cultural sites. Provision of additional resources is required to undertake these site assessments and development of site specific prescriptions. (e.g personnel for 6 months) All landowners that have fire containment lines should be contacted prior to recovery work, so as to determine if there are any site specific requirements. With this information land managers will be able to identify threats to these sites, prioritize sites for rehabilitation, and

prescribe the appropriate technique(s) to prevent further damage to these areas.

Dozer tracks and hand trails will serve as avenues for non-native red foxes, wild dogs, feral cats, rats, goats, pigs, deer, rabbits and introduced flora (weeds or pest plants), to reach deeper into areas of the bush that they were previously excluded from or where they existed in low population numbers. It is also likely that earth movement has transported weed propagules along fire-lines. These species may further degrade unburned areas or prevent the regeneration of vegetation in burned sites through browsing (rabbits and deer). Foxes, feral dogs and feral cats could increase competition for forage resources and predation risks to a host of species. In addition, the bare ground created by tracks can become infested with noxious and environmental weed species, which will further degrade habitats.

B. Emergency Stabilization

Water Quality Monitoring and Fish Translocation (see Part E)- An emergency stabilization specification was written to request funding for water quality monitoring in reaches of creeks with barred galaxias and Macquarie perch within and adjacent to the fire perimeter. Based on the findings of this monitoring, some populations of galaxia and perch were extracted from sites and housed in aquariums or hatchery facilities until water quality improves to the point where fish can be released back into sites (F. Hames, pers. comm.). The direct and indirect impacts of the fire could result in losses of individuals that could further threaten these already at risk species. The degradation of water quality and loss of riparian vegetation may further longer term threats to both the Barred Galaxias and Macquarie Perch. Determining impacts to water quality and if necessary, fish extraction will be paramount to this species continued persistence in these watersheds.

Steps to stabilize wildlife habitat are being specified by BAER Vegetation Specialists. These focus on invasive weed assessment/identification, treatment, and habitat monitoring. See the BAER Biodiversity-Flora Assessment and Weed Identification, Weed Treatment, and Vegetative Monitoring Specifications for further details.

C. Rehabilitation

Threatened Species Monitoring Specification (see Part E) - A Rehabilitation Specification has been written to request funding for monitoring of the Leadbeater's Possum. Monitoring is critical to determining the fire impact to this threatened species, and determining if further rehabilitation measures are needed. The Leadbeater's possum faces specific threats as a result of the fire including direct mortality, loss of hollow bearing trees and mid-story connectivity, and increased competition for resources. Immediate replacement of utilized nest boxes lost in 2009 fire. Provide supplemental den sites (nest boxes) in areas identified by ground truthing as lacking natural hollows and good LBP habitat. Maintain professional partnerships in recovery and ongoing long term monitoring. Closely monitor the surviving animals at Lake Mountain plateau and consider supplementary feeding program over winter (snow) season. Utilise monitoring cameras in the field to assist with species monitoring and to assist in driving recovery actions.

Monitoring will be focused in areas of known occurrence, established monitoring plots, and preferred EVC types (K. Marcoux, pers. comm.) and stratified across fire intensity classes. Monitoring should include some measures of vegetation composition and structural heterogeneity in order to associate species occurrence with habitat conditions. The data generated will provide researchers and land managers with information needed to ascertain short and mid-term effects to Leadbeater's possum survival/persistence and habitat conditions.

Reinstate the monitoring programs at Kinglake National Park for Brush-tailed Phascogale and determine the requirements for nestbox replacement within the Everard block. Facilitate animal movement through the Kinglake – Warrandyte link by undertaking targeted predator control and revegetation

Establishment of Trout Barriers - A Rehabilitation Specification has been written to request funding for the establishment of trout barriers within creeks/rivers known to contain populations of Barred Galaxias. Through a reduction in trout numbers, barriers will also allow Barred Galaxias to expand their range within waterways. A cost effective design has been successfully used on Leary's Creek, and can serve as a model for use in other waterways. Trout, introduced species, are a major predator of Barred Galaxias and have been shown to significantly reduce and/or eliminate galaxia populations (Barred Galaxias Action Statement, F. Hames, pers. comm.). The introduction of downed trees and debris into creeks/rivers, and increased flows due to higher rates of run-off in fire effected catchments, may alter stream hydrology and could allow trout to access areas they were previously excluded from. This coupled with degraded water quality as a result of the fire could significantly impact Barred Galaxias populations. While prevention of water quality degradation is difficult to prevent on a landscape scale, the establishment of trout barriers will help to mitigate the long term impacts to Barred Galaxias and other native fishes.

D. Management Recommendations – Non-Specification Related

1. Local DSE and Parks Victoria personnel should identify other species of importance and establish monitoring/research programs to assess fire impacts to these species and their habitats. The 2009 Australian Fires provide a unique opportunity for biologists and the scientific community to determine species and habitat responses to wildfire. Given the high level of interest regarding the effects of the fires to threatened species, it seems prudent for biologists to collaborate on a list of questions to address identified concerns. Other species to study/ monitor are, Broad-toothed Rat, Common Dunnart, Powerful Owl, Sooty Owl and Spot-tailed Quoll. The short time frame of this assignment only allowed the BAER Team to provide a cursory assessment of fire effects to the many other important species that contribute to the biodiversity of the area. Research and monitoring should seek to associate wildlife species abundance or density with habitat characteristics stratified across fire intensity and burn severity classes. Work should incorporate and build on existing datasets in order to make comparisons with pre-fire conditions. Findings should be incorporated into an adaptive management framework and used to determine if further measures are needed to rehabilitate populations and/or habitats.

2. Numerous research opportunities have been identified that focus on the Barred Galaxias. Much of this is a continuation of work conducted following the 2003 fires. It has been suggested that further surveys of these sites would be beneficial in predicting recovery rates. As data sets continue to grow predictive models can be developed that can be employed to illustrate which sites to protect/rehabilitate following future fires. The number of downed trees provides the opportunity to conduct in stream restoration using natural materials. Using logs and root balls to create in stream habitat structure and trout barriers is technique that is commonly used to increase habitat quality.

3. While the exclusion of trout through the establishment of barriers from creeks that contain galaxiids will protect these reaches, to expand the range of these species and other native fish subject to trout predation, trout should be removed from streams. We are aware that this is a controversial issue, as trout fishing is a popular outdoor activity; however the evidence

illustrating the impacts of trout predation on galaxia species is compelling. The Barred Galaxias Action Statement (DSE 1995) lists increasing populations of rainbow and brown trout as the main threats to Barred Galaxias population viability. It list three examples of the disappearance of Barred Galaxias following the upstream invasion by trout. Trout have recently been found in tributary 4 of the Torbrebk River, where they were previously unrecorded. It is likely that the barrier in the creek has been breached (Fairbrother , pers. comm.). The negative interaction between native galaxids and trout, mainly through predation and competition, has been well documented (Tilzey 1976, Cadwallader 1979, Raadik 1993).

A variety of techniques are available to remove trout from sections of creeks. Local resource professionals should work with trout interest groups to develop plans that will ensure trout free habitats for galaxiids while still providing ample fishing opportunities. For example, trout fishing is popular in the Goulburn River system, but not prevalent in small headwater streams which are generally inaccessible and have high densities of small fish (Barred Galaxias Action Statement, DSE 1995). Trout removal in this instance should have minimum impact on recreational fishing. Communication and open dialog should occur between all parties to be clear that the intention of any removal actions are small-scale, specific efforts and not interpreted as threatening to major recreational fisheries. Any removed trout should be either destroyed or if relocated, then placed in waterways disconnected from removal site so as to avoid potential of naturally spawning fish returning to their spawning ground.

4. The loss of large hollow bearing trees has been listed as a threatening process in the Flora and Fauna Guarantee Act (1988). As such, land managers are obliged to manage hollow resources sustainably. The preservation of as many of these trees as possible is crucial to the approximately 400 fauna species (Ambrose 1982) that depend on them, of which approximately 100 are listed as rare, threatened, or near-threatened in state or commonwealth endangered species legislation. For many of these species the use of hollows is obligate; no other habitat resource represents a feasible substitute (Gibbons and Lindenmayer 2002). Though there is an economic need to salvage log areas impacted by the fires, extreme care should be exercised in removing large hollow bearing trees from areas of the landscape. Salvage logging after the 1939 fires within the study area “contributed to a pronounced shortage of cavity trees for more than 40 species of vertebrates—a major biodiversity conservation problem that will take more than 200 years to rectify” (Lindenmayer et al. 1997 quoted in Lindenmayer and Noss 1996). It is recommended that none be removed from fire affected areas known to contain Leadbeater’s Possum, Powerful and Sooty Owls, and within Leadbeater’s Possum reserves. The indirect effects of the fires will result in decreased cover and prey abundance and increased competition and predation. The mid-story canopy which provides habitat connectivity and allows arboreal mammals to move through forests has been lost. These impacts in conjunction with decreased numbers of hollow bearing trees per hectare in most forests types due to silviculture, firewood collection, die backs, grazing, and clearing (Gibbons and Lindenmayer 2002), could lead to significant negative effects. Further loss of a critical habitat component, such as hollow bearing trees, will decrease the chances of survival and persistence of these species in many areas. In general, salvage logging in less sensitive areas should be well planned to minimize decreases in large hollow bearing tree density. Surveys prior to harvest should be conducted to identify large hollow bearing trees to be left standing. The number of trees/ha should strictly follow prescriptions in the Fire Salvage Harvesting Prescriptions (2008). During salvage operations surveys should be conducted to ensure prescriptions are being followed and regulations are

enforced.

Given the extent of the three large fires in the past six years and the significant reduction in available hollows amongst appropriate habitat/food resources and the subsequent threat this presents to hollow dependant species, further consideration should be given to increasing the number of large trees/Ha retained as part of fire salvage harvesting prescriptions. The reduction of available log volumes must not be supplemented from other logging areas; rather the volumes must be reduced to reflect the overall depletion of the timber resource and habitat resource. Logging license volumes must be reviewed and if necessary reduced to reflect the decreased availability of suitable saw logs as a result of the three large fires in the past six years.

5. Review of fuels management and fire ecology plans should be conducted and available data should be analyzed by appropriate resource personnel to determine if fire return intervals are too small. Steps should be taken to ensure that fire return intervals mimic historic fire regimes in individual EVCs as closely as possible while still providing for public safety. An increased frequency of fire within many of the EVCs in the fire area can lead to type conversion to an earlier seral ecological stage. This could have significant negative consequences for a host of wildlife species, rare flora communities, timber resources, and public safety. A blanket approach to fuel reduction burns across a landscape as diverse as the habitats across the Central Highlands region will not take into account the complicated fire regimes that occur there. In short, each unique habitat type has a unique fire regime that has evolved over time. Analysis of available data, careful review of published literature, and collaboration between resource professionals should be used to guide fuel reduction burns and fire management planning. A review of any planned fuel reduction burns for 2009 within the fire affected area should be undertaken.

6. Linking unburned patches and areas of low intensity fire should be made a high priority to enable fauna dispersal and re-colonization. Threats to habitat corridors should also be identified and mitigated in order to improve movement among habitat types and populations of individuals. Identification of major wildlife corridors should be made based in priority order on, unburned areas within the current reserve system (National Parks and Leadbeater's Possum Reserves), unburned areas of mountain and alpine ash, areas of low intensity fires, riparian corridors, and areas with moderate to severe intensity vegetation mortality which link the remaining green areas.

7. The fires have resulted in the loss of large amounts of riparian vegetation that is critical in shading creeks and streams and maintaining low water temperatures. These low water temperatures are important to the survival of native galaxiids and Macquarie Perch. While much of the riparian vegetation within the fireground will regenerate naturally, active re-vegetation of fire impacted riparian areas may be necessary on private land and plantation areas etc. This work should commence as soon as possible in order for vegetation to develop and begin to shade creeks and rivers. Land managers should encourage private land owners to restore native plants along water courses through the use of government incentives and grants (e.g. Land Care). Fence off-set coupled with native plant community recovery would widen riparian corridors and provide the maximum benefit to riparian dependent fauna species. Consider temporary shade structures along sections of small creeks where no shade is currently available.

8. Numerous kilometers of fence that have been damaged or destroyed by the fires will be repaired in the coming months. While downed trees along fence lines should be relocated so as to allow fence reconstruction, we strongly recommend that large standing trees near fence lines not be cut unless they represent a clear and immediate hazard. Retention of fallen material within the general area is preferable rather than removing off site or burning, unless the volume of fallen material is significantly above the coarse woody debris benchmark levels. DSE/DPI must clarify their position on the use of barb wire in fence reconstruction. Government grant guidelines prohibit the use of barbwire in fencing grants due to detrimental impacts on wildlife. This policy requires urgent review for application in all Crown land boundary fences as it is highly likely that barb wire will be used unless prevented by government authorities. Fence lines between the public and private interface are often found at the toe of slopes where soils are deeper and allow trees to grow larger. These larger older trees often contain hollows that are a critical habitat component for a variety of wildlife. For many species of native wildlife the use of hollows is obligate; no other habitat resource represents a feasible substitute (Gibbons and Lindenmayer 2002). Land owners should be encouraged to leave trees and offset fences away from tree lines through the use of government incentive, cost-share, and grant programs that provide the land owner with financial assistance. Additional resources are required so DSE personnel can provide site assessments and extension related activities to encourage retention of these trees. Failure to provide assistance in tree assessment will result in unnecessary tree removal which will compromise critical habitat values for hollow dependant species. It is recommended that Landholders should check with their local Council to clarify exemptions / permit requirements

9. Local DSE and Parks Victoria staff along with pest animal management specialists should further evaluate the threats posed by red fox, wild dogs, feral cats, goats, pigs, and rabbits to determine if steps to control these species are warranted.

   Reduction in biodiversity of native vegetation by Sambar deer (*Cervus unicolor*) has been listed as a threatening process under the FFG Act 1988. The fire presents and unprecedented opportunity to greatly reduce and control the numbers of feral Deer species (including Sambar deer, Red deer, Fallow deer and Wapiti) across the fire-ground. Deer numbers and densities can be expected to have declined as a consequence of the fires. However deer populations returning to the burned areas will have the potential to severely impact the native vegetation particularly palatable obligate seed regenerating shrubs. Deer monitoring and control should be initiated to investigate, monitor and mitigate these anticipated impacts. Plans should be developed in consultation with relevant stakeholders towards this objective.

   The existing joint PV and Melbourne Water deer control (shooting) program should be boosted. It may be necessary to modify or adjust the focus to include areas with high floral/ faunal values in the South Complex Fire area. Areas to be considered for increased focus include the Deep Creek reference area, known *Shiny Nematolepsis* and *Pomaderris vaccinifolia* sites and Kinglake National Park where germinating seedlings are all at increased risk of browsing.

   Browsing by goats is a threat to regenerating habitat and threatened flora populations in the Kinglake area. There is an opportunity within this post fire environment to eliminate goats in this area and eliminate the threat.

10. Wildlife rescue teams should operate within the Incident Management Team to ensure that injured wildlife are collected, rehabilitated, and released back into native habitats.

V. CONSULTATIONS

The following people participated in post fire reconnaissance, data collection and analysis, and developing the information included in this assessment.

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VI. REFERENCES

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Legislation

Conservation, Forests and Lands Act 1987 — provides for the management of public land under the Act, the co-ordination of legislation administered by NRE and for the preparation of Codes of Practice.

Crown Land (Reserves) Act 1978 — provides for reserving areas as public land and for making a specific reservation status for existing public land.

Country Fire Authority Act 1958 — provides for fire protection and suppression in country areas and requires that authorities take practical steps for the prevention of fires.
Domestic (Feral and Nuisance) Animals Act 1994 — provides for the management of domestic and feral cats and dogs to be in accord with responsible pet ownership.

Endangered Species Protection Act 1992 — provides for the protection and conservation of threatened species of plants and animals throughout Australia.

Flora and Fauna Guarantee Act 1988 — provides for the protection of flora and fauna in Victoria through a range of mechanisms including the determination of critical habitat.

Forests Act 1978 — provides for the management of forests, including fire management and controls over the taking of forest produce.

Local Government Act 1958 — provides for local municipal by-laws and conservation regulations (e.g. permit requirement for land clearing).

Mineral Resources Development Act 1990 — provides for the facilitation of mineral development and management of mineral resources and includes controls over exploration and mining activities to minimise impacts on the environment.

National Parks Act 1975 — provides for the preservation, protection and management of specified natural areas and includes controls over taking native flora and fauna from parks.

Planning and Environment Act 1987 — provides for the protection of native vegetation through the State section, and for regional planning controls in all planning schemes.

Victorian Conservation Trust Act 1972 — provides for the establishment of conservation covenants on land titles.

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Wildlife Act 1975 — provides for the management of wildlife and includes controls over the handling of protected wildlife. The status of the Brush-tailed Phascogale as protected wildlife makes the taking of it an offence under the Act unless an appropriate permit has been obtained.

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