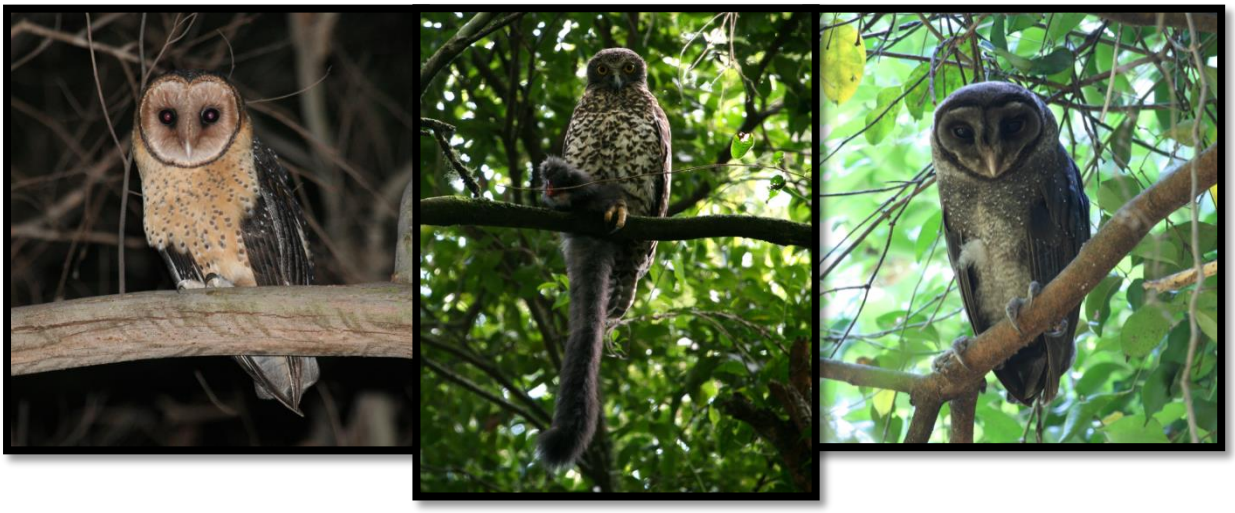
Report on the potential impact of the 2014 'Orbost Fire Complex' on Large Forest Owls in the East Gippsland Forest Management Area

By

Rohan J. Bilney



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Report for

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Prepared by

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Front Cover Images: Top - A collapsed Sooty Owl nest tree following fires in East Gippsland in January 2007 with the nest hollow near centre of the image. **Below** – left to right – female Masked Owl, female Powerful Owl with Greater Glider, male Sooty Owl. All photos by Rohan Bilney.

Rohan John Bilney

I have read and understand the Expert Witness Code of Conduct and agree to be bound by it.

Education

2005-2009	**Doctor of Philosophy**
	Deakin University, Burwood Campus
2004	**Bachelor of Environmental Science (Honours)**
	Deakin University, Burwood Campus
2001-2003	**Bachelor of Science (Zoology, Ecology & Evolution)**
	Monash University, Clayton Campus

Qualifications and Experience relating to owls

Since 2002 I have been undertaking research into the ecology of Sooty Owls and Powerful Owls in East Gippsland. This research contributed towards my Honours degree (in 2004) and eventually PhD (2005-2009). The ecological attributes that I investigated included diet, roosting, breeding, habitat utilization, and home-range. This research culminated in amongst the most detailed ecological studies ever undertaken on these owls. In contrast, the ecological information I have collected on Masked Owls is limited, and mainly includes short-term radio-tracking of several individuals and general observations of the species while undertaking research on Powerful Owls and Sooty Owls. From my research on owls I have written 11 papers published in scientific journals (see list below), with several more papers expected. Since completing my PhD I periodically visit some long-term study sites to monitor owl activity and collect dietary items (for a long-term dietary study). In recent years I have also undertaken contract work for various clients conducting call-playback surveys and dusk listening surveys to detect owls throughout East and South Gippsland.

Publications relating to owls

L'Hotellier, F. and Bilney, R. (in progress). The diet and roosting sites of Sooty Owls from coastal habitats at Cape Conran, Victoria.

Bilney, R.J. (2014). Poor historical data drive conservation complacency: the case of mammal decline in south-eastern Australian forests. *Austral Ecology (online early)*

Bilney, R.J. (2013). Geographical variation in the diet of the powerful owl *Ninox strenua* at a local scale. *Australian Journal of Zoology* **61**, 372-377.

Bilney, R.J. and L'Hotellier, F. (2013). Observations of Masked Owls *Tyto novaehollandiae* in East Gippsland, Victoria. *Australian Field Ornithology* **30**, 113-125.

Bilney, R.J. (2013). Home-range, diet and breeding of a Powerful Owl *Ninox strenua* in East Gippsland. *Australian Field Ornithology* **30**, 40-46.

Bilney, R.J. (2012). A reassessment of the predator responsible for Wakefield's 'Natve Cat den' sub-fossil deposits in the Buchan district: Sooty Owl, not Eastern Quoll. *The Victorian Naturalist* **129**, 138-143.

Bilney, R.J., White, J.G. and Cooke, R.. (2011). Reversed sexual dimorphism and altered prey base: the effect on sooty owl (*Tyto tenebricosa tenebricosa*) diet. *Australian Journal of Zoology* **59**, 302-311.

Bilney, R.J., Cooke, R. and White, J. (2011). Potential competition between two top-order predators following a dramatic contraction in the diversity of their prey base. *Animal Biology* **61**, 29-47.

Bilney, R.J., White, J., L'Hotellier, F.A. and Cooke, R. (2011). Spatial ecology of sooty owls in south-eastern Australian coastal forests: implications for forest management and reserve design. *EMU* **111**, 92-99.

Bilney, R.J., Cooke, R. and White, J. (2010). Underestimated and severe: Small mammal decline from forests of south-eastern Australia since European settlement, as revealed by a top-order predator. *Biological Conservation* **143**, 52-59.

Bilney, R.J. (2009). Sooty Owl secrets. *Wingspan* **19**(3), 16-19.

Bilney, R.J., Kavanagh, R.P. and Harris, J.M. (2007). Further observations on the diet of the Sooty Owl *Tyto tenebricosa* in the Royal National Park, Sydney. *Australian Field Ornithology* **24**, 64-69.

Bilney, R.J., Cooke, R., and White, J. (2006). Change in the diet of Sooty Owls since European settlement: from terrestrial prey to arboreal prey and increased dietary overlap with Powerful Owls. *Wildlife Research* **33**, 17-24.

Theses

Bilney, R.J. (2009). Sooty Owl ecology and recent small mammal decline. (Unpublished PhD Thesis. Deakin University, Melbourne)

Bilney, R.J. (2004). Dietary change of Sooty Owls (*Tyto tenebricosa*) since European settlement: their response to fox control and dietary overlap with Powerful Owls (*Ninox strenua*) in East Gippsland, Australia. (Unpublished Honours Thesis. Deakin University, Melbourne).

1. What is the conservation status of the Sooty Owl, Powerful Owl and Masked Owl in Victoria?

In Victoria, the Powerful Owl *Ninox strenua*, Sooty Owl *Tyto tenebricosa tenebricosa* and Masked Owl *Tyto novaehollandiae novaehollandiae* are all listed under the Flora and fauna Guarantee Act 1988 as threatened (Webster *et al.* 1999; Schedvin *et al.* 2003; Silveira *et al.* 2003), with the Powerful Owl and Sooty Owl considered Vulnerable and the Masked Owl Endangered (DSE 2013). They are not listed under the EPBC Act 1999, and all are listed as Least Concern under the IUCN Red List.

2. Are there any threats to the continued survival of any of these species? If so, please describe them briefly.

Threatening processes to all three species of large forest owl are similar, and primarily include factors that reduce the availability of key resources (habitat, prey, nesting and roosting sites), such as clearing, exotic species, logging and altered fire regimes (Kavanagh 2002; Bilney 2009). Predation by exotic species (Feral Cat *Felis catus*, Red Fox *Vulpes vulpes*) on small mammals reduces the abundance of prey available for owls (Dexter and Murray 2009; Bilney *et al.* 2010), while exotic herbivores (e.g. rabbits *Oryctolagus cuniculus*, feral horses *Equus caballus*, deer, feral goats *Capra hircus*, feral pigs *Sus scrofa*) alter vegetation structure and composition, potentially impacting important habitat features for the owls and their prey (Bilney 2009, 2014). Logging removes roosting and nesting sites used by owls and some prey species, alters habitat quality by modifying and simplifying vegetation structure and composition, resulting in the loss of hollow-bearing trees, the reduced recruitment of hollow-bearing trees and increased fire susceptibility (Kavanagh 1997; Gibbons and Lindenmayer 2002; Garnett *et al.* 2003; Hollands 2008; Lindenmayer *et al.* 2009; Bilney 2009). Logging impacts upon the abundance of small mammals, especially of hollow-dependent arboreal mammals, thereby reducing food availability for owls (Gibbons and Lindenmayer 2002; Lunney *et al.* 2009; Bilney 2009, 2013). Fires can kill individual owls and their prey, while consuming important habitat including roost and nest sites (Schedvin 2007; Hollands 2008; Bilney 2009). Frequent fires can simplify vegetation structure and composition which is detrimental to most small mammals, while infrequent hot fires can be at so severe that most critical resources can be consumed (Catling 1991; Bilney 2009; Lindenmayer *et al.* 2012, 2013).

3. Please briefly describe the optimal habitat of the Sooty Owl, Powerful Owl and Masked Owl.

Detailed analysis of optimal habitat for large forest owls in East Gippsland has been described by McIntyre and Henry (2002). Powerful Owls are not closely associated with any particular forest type, being virtually capable of occupying most forested habitats, with the total area considered optimal habitat in East Gippsland equalling 999,276ha. Sooty Owls are closely associated with damp and wet forest types and rainforests at low elevation, with the total area considered optimal habitat in East Gippsland equalling 507,778ha. Masked Owls are closely associated with coastal lowland forests, especially Banksia Woodland, with the total area considered optimal habitat in East Gippsland equalling 314,932ha.

4. Do forestry operations have an impact on the habitat of the Sooty Owl, Powerful Owl and Masked Owl?
(a) If yes, can you identify what aspects of forestry operations have an impact on the habitat of the species or the species themselves?
(b) If yes, can you describe or quantify the impact?

(c) If yes, can you explain the impact with particular reference to the prospects of each of the Sooty Owl, the Powerful Owl and the Masked Owl successfully breeding and raising young to adulthood, and those adults surviving to breed successfully?

Logging is considered to represent amongst the greatest threats to owl populations, and most owl conservation measures are targeted towards mitigating the impacts of forestry operations (Webster *et al.* 1999; Kavanagh 2002; Silveria *et al.* 2003; Schedvin *et al.* 2003; DEC 2006). However, it is important to recognise that due to the limited extent of logging across the landscape (i.e. approximately 32% of East Gippsland is available to logging), that logging alone is not a threat to the species survival *per se*. Instead, it is the accumulative impacts of logging that can reduce the availability of resources across the landscape that makes the owls less resilient and more vulnerable to other threats (e.g. to stochastic events such as wildfire and continued impacts of exotic species). It is also possible that logging has the potential to exacerbate wildfire severity in some landscapes (Lindenmayer *et al.* 2009; Attiwill *et al.* 2013; Bradstock and Price 2014; Attiwill *et al.* 2014).

The short-term impacts of logging can include the loss of roost and nest sites and a reduction in prey availability, but the long-term impacts appear to vary geographically due to differing prey responses; and it is prey availability that is likely to dictate how owls respond to logging more than any other factor (Kavanagh 1997, 2002; Bilney *et al.* 2011b; Kavanagh 2013). For example, clear-fell logging severely depletes the densities of hollow-bearing trees in the landscape and can result in the long-term decline of important prey species (including arboreal and terrestrial mammals) (Smith and Lindenmayer 1988; Kavanagh and Bamkin 1995; Gibbons and Lindenmayer 2002; Garnett *et al.* 2003; Bilney 2009; Lunney *et al.* 2009). Logging in such landscapes is likely to have considerable impacts on owls (Kavanagh 2002; Bilney 2009). However, in other landscapes, non-hollow dependent mammals (such as Common Ringtail Possums *Pseudocheirus peregrinus*) can reach high densities in regrowth several decades after logging and consequently support high densities of owls (Kavanagh 1997; 2002; DEC 2006; Kavanagh 2013).

The results of studies investigating the impacts of logging on owls are therefore often conflicting, probably due to spatially varying resource availability, forest age and potentially sample sizes and study design (Kutt 1994; Kavanagh and Bamkin 1995; Kavanagh *et al.* 1995; Kavanagh 1997; Kambouris 2000; Alexander *et al.* 2002; Cann *et al.* 2002). For example, in some studies Masked Owls have been detected less frequently in areas subjected to clear-felling logging (Kavanagh *et al.* 1995; Kavanagh 2002), whereas they have also been detected more frequently after logging (Cann *et al.* 2002). Studies have shown that owls typically occupy selectively logged and unlogged forests at similar frequencies, but at lower frequencies in heavily logged (clear-fell) areas (Kavanagh *et al.* 1995; Kavanagh 2002). The impacts of logging appears to be reduced by the retention of stream-side buffers, and retention of significant areas of unlogged habitat surrounding logged areas (Kavanagh 2002).

The greatest impact caused to Sooty Owls and Powerful Owls by logging will be the impacts on populations of hollow-dependant mammals where they dominate the owls diet, and where non-hollow-dependant prey are uncommon (Kavanagh 2002; Bilney 2009). Greater Gliders *Petauroides volans* and Sugar Gliders *Petaurus breviceps* are amongst the main species most adversely affected by clear-fell logging (Tyndale-Biscoe and Smith 1969; Lunney *et al.* 1987; Lindenmayer *et al.* 1997; Kavanagh and Webb 1998; Kavanagh 2000; Gibbons and Lindenmayer 2002), therefore the overall reduction in abundance of these two species following logging will likely have deleterious impacts on the owls in many landscapes. In some areas of Gippsland, hollow-dependent arboreal mammals (mainly the Sugar Glider and Greater Glider) constitute on average 75% of the dietary intake of both Powerful Owls and Sooty Owls (Bilney *et al.* 2011b). This is primarily because they are virtually the only common species remaining following dramatic declines in small terrestrial mammals (e.g. especially terrestrial native rodents, bandicoots) associated with European settlement (Bilney *et al.*

2006, 2010, 2011a). Therefore, regrowth forests support low prey availability, and have been shown by radio-tracking studies to be avoided by owls (Bilney 2009; Bilney *et al.* 2011c).

The capacity for small mammal populations to recover post clear-fell logging is constrained by the alteration of forest composition and structure. Although some eucalypt species can begin forming hollows within ~100 years (Gibbons and Lindenmayer 2002), with forest composition often altered after logging there is limited capacity for hollow-dependant mammals to achieve the same abundances as prior to logging. This is particularly the case in lowland forest types in Gippsland where virtual monocultures can regrow, particularly of Silvertop Ash *Eucalyptus sieberi*, which supports low densities of arboreal mammals due to forming few hollows and is nutritionally poor (for folivorous species such as Greater Glider, *Trichosurus spp*. and Common Ringtail Possum) (e.g. Braithwaite *et al.* 1988; Kutt 1994; pers. obs.). Therefore in many areas the densities of hollow-dependent mammals has been permanently affected.

How individual owls are affected by logging is poorly understood, but several individuals have been radio-tracked in areas subject to extensive logging history. Kavanagh (1997) found that owls still foraged in logging regrowth (where densities of Common Ringtail Possums were high and dominated the owls diet), but they nested and roosted predominantly in unlogged areas. No statistical analysis was conducted to determine if any selection or avoidance of forest structure was occurring. Bilney *et al.* (2011c) radio-tracked two Sooty Owls in East Gippsland that occupied home-ranges subject to extensive logging history. Both owls significantly avoided logging regrowth (primarily <40 year regrowth), primarily because their diet comprised high proportions of hollow-dependant mammals, and species such as Common Ringtail Possums were rare in the region.

Although logging operations are unlikely to directly cause the mortality of adult birds, nestlings would be killed, eggs would be destroyed, and recently fledged juveniles could be killed. Even disturbance caused by logging machinery nearby to a nest could result in the abandonment of nesting events and even nest sites, hence why unlogged buffers (50-300m) are mandatory around all known nest sites (e.g. Webster *et al.* 1999; DEC 2006). The effectiveness of an unlogged buffer distance has not been tested, so the established distances are based on speculation. Therefore, it is important to recognise that the impacts of logging is not confined to the area actually harvested. The size of a clear-fell logging coupes cannot exceed 40 ha (DSE 2007), which does only represent a small fraction of an owls home-range (e.g. 4% of a 1000ha home-range). However, if harvesting activities can disturb nesting within 300m (as specified within all owl species action statements), then the impacts upon the landscape is dramatically larger. For example the smallest dimensions of a 40 ha coupe is a circle with a diameter of 713m, but with a 300m potential disturbance zone around this, the 'disturbance area' becomes over three times larger at 135.3 ha in size. Any other shape would result in a larger area being affected (e.g. a rectangle coupe of 1000m x 400m has a 'disturbance area' of 160 ha). Therefore the potential impact to breeding of harvesting a 40 ha logging coupe is considerably high (potentially 1/3 of a territory size of 500 ha). The size of this disturbance area is concerning when Sooty Owls and Masked Owls can breed at any time of year (Kavanagh 1997; Hollands 2008; Bilney *et al.* 2011a), so it is virtually impossible to avoid harvesting outside the breeding season.

Although individual owl nests and roosts are likely to be lost during logging activities, how this impacts upon owl populations remains unknown. It is considered that nesting hollows are sufficiently abundant in most forested landscapes (including heavily logged areas), as the owls only require one hollow for breeding per year (several nesting hollows may be required within a home-range long-term). Therefore the unlogged riparian buffer areas can provide important nesting and roosting habitat in logged landscapes (Kavanagh 1997).

It is difficult to quantify the impacts of logging, but it is important to consider the cumulative impacts of logging over time. Selective logging has occurred throughout most forests for over 100 years while clear-fell logging has been occurring since the 1960s, which has significantly altered stand structure (McKinty 1969). To my knowledge, information on the total area clear-felled logged in East Gippsland is not publically available, but in 1995 it was considered that approximately 32% of the forest was available for logging (DCNR 1995). It is also important to recognise that logging is not uniformly conducted across the landscape, with some regions and habitats disproportionately targeted. This is often highly fertile wet/damp/tall forest types on flat terrain, which includes optimal Sooty Owl habitat.

Overall, logging activities have the potential to affect the 'carrying capacity' of the landscape for owls long-term (in terms of mammalian biomass), especially in areas where non-hollow-dependent mammals are uncommon. This reduction in carrying capacity would impact upon owl home-range size, breeding success, population densities and population size within the landscape. However, it remains unknown how much logging can be tolerated by owls before it impacts upon home-range size and breeding success. Owl home-ranges are large (usually >1000ha, but up to 4500ha: Soderquist and Gibbons 2007; Bilney *et al.* 2011), so a large proportion of home-ranges in East Gippsland would incorporate some logging history. It is important to recognise that logging only a small percentage of an owl's home-range could result in adverse impacts on breeding success and owl densities due to reduced resource availability (e.g. Baker-Gabb 2013). It is also difficult to quantify the true impacts upon the owls without having detailed knowledge of the owl's historic and current population size.

5. Are the Sooty Owl, Powerful Owl and Masked Owl present in the area of East Gippsland? If so,
(a) Can you say where and to what extent they have been found in East Gippsland?
(b) Can you produce a map which shows the precise locations in which they have been found prior to 2009? Please indicate in your response the details of the researcher and the date on which detections/records were found (so far as you are aware).
(c) Can you produce a map which shows the precise locations in which they have been found in the last 5 years (ie since 2009)? Please indicate in your response the details of the researcher and the date on which detections/records were found (so far as you are aware).

As revealed by the Victorian Biodiversity Atlas (VBA), all three large forest owl species have been detected throughout East Gippsland (Figures 1, 2 & 3). Both the Powerful Owl and Sooty Owl are widely distributed, whereas most records of the Masked Owl are closely associated with coastal and lowland forests.

The VBA records I have access to were up-to-date in September 2013, but the latest owl record included was April 2011. It would be a difficult process for me to summarise details of each owl record obtained prior to 2009, other than to specify that records were submitted from various members of the community, including private citizens, government researches, university researchers and environmental consultancies (many individuals who made records are unknown to me). Between 2009-2011, a total of 101 owl records were submitted, with most coming from staff members associated with Environmental Consultants (80), DEPI/ARI (10) and VicForests (9) (Table 1).

Table 1. The number of owl records on the Victorian Biodiversity Atlas between 2009 and 2011, and organisations where observers work.

	Powerful Owl	**Sooty Owl**	**Masked Owl**
Environmental Consultancy			
- Wildlife Unlimited	23	25	16
- Ecology Australia	4	8	1
- Biosis	1	2	
VicForests	4	3	2
DEPI/ARI	6	4	
Unknown (private ecologist?)	1		
Birdlife East Gippsland member	1		
Total	**40**	**42**	**19**

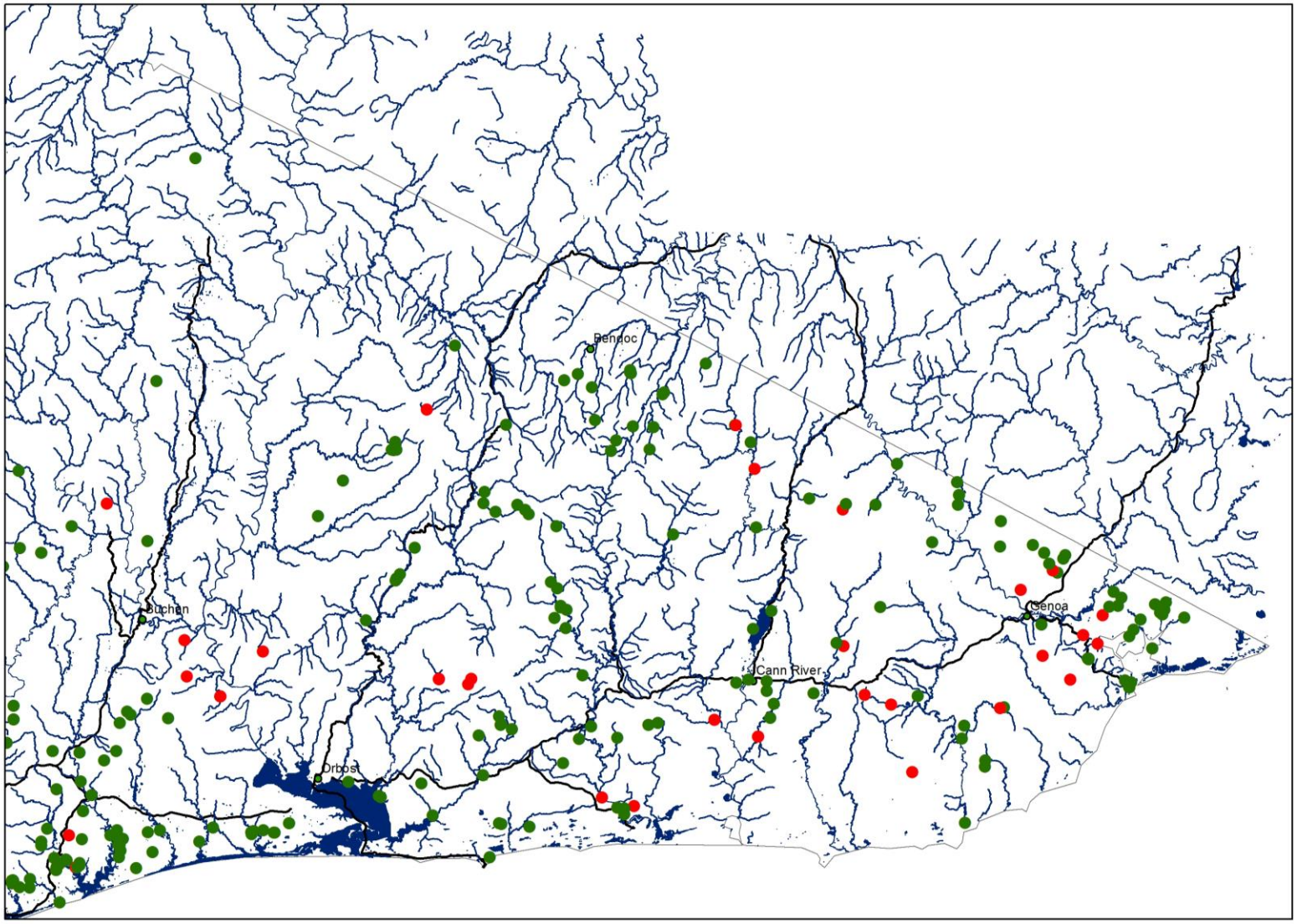

Figure 1. Powerful Owl records in East Gippsland as represented on the Victorian Biodiversity Atlas (as of October 2013). Green dots represent records pre-2009, Red dots represent records between 2009 and 2011. Hydrology and floodplains are blue, major roads are black lines.

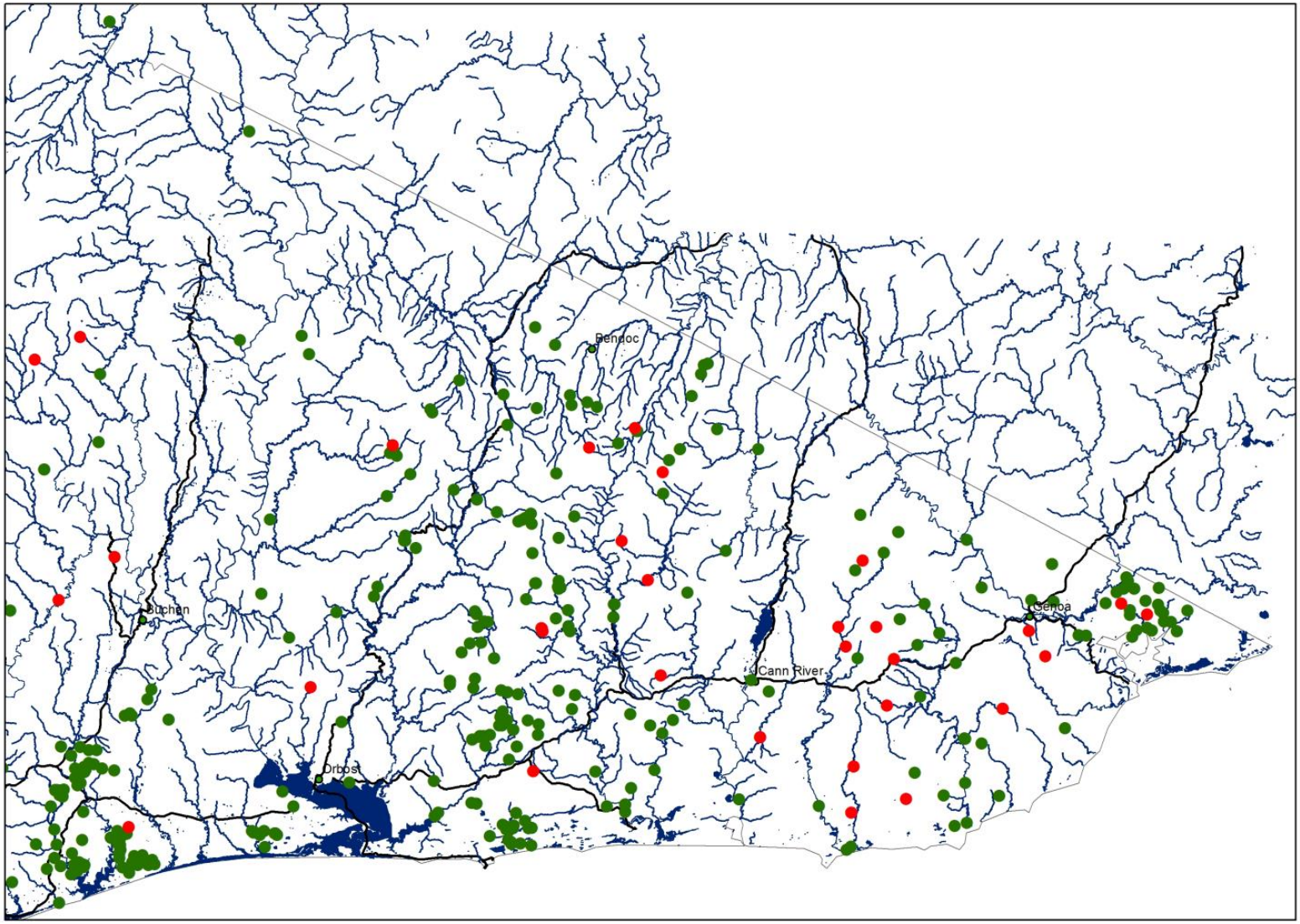

Figure 2. Sooty Owl records in East Gippsland as represented on the Victorian Biodiversity Atlas (as of October 2013). Green dots represent records pre-2009, Red dots represent records between 2009 and 2011. Hydrology and floodplains are blue, major roads are black lines.

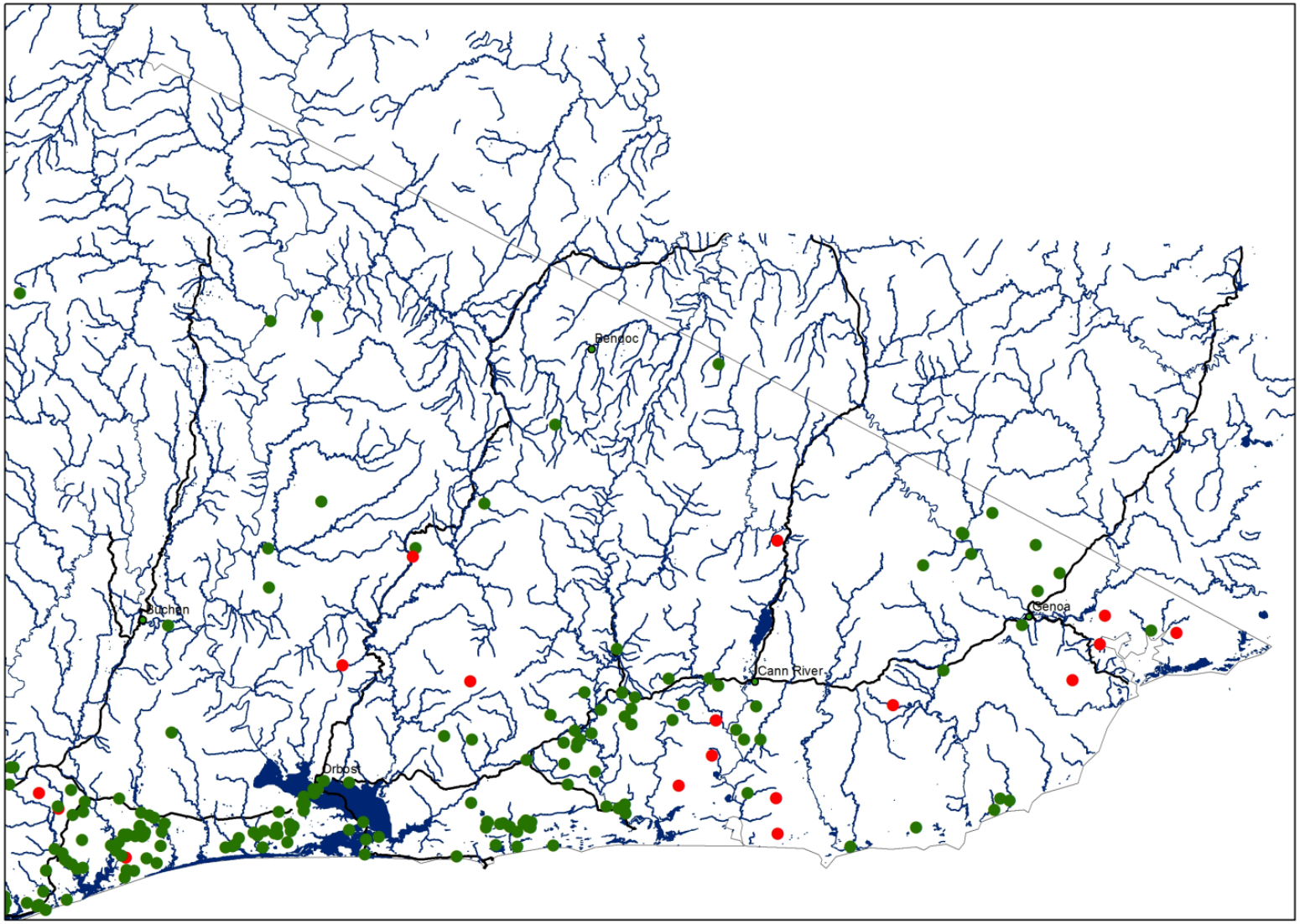

Figure 3. Masked Owl records in East Gippsland as represented on the Victorian Biodiversity Atlas (as of October 2013). Green dots represent records pre-2009, Red dots represent records between 2009 and 2011. Hydrology and floodplains are blue, major roads are black lines.

6. As to the Sooty Owl, Powerful Owl and Masked Owl populations in East Gippsland:
(a) Briefly describe the quality of their habitat in East Gippsland.
(b) What are their population levels? That is, are they stable, increasing or declining?
(c) Please include any other observations you believe are relevant about the security of the Sooty Owl, Powerful Owl and Masked Owl populations in the East Gippsland area.

East Gippsland contains high quality habitat for all three owl species, and the region is considered to support the largest population of each species in the state, with the number of breeding pairs speculated to be approximately 102-182 Powerful Owls, >131 Sooty Owls and >100 Masked Owls) (Webster *et al.* 1999; Schedvin *et al.* 2003; Silveira *et al.* 2003). There have been no long-term studies investigating population changes in owls across East Gippsland, but studies conducted in Central Gippsland, Central Highlands and southern New South Wales have documented declines in detection rates of owls in recent years (especially of Powerful Owls) (Kavanagh 2013; Lumsden *et al.* 2013; Willig and Atkins 2013). During my own studies breeding success of Powerful Owls was low and declining, and much lower than has been noted in previous studies, and detection rates have declined sharply (Bilney *et al.* 2011a; Bilney 2013; pers. obs.). Factors responsible for this decline are likely due to declines in densities of arboreal mammals (especially Greater Glider and Common Ringtail Possum) possibly due to long-term drought during the 2000s (Lindenmayer *et al.* 2011; Lumsden *et al.* 2013; Kavanagh 2013). Additionally, substantial wildfires have occurred over the past 12 years, burning over 3 million hectares of forest in eastern Victoria (Attiwill and Adams 2013), and this has further impacted upon owl populations (Lumsden *et al.* 2013; Willig and Atkins 2013). In my opinion, these factors seriously jeopardise the security of owl populations in Victoria, and the unburnt and unlogged habitat that remains, especially in regions like East Gippsland and Central Highlands, remain highly important refuges for the species.

Bushfires

7. What is the effect of bushfire on the owl habitat in East Gippsland you described in answer to question 2 and / or 3, and, in turn, on the existence or survival of the Sooty Owl, Powerful Owl and Masked Owl?

There have been few studies investigating the impacts of fire on owls in Australia, but impacts likely include direct mortality of owls and prey, and the loss of nest and roost trees (Schedvin 2007). Recent studies conducted soon after wildfire have shown that fires had a significant negative impact upon Powerful Owl and Sooty Owl occupancy three years after fire (Lumsden *et al.* 2013; Willig and Atkins 2013). The occupancy of sites post-fire is likely to be strongly influenced by fire severity and prey availability, but many important prey species are significantly impacted by fire, even at low severity and sometimes even in surrounding unburnt habitats (e.g. Lindenmayer *et al.* 2013). Fire can consume a high percentage of hollow-bearing trees in the landscape, thereby reducing the availability of nesting and roosting sites for the owls and their prey (e.g. Lindenmayer *et al.* 2012). Therefore fire, even at low severity, is likely to have major impact upon the habitat and critical resources required by owls.

Although the 'Orbost Fire Complex' burnt over 170,000 hectare (approximately 17% of East Gippsland Forest Management area) the overall impact on owls is difficult to evaluate with confidence. Undoubtedly, populations of all owl species have been affected due to the temporary loss of habitat and resources, and potential mortality to individual owls, but large areas of optimal habitat remain unburnt which likely still supports strong populations. However, it is also important to consider recent fuel reduction burns across East Gippsland (exact area treated in recent years

unknown), as well as considering the cumulative area burnt across Victoria since 2002 (over 3 million hectares: Attiwill and Adams 2013), which have also further reduced the habitat quality and availability of resources to owls.

8. Does the Sooty Owl, Powerful Owl and/or Masked Owl persist in areas affected by bushfire that were previously known to be occupied by these species?
(a) If not, how long does it take for the Sooty Owl, Powerful Owl and/or Masked Owl to reinhabit a bushfire-affected area (assuming that they do)?

The influence of fire on owls in Australia has been poorly studied, but recent studies have shown that owls and important prey species are negatively affected by fire (McNabb *et al.* 2012; Lindenmayer *et al.* 2013; Lumsden *et al.* 2013; Willig and Atkins 2013). Although fire can impact upon site occupancy and result in reduced densities of owls (e.g. Lumsden *et al.* 2013), there are documented cases where owls have persisted in areas subjected to recent fire (e.g. Loyn *et al.* 1986; Kavanagh and Jackson 1997; Kavanagh 2002; Schedvin 2007; pers. obs.) including reoccupation several years after fire (McNabb *et al.* 2012). However, the ability for owls to persist in landscapes post fire does not reveal whether they are breeding. The impact of a wildfire on a population of Barking Owls *Ninox connivens* was studied by Schedvin (2007) in north-eastern Victoria, and the results of this study are highly relevant. Most Barking Owls survived the initial fire, but the full extent of the impacts became apparent during the breeding season when 30% of pairs could not be located and no successful breeding was documented with surviving pairs. Owls were recorded foraging within the recently burnt habitat, and home-rage size generally increased post-burn.

Overall, it is likely that owl recovery will be closely linked to mammal recovery and the intensity and scale of the fire. Some terrestrial prey species are capable of reaching high abundances several years after fire and usually related to vegetation cover and structural density (e.g. Fox and McKay 1981; Calting *et al.* 2001), while others are likely to be longer, especially some hollow-dependent species (e.g. Lindenmayer *et al.* 2012). In recent years owl breeding success has been low (Bilney *et al.* 2011), which would also hinder owl post-fire recovery.

9. Does the severity of the bushfire have any bearing on whether the Sooty Owl, Powerful Owl and Masked Owl will persist in (or return to) areas affected by bushfire that were previously occupied by the species?

As mentioned in Question 7 & 8, there is limited information on post-fire survival and recovery of owls, and it is likely to be strongly influenced by fire severity and survival of prey populations (e.g. Schedvin 2007; McNabb *et al.* 2012; Lumsden *et al.* 2013; Willig and Atkins 2013). Although owls may be able to persist in some areas following fire (especially of low severity), aspects such as breeding are likely to be affected (Schedvin 2007). Some important prey species are significantly impacted by fire, even at low severity and sometimes even in surrounding unburnt habitats (e.g. Lindenmayer *et al.* 2013).

10. What steps can be taken to determine whether Sooty Owls, Powerful Owls and Masked Owls are, or are likely to be, present in or near, areas affected by bushfires that were previously occupied by the species?
(a) Can you determine whether the species is likely to persist

The area burnt by the 'Orbost Fire Complex' contains relatively few owl records compared to other areas of East Gippsland (Appendix 1 compared with Figures 1, 2 & 3), but reasons for this remain unknown. It could be a function of limited previous survey effort and difficulty of access, because

seemingly highly suitable habitat existed throughout the area (especially for Powerful Owls and Sooty Owls) (based on DEPI Ecological Vegetation Class maps; pers. obs.). In particular, there are very few recent owl records within the burn area (<5 years: see figures 1,2 & 3), so it is impossible to state with confidence which areas were actually occupied by owls prior to the fire. Therefore, it is difficult to confidently assess the extent of population decline directly associated with the fire. Instead, conducting broad-scale call-playback surveys in burnt and unburnt habitat (in similar habitats, topography etc) and comparing detection rates can provide an indication as to the likely impacts of fire on owl occupancy (e.g. McNabb et al. 2012; Lumsden *et al.* 2013; Willig and Atkins 2013). Detection rates of owls is generally quite low (<25%), so a large number of sites would need to be visited, including several repeat visits, to obtain sufficient data to draw conclusions.

Sooty, Powerful and Masked Owl Managements Areas in East Gippsland

11. Can you determine which, if any, Sooty Owl, Powerful Owl and/or Masked Owl Managements Areas have been affected by the 2014 bushfires in East Gippsland on the basis of spatial data analysis?
(a) Can you form a view on the basis of the maps enclosed with this letter? If so, please do so and explain your answer.
(b) If you are unable to form a view on the basis of the maps enclosed, please explain why, and specify the nature of any limitations and what additional data is required to enable a greater degree of confidence in your determination. If you have access to that data, please use it to provide your answer.

It is difficult to accurately assess the impact of the 'Orbost Fire Complex' upon Owl Management Areas (OMAs) based on the maps provided. Ultimately using detailed GIS spatial information showing the location of OMAs on top of the fire severity map would be best, and this could be used to calculate exact proportions of each OMA affected by differing fire severity. It would also be important to visually inspect (on-ground) some sites to understand how the fire severity mapping relates to reality. However, the maps do provide a guide, and from a comparison of the fire severity map and the OMAs it is possible to estimate with reasonable confidence that numerous OMAs have been affected by fire. It appears that close to 22 (or 17%) SOMAs, 15 (or 15%) POMAs and 9 (or 9%) MOMAs were impacted by the fire to differing extents (see Table 2).

Table 2. Apparent Owl Management Areas impacted by the 2014 wildfires in East Gippsland.

Sooty Owl management areas	Powerful Owl management areas	Masked Owl management areas
0004	0012	0002
0005	0022	0003 (partial)
0023	0032 (partial)	0004
0117	0033	0005
0118	0034	0005
0119	0035	0014
0120	0036	0048
0126	0037	0049
0128	0038	0092
0129	0047	
0136	0048	
0138	0049	
0140	0053	
0141	0054	
0142	0128	
0143		
0144		
0145		
0149		
0150		
0151		
0152		

13. Can you determine whether the relevant species is likely to persist in any of the Sooty Owl, Powerful Owl and/or Masked Owl Managements Areas affected by the 2014 bushfires in East Gippsland on the basis of spatial data analysis?
(a) Can you form such a view on the basis of the maps enclosed with this letter? If so, please do so and explain your answer.
(b) If you are unable to form a view on the basis of the maps enclosed, please explain why, and specify the nature of any limitations and what additional data is required to enable a greater degree of confidence in your determination. If you have access to that data, please use it to provide your answer.

In my opinion OMAs affected by medium-high severity fire would currently support low resources for owls (especially small mammals) and therefore unlikely to currently support owls, let alone breeding owls. This opinion is based on results from post-fire studies conducted elsewhere (McNabb *et al.* 2012; Lumsden *et al.* 2013; Willig and Atkins 2013) and the loss of critical resources that occurs after fire (e.g. Lindenmayer *et al.* 2012, 2013). The prospect of owls occupying the lower intensity burnt areas is more plausible, and probably depends upon the proximity and extent of unburnt forest nearby. But resources are likely to be low even in areas burnt by low severity fire and breeding is probably affected (e.g. Schedvin 2007; Lindenmayer *et al.* 2013). Ultimately, what is required in an on-ground call-playback survey to assess whether OMAs are actually occupied.

It is important to recognise that it was not known whether owls were actually occupying OMAs prior to the fire, and that OMAs would only ever provide a small fraction of resources actually required by a breeding pair of owls (e.g. Bilney *et al.* 2011c). This is because home-range sizes are usually in the order of 1000-4500 ha, which is significantly larger than the 500 ha allocated for individual OMAs (Soderquist and Gibbons 2007; Bilney *et al.* 2011c). Post-fire, OMA's would support less resources (e.g. such as food and hollows: Lindenmayer *et al.* 2012, 2013) and owl home-ranges are likely to increase (Kavanagh and Jackson 1997; Schedvin 2007).

Instead, it is more important to assess the entire impact of the fires at a landscape scale, rather than within each OMA. It is highly probable that there were good populations of Sooty Owls and Powerful Owls throughout much of the area burnt by the 'Orbost Fire Complex'. Much of the area burnt was also unlogged, so a large proportion of landscape has now been disturbed by either logging or fire, providing limited optimal owl habitat remaining (see Appendix 1). For example, if an average home-range size is 2000 ha that equates to a circular diameter of approximately 5km and by looking at the fire map there are limited areas, especially of prime Sooty Owl and Powerful Owl habitat, that would not incorporate some degree of logging and fire disturbance.

14. Assuming that, in line with the Management Guidelines in the East Gippsland Forest Management Plan, as updated in 2011, each of the Sooty Owl, Powerful Owl and/or Masked Owl Managements Areas comprised good quality habitat for the relevant species prior to the 2014 bushfires in East Gippsland, with what level of confidence are you able to predict whether each such area continues to comprise good quality habitat for the relevant species on the basis of spatial data analysis?
(a) Can you form such a view on the basis of the maps enclosed with this letter? If so, please do so and explain your answer.
(b) If you are unable to form a view on the basis of the maps enclosed, please explain why, and specify the nature of any limitations and what additional data is required to enable a greater degree of confidence in your determination. If you have access to that data, please use it to provide your answer.

I can confidently state that any OMA impacted by fire, even to a small extent, has resulted in a temporary reduction in the availability of critical resources (e.g. a loss of prey availability or carrying capacity: e.g. Lindenmayer *et al.* 2013). The fire has undoubtedly reduced the owl population, and surviving owls within the burn area are unlikely to be breeding (e.g. Schedvin 2007). Considering the extent of the fires and the number of OMAs impacted (see Question 11: Table 2), this indicates that conservation management objectives to conserve 'good quality habitat' within a specified target number of OMAs across East Gippsland is not currently being met.

15. With what level of confidence are you able to predict whether or not the relevant species will be present in, likely to be present in, using or traversing the Sooty Owl, Powerful Owl and/or Masked Owl Managements Areas affected by the 2014 bushfires in East Gippsland? What factors, presence or absence of information, if any, influence your level of confidence?

It is impossible to predict with a high level of confidence how owls are currently using the OMAs. I would expect owls to be absent from areas subjected to moderate-high severity burns, but owls could potentially persist in areas subjected to a lower severity burn. A detailed call-playback survey would be required to establish whether owls persist in the landscape, but that would not indicate how OMAs are being used (e.g. foraging, breeding, roosting).

Logging in coupes in East Gippsland forest management area that contain Sooty, Masked and Powerful Owl detections

16. Would logging the coupes in East Gippsland that contain detections of Sooty, Powerful and Masked Owls have any impact on the continued survival of the Sooty Owl, Powerful Owl and Masked Owl?
(a) If so, can you estimate what the level of impact will be? Please explain your answer in terms of the species as a whole, the local population and the individual members of each species;
(b) To the extent that you find there to be an impact by reason of the intended logging operations, will the Sooty Owl, Powerful Owl and Masked Owl recover from that impact and if so over what time would you expect that recovery to occur?
(c) Does the impact of the 2014 bushfires in East Gippsland affect your answer to 16, 16(a) and 16(b)? If so, explain why.
(d) If you are unable to form a view in response to questions 16, 16(a), 16(b) or 16(c), or if your answers to those questions are limited, please explain why, specify the nature of any limitations and what additional data is required to enable a greater degree of confidence in your determination. If you have access to that data, please use it to provide your answers.

Based on the extent of fires over the last 12 years (over 3 million hectares burnt: Attiwill and Adams 2013), the low owl breeding success recorded in recent years (Bilney *et al.* 2011a), and a recent reduction in the density of owls across the landscape (e.g. Lumsden *et al.* 2013; Willig and Atkins 2013; Kavanagh 2013; pers. obs.) owl populations are probably at historically low levels, and potentially below conservation population targets (500 Powerful Owl and Sooty Owl breeding pairs: Webster *et al.* 1999; Silveira *et al.* 2003). Despite these factors, and no understanding of current population levels, it is therefore concerning that good quality habitat with known owl records nearby is continuing to be further lost/modified by logging and contributing to further declines of these owl species. This is particularly the case if 14 coupes expected to soon be harvested contain Sooty Owl records nearby and 11 of these were recent records. It is important to recognise that over 2/3 of the Sooty Owl distribution in Victoria has been burnt in the past 12 years, and the most

important populations for the species is within unburnt habitat in the Central Highlands and East Gippsland which also happens to be prime logging sites. Therefore logging sites of suitable habitat known to be occupied by owls further hampers the ability of owls to recover following the extensive fires. This issue is particularly pressing following the further loss of important resources associated with the Orbost Fire Complex. If additional large fires occur within East Gippsland or Central Highlands over the next few years it could jeopardise the persistence of the species within the state. A state-wide review of the owl conservation management (especially of Powerful Owl and Sooty Owl) and forest management practices is desperately warranted – preferably following extensive surveys to evaluate current population levels and the impacts of wide-scale fire.

Although logging any site that contains suitable owl habitat is likely to cause negative impacts, the logging of five sites that contain records of Powerful Owl nearby, and one site of Masked Owl nearby does not represent as great a threat as that posed by logging 14 Sooty Owl sites. This is mainly because of the differences in the number of sites affected (and as further explained above). The Powerful Owl also has a wider distribution across Victoria and occurs widely throughout forests in areas where logging does not exist. Although this scenario is similar for the Masked Owl, their population is substantially smaller, and logging near one site with recent records still has the potential to cause negative impacts. It is also important to remember that in some habitats the impacts of logging are cumulative, so it is important to consider historical impacts of logging as well.

It is suggested by VicForests that approximately 3700ha (or 0.2%) of native forest is harvested in East Gippsland each year (VicForests date unknown). This potentially equates to an area occupied by approximately 1-3 pairs of each owl species (depending upon site productivity) (Kavanagh 1997; Bilney *et al.* 2011c). Following logging it is difficult to predict when sites will again harbour resources comparable to pre-logging levels, because at some sites resource availability will be permanently affected (following alterations of forest composition and loss of hollow-dependent prey). For the availability of some non-hollow-dependent prey the time-frame for recovery could take several decades (e.g. Kavanagh 1997, 2013), whereas for eucalypt nesting and roosting sites for the owls and hollow-dependent prey it is likely to exceed 100 years (e.g. Gibbons and Lindenmayer 2002).

17. Would logging the coupes in East Gippsland that have detections of Sooty, Powerful and Masked Owls within 50 meters of the coupe boundaries have any impact on continued survival of the Sooty Owl, Powerful Owl and Masked Owl?
(a) If so, can you estimate what the level of impact will be? Please explain your answer in terms of the species as a whole, the local population and the individual members of each species;
(b) To the extent that you find there to be an impact by reason of the intended logging operations, will the Sooty Owl, Powerful Owl and Masked Owl recover from that impact and if so over what time would you expect that recovery to occur?
(c) Does the impact of the 2014 bushfires in East Gippsland affect your answer to 17, 17(a) and 17(b)? If so, explain why.
(d) If you are unable to form a view in response to questions 17, 17(a), 17(b) or 17(c), or if your answers to those questions are limited, please explain why, specify the nature of any limitations and what additional data is required to enable a greater degree of confidence in your determination. If you have access to that data, please use it to provide your answers.

Without knowing the circumstances behind each owl record (e.g. roost, nest, incidental call, call playback response) it is difficult to predict the true impact logging a particular site would have. Most

records are likely to be on a road where an observer was positioned when hearing an owl call during a call-playback survey (virtually all records post 2009), whereas the owl could have been heard from ~1 km distance away in any direction. However, a record potentially suggests that an owl territory exists nearby, and logging the habitat is likely to cause considerable impacts (territory would incorporate numerous roosting sites and nest). It is important to recognise that home-ranges are likely to be larger than a defended territory (e.g. Schedvin 2007), so even if an owl was recorded considerable distance away it is probable that the area in question would comprise foraging habitat. Even if an owl is not recorded, it does not mean that an owl is absent and that the area is unoccupied. If suitable habitat exists, it will undoubtedly be used by the owls and its prey at some stage in the future.

If, however, the owl record does accurately represent the precise location where an owl was heard, then logging within 50m of that record is almost certainly going to have negative impacts because it likely incorporates an owl territory. Owls tend to call within their core territory, so if the record was in response to call playback that suggests important resources exist nearby (e.g. high densities of prey, harbour roosting and nesting sites). In such circumstance, there would be a high probability that logging such an area could result in the loss of important resources including roosting or nesting site. Removing critical resources within a core territory could potentially jeopardise the existence of the pair at the site, especially if a nest is lost or breeding is disturbed by logging activities. Overall, a reduction in carrying capacity of the landscape will have impacts upon the population at large.

As mentioned in Question 4, the area of 'disturbance' associated with logging (that could impact upon nesting/breeding) actually covers an area substantially larger than the actual coupe size, potentially up to approximately 160 ha. As owl territories or calling-areas are substantially smaller than home-range sizes (Schedvin 2007), logging an area that has been actively defended by an owl could impact upon breeding success even if the nest it not destroyed (e.g. if a territory equals 500ha, logging of one coupe could potentially result in disturbance covering almost 1/3 of an owls territory).

As mentioned previously, the capacity for owl populations to recover is likely to vary geographically and potentially take several decades for some food resources to recover, and potentially centuries for roosting and nesting sites – that is if forest composition hasn't been significantly altered and assuming that logging won't again occur at the same locality.

The impacts of the 2014 'Orbost Fire Complex' only adds to the importance of conserving habitat with known recent records of the owls. Logging such areas is likely to result in further declines and reduce the ability for the owls to recover in the short-term.

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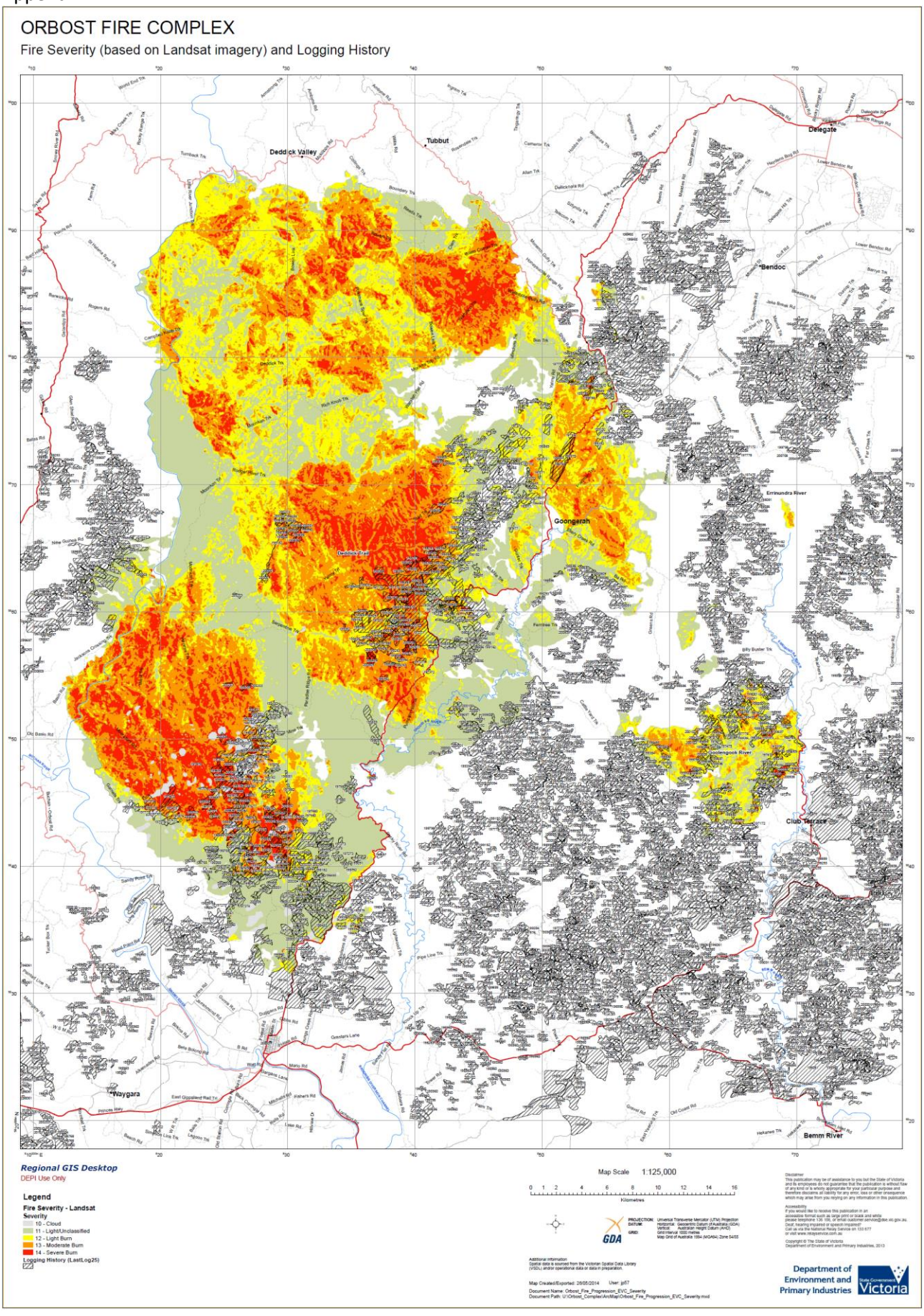
Appendix 1


ORBOST FIRE COMPLEX
Fire Severity (based on Landsat imagery) and Logging History
Deddick Valley
Tubbut
Delegate
Bendoc
Goongerah
Deddick River
Errinundra River
Coolengook River
Club Terrace
Waygara
Bemm River
Regional GIS Desktop
DEPI Use Only
Legend
Fire Severity - Landsat
Severity
10 - Cloud
11 - Light/Unclassified
12 - Light Burn
13 - Moderate Burn
14 - Severe Burn
Logging History (LastLog25)
Map Scale 1:125,000
Kilometres
GDA
Department of Environment and Primary Industries
Victoria