Habitat requirements of the yellow-footed antechinus (*Antechinus flavipes*) in box–ironbark forest, Victoria, Australia

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Abstract. Understanding the habitat requirements of a species is critical for effective conservation-based management. In this study, we investigated the influence of forest structure on the distribution of the yellow-footed antechinus (*Antechinus flavipes*), a small dasyurid marsupial characteristic of dry forests on the inland side of the Great Dividing Range, Australia. Hair-sampling tubes were used to determine the occurrence of *A. flavipes* at 60 sites stratified across one of the largest remaining tracts of dry box–ironbark forest in south-eastern Australia. We considered the role of six potential explanatory variables: large trees, hollow-bearing trees, coppice hollows, logs, rock cover and litter. Logistic regression models were examined using an information-theoretic approach to determine the variables that best explained the presence or absence of the species. Hierarchical partitioning was employed to further explore relationships between occurrence of *A. flavipes* and explanatory variables. Forest structure accounted for a substantial proportion of the variation in occurrence of *A. flavipes* between sites. The strongest influence on the presence of *A. flavipes* was the cover of litter at survey sites. The density of hollow-bearing trees and rock cover were also positive influences. The conservation of *A. flavipes* will be enhanced by retention of habitat components that ensure a structurally complex environment in box–ironbark forests. This will also benefit the conservation of several threatened species in this dry forest ecosystem.

Introduction

The central task of ecology is to understand the factors that influence the distribution and abundance of organisms (Krebs 2001; Wiens 2002). This knowledge is essential for conservation-based management, primarily because it can be used to establish what constitutes habitat for a species (Rushton *et al.* 2004; Gibson *et al.* 2004). This is particularly important for species associated with environments that have been heavily modified, so that knowledge of their habitat requirements can be used to protect sites of significant conservation value, mitigate threatening processes, guide restoration efforts and predict the species' occurrence in other areas (Manel *et al.* 2001; Scott *et al.* 2002).

The yellow-footed antechinus (*Antechinus flavipes*) is a small (20–75 g) dasyurid marsupial that occurs in eastern and south-western Australia (Van Dyck 1995). In Victoria, the distribution of *A. flavipes* is closely associated with dry forests and woodlands on the inland side of the Great Dividing Range (Menkhorst 1995). Box–ironbark forests are a major component of this zone and contain more than 50% of known populations of *A. flavipes* in the state (ECC 1997). Since European settlement, 85% of the box–ironbark region has been cleared (ECC 2001) and much of the remaining forest and woodland has been degraded by timber harvesting, firewood collection and grazing (Muir *et al.* 1995). The structure over much of the ecosystem has changed from one dominated by open stands of large, hollow-bearing trees with a complex ground cover to dense stands of small-stemmed coppice regrowth with a simplified ground cover (Soderquist 1999; ECC 2001). Changes to the extent and structure of these forests are likely to have altered the amount and quality of habitat available to *A. flavipes*.

In eucalypt woodland in New South Wales, the movements and foraging behaviour of *A. flavipes* were found to be associated with structurally complex microhabitats characterised by logs and rock crevices (Stokes *et al.* 2004). In floodplain forests of Victoria, several studies have highlighted a positive relationship between the abundance of *A. flavipes* and both the volume of fallen timber and density of large trees (Mac Nally *et al.* 2001; Lada *et al.* 2007; Mac Nally and Horrocks 2007). Large trees are more likely to support hollows, a key nesting site, and may also provide a high-quality foraging substrate (Dickman 1991; van der Ree 2003). Radio-tracking of individuals in the north-east of the box–ironbark region indicates that the species regularly forages amongst the litter layer (Coates 1995).

In this study, we investigated the distribution and habitat requirements of *A. flavipes* in the largest remaining tract of box–ironbark forest and woodland in Victoria. Results from previous studies of the species (see Kelly 2006 for review) were used to guide the *a priori* selection of a small number of potential explanatory variables. We asked two main questions:

(1) What is the distribution of *A. flavipes* in the study area?
(2) Which components of forest structure have the strongest influence on the species' distribution?

Methods

Study area

Rushworth–Heathcote State Forest (23 500 ha) and Heathcote–Graytown National Park (12 500 ha) (hereafter collectively termed Rushworth Forest) form the largest remaining

tract of box–ironbark forest and woodland in Victoria (36°45′S, 144°55′E). The landscape is characterised by gently undulating rises and low hills with forests dominated by red ironbark (*Eucalytptus tricarpa*), grey box (*E. microcarpa*) and red stringybark (*E. macrorhynca*), interspersed with gullies where yellow gum (*E. leucoxylon*) is common. The understorey includes gold dust wattle (*Acacia acinacea*) and drooping cassinia (*Cassinia arcuata*), with grey grass tree (*Xanthorrhoea glauca*) locally common. Several sites at higher elevation in the study area, Mount Black (318 m), Mount Melville (300 m) and Mount Ida (440 m), consist of rocky areas where red box (*E. polyanthemos*) is present.

State forest in the study area is managed primarily for the production of hardwood for sawlogs, posts and firewood (ECC 2001). Management practices have resulted in a high density of small-diameter trees and a paucity of large, hollow-bearing trees across most of the forest. Heathcote–Graytown National Park, established in 2002, has a relatively higher density of large, hollow-bearing trees than other box–ironbark forests (Parks Victoria 2006).

Study design

We identified a small number of explanatory variables likely to influence the distribution of *A. flavipes* (Kelly 2006): large trees, hollow-bearing trees, coppice hollows, logs, rock cover and litter. Sixty survey sites were selected in Rushworth Forest. Given the uniform nature of much of the forest (i.e. even-aged coppice growth with few mature trees), site selection was stratified to ensure variation in the habitat features of interest. After inspecting a number of potential sites in the field we selected 20 sites in each of three topographic positions: gullies, flats and ridges. Ten sites in each topographic position were selected on the basis of having large or hollow-bearing trees. Survey sites were generally >1 km apart in an effort to ensure independence; the average home range of *A. flavipes* has been estimated at 0.78 ha for females and 1.2 ha for males (Coates 1995).

Mammal surveys

All 60 sites were surveyed using hair-tubes in June 2005. This method detects the presence of mammals by attracting individuals to an open cylinder containing bait. Hair from mammals entering the tube adheres to double-sided tape on the inside of the tube and hair samples are identified following the methods of Brunner *et al*. (2002). Hair-tubes were constructed from PVC pipe, 10 cm in length and 4 cm diameter, and baited with a mixture of honey, rolled oats and peanut butter. At each site, 10 hair-tubes were placed along a 100-m transect at 10-m intervals. The placement of hair-tubes was alternated between 'tree' (2 m above ground on a tree) and 'ground' locations (a stump, log or tree base), to examine the influence of tube placement on the probability of detecting *A. flavipes*.

In addition, 20 of these sites were surveyed using Elliot traps (33 × 10 × 10 cm) in July 2005. A trap grid at each site consisted of two parallel lines 10 m apart, with 10 traps set at 10-m intervals in each line. Traps were baited with a mixture of honey, rolled oats and peanut butter and checked twice daily for three days (i.e. 60 trap-nights at each site). The mass, sex and species of each animal was recorded and an ear notch used to mark individuals to identify recaptures. Elliot trapping was undertaken

for comparison with hair-tube surveys to verify the use of hair-tubes as a survey technique. We assumed that if the results of Elliot trapping (an established method to survey *A. flavipes*) and hair-tubes were similar at this subset of sites, then inference based on the hair-tube surveys would be adequate for modelling. Jaccard's similarity coefficient (Krebs 1999) was used to analyse the overlap of the two techniques.

Site assessment and explanatory variables

Structural variables were recorded within a 20 m × 100 m quadrat at each site. The species, number and size (DBH, cm) of all canopy trees were recorded. The number of trees with hollows >1.5 m from the ground and the number of trees with coppice (or basal) hollows were recorded. The number of logs >10 cm in diameter and >50 cm in length was recorded, and the diameter and width of each of these was measured to allow the calculation of log volume. The percentage cover of coarse litter, fine litter, bare ground, rock, grass and herb was visually estimated (to the nearest 5%) in five randomly placed quadrats, each 5 × 5 m, at each site. The five values were averaged to give a site value. Leaf-litter depth (cm) was measured at five randomly placed points in each quadrat and averaged to give a site value. Previous studies have shown that grass trees (*Xanthorrhoea* sp.) can provide nest sites for *A. flavipes* (Marchesan and Carthew 2004). Although locally common in some parts of our study area, grass trees were present at few of our survey sites and were not pursued as a potential explanatory variable.

To reduce the number of explanatory variables (to avoid overfitting models) we used only one of three variables describing litter and one of two variables describing logs. We retained percentage cover of coarse litter for analysis as field observations suggested that this was the most useful surrogate for total litter. Coarse litter largely consisted of strips of bark, fallen branches and debris <10 cm in diameter. As coarse litter increases at a site the cover of fine litter and depth of the litter layer also increase. Analysis showed that both log density and log volume were highly correlated (Pearson correlation coefficient ≥ 0.75); we retained the use of log density. No other explanatory variables were highly correlated.

Data analysis

Six explanatory variables were considered in the modelling process (Table 1). Models of all possible subsets of the six explanatory variables ($2^6 = 64$ models) were generated using logistic regression, with presence or absence of *A. flavipes* as

Table 1. Explanatory variables used to examine the distribution of *A. flavipes* in Rushworth Forest, Victoria

Mean values (and standard errors) are given for each variable, averaged across all 60 survey sites, together with the range in values (minimum to maximum)

Variable	Description	Mean ± s.e.	Range
Litter	Percentage cover of coarse litter	17.6 ± 1.5	0–58
Log	No. of logs	11.0 ± 1.0	1–29
Rock	Percentage cover of rock	4.0 ± 1.0	0–39
Hollow	No. of hollow-bearing trees	3.1 ± 0.6	0–21
Large	No. of trees with DBH >60 cm	1.0 ± 0.2	0–6
Coppice	No. of trees with coppice hollows	4.5 ± 0.5	0–14

the dependent variable. Alternative models were ranked by using Akaike's Information Criterion corrected for small sample size (AIC_c), with log-likelihood as the measure of fit (Burnham and Anderson 2002). AIC_c ranks models according to the weight of evidence in favour of each, based on their fit to the data and the number of parameters in the model. Models with more parameters are penalised to find the most parsimonious model (Burnham and Anderson 2002).

For each model, the AIC_c, the AIC_c difference (Δ_i), the Akaike weight (w_i) and the maximised log-likelihood value ($\log(L)$) were calculated. The AIC_c difference is the difference between the AIC_c value for a particular model and that for the 'best' model (i.e. the model with the lowest AIC_c value). The Akaike weights of a model set sum to 1.0 and indicate the weight of evidence in favour of each model, out of the set of models considered (Burnham and Anderson 2001). Burnham and Anderson (2001) suggest that models having Δ_i values ≤ 2 have substantial support, with higher Δ_i values having considerably less support. For all models with Δ_i values ≤ 2, and the global model including all variables, Nagelkerke R^2 values were calculated. This gives a measure of the variance in the dependent variable explained by the independent variables on a scale of 0 (no relationship) to 1 (perfect relationship) (Tabachnik and Fidell 2007).

Where no single model is clearly supported over others in the set ($w_i < 0.9$), model-averaging is a useful method to obtain robust estimates of model parameters and to determine the relative importance of predictor variables (Burnham and Anderson 2002). Model averaging was undertaken to provide coefficients and standard errors for each variable based on the entire model set (Burnham and Anderson 2002). The relative importance of predictor variables was examined by calculating the sum of Akaike weights for all models containing each given variable. The variable with the larger predictor weight can be interpreted as the most important (Burnham and Anderson 2001).

Hierarchical partitioning (Mac Nally 2000) was used as a complementary technique to explore the variables most likely to influence the distribution of *A. flavipes*. This method aims to circumvent problems of including collinear variables in multivariate regression by calculating the independent explanatory power of each variable (Mac Nally 2000). Hierarchical partitioning measures the improvement in goodness-of-fit of all models with a particular variable compared with the equivalent model without that variable (Quinn and Keough 2002). Log-likelihood was used as the goodness-of-fit measure. We calculated the log-partition independent and joint contribution of each variable and the percentage of the total independent contribution (summed across all variables) accounted for by each variable. Inferences about which variables are most important are considered more meaningful when the results of hierarchical partitioning and criteria-based model-selection methods concur (Mac Nally 2000).

The R statistical package ver. 2.1.0 (R Development Core Team 2005) was used to calculate AIC_c and model-averaged values, using algorithms from M. Scroggie (unpublished), and to run hierarchical partitioning analysis (Walsh and Mac Nally 2005). Calculation of Nagelkerke R^2 was undertaken in SPSS (ver. 12 for Windows).

Results

Hair-tube surveys

A. flavipes was recorded from 24 of the 60 survey sites (40%) by using hair-tubes. Six other mammal species were also recorded. Hair from *Petaurus* sp. was recorded at 14 sites. Both the sugar glider (*Petaurus breviceps*) and squirrel glider (*Petaurus norfolcensis*) occur in the study area and are difficult to separate on the basis of hair morphology. The common brushtail possum (*Trichosurus vulpecula*) (13 sites), red fox (*Vulpes vulpes*) (13 sites), house mouse (*Mus musculus*) (6 sites) and brush-tailed phascogale (*Phascogale tapoatafa*) (4 sites) were also recorded.

Of the total of 600 hair-tubes, *A. flavipes* was recorded from 112 (19%). It was recorded from 21% (64 of 304) of hair-tubes placed at ground-level and 16% (48 of 296) of hair-tubes placed in trees.

Elliot trap surveys

Fourteen individual *A. flavipes* were recorded from a total of 26 captures (trap success = 2.2 captures per 100 trap-nights). Seven males (bodyweight 45–59 g, mean 53 g) and seven females (25–41 g, mean 30 g) were captured. A single male common dunnart (*Sminthopsis murina*) was also captured.

A. flavipes was recorded by hair-tubes at 12 of the 20 sites where Elliot trapping was undertaken, while Elliot trapping recorded them at 10 of 20 sites. Hair-tubes recorded *A. flavipes* at three sites where they were not trapped, while trapping recorded *A. flavipes* at one site where they were not recorded by hair-tubes. There was a high level of congruence between techniques, with a Jaccard's Similarity Coefficient of 0.833. This confirmed that hair-tubes are an effective way to survey for the species. Model building and further analyses are based only on data from hair-tube surveys.

Habitat modelling

Model selection using AIC_c resulted in a set of seven models that had substantial support (i.e. $\Delta_i \leq 2$) (Table 2). All models in the set included the variable Litter, with Rock and Hollow also frequent. The global model (all six variables) accounted for 43% of the variation in presence or absence *of A. flavipes*, indicating that forest structure is a key determinant of the species' distribution. The top-ranked model (lowest AIC_c value) explained 36% of the variation in occurrence of *A. flavipes* with the inclusion of only two variables (Litter, Rock). However, the low Akaike weight of this model (0.12) suggests considerable model-selection uncertainty, indicating the value of using a model-averaging approach to examine the influence of each explanatory variable.

Model-averaged coefficients, standard errors and the sum of Akaike weights were calculated for each variable (Table 3). Litter had a strong positive influence and summing the Akaike weights of each variable showed it to have the highest relative importance (0.97), with Rock (0.65) and Hollow (0.57) having some support (Table 3). Rock and Hollow were both positive influences; however, the standard errors of parameter estimates suggest some uncertainty as to the degree of influence of these variables. Model-averaged coefficients and predictor weights indicate little support for other variables. Surprisingly, Large

Table 2. Logistic regression models of the occurrence of *A. flavipes* ranked according to AIC$_c$

This table includes the set of models with strongest support (i.e. $\Delta_i \leq 2$) and the global model. The maximised log-likelihood (log(L)), Akaike's information criterion corrected for small sample size (AIC$_c$), AIC$_c$ difference (Δ_i), Akaike weight (w_i) and Nagelkerke R^2 are shown for each model

Model	Variables						log(L)	AIC$_c$	Δ_i	w_i	R^2
1	Litter	Rock					−31.02	68.47	0	0.12	0.36
2	Litter	Rock	Hollow				−30.00	68.73	0.26	0.10	0.40
3	Litter	Rock	Hollow	Coppice			−29.15	69.42	0.95	0.07	0.42
4	Litter		Hollow				−31.54	69.50	1.03	0.07	0.35
5	Litter		Hollow	Coppice			−30.57	69.86	1.39	0.06	0.38
6	Litter	Rock			Log		−30.69	70.11	1.64	0.05	0.37
7	Litter	Rock		Coppice			−30.73	70.18	1.71	0.05	0.37
Global	Litter	Rock	Hollow	Coppice	Log	Large	−29.02	74.19	5.72	0.01	0.43

Trees had a slightly negative coefficient. Parameter estimates for this variable had a very high standard error and we do not interpret this to mean that large trees have a negative influence on the distribution of *A. flavipes*.

Hierarchical partitioning supported the selection of Litter as the most important variable (Fig. 1). It had the highest independent explanatory power of all variables, accounting for 45.6% of the total independent contribution of all variables. It also functioned largely as an independent variable, with only a small joint influence with other variables (Fig. 1). Hollow had the second highest independent contribution (21.8%), and also a high joint influence with other variables. The independent contributions of Rock (13.0%) and Log (12.5%) were similar, but Rock functioned largely as an independent variable, whereas Log had a larger joint than independent influence (Fig. 1). Inferences about which variables are most important are considered more meaningful when the results of hierarchical partitioning and information-theoretic approaches concur. Both methods clearly indicate that Litter is the most influential variable, and offer some support for the positive influence of Hollow and Rock. The variables Log, Coppice and Large Trees had little explanatory power.

The model-averaged coefficients for each variable (Table 3) can be used to examine the change in odds of finding *A. flavipes* at a site as a function of explanatory variables. Holding other variables constant, an increase in percentage cover of coarse litter by 5% increases the odds of finding *A. flavipes* at a site by 57%. Given that the mean cover of coarse litter was 17%, this suggests that coarse litter has substantial influence. An increase in the number of hollows at a site by 3 (i.e. the mean number of hollow-bearing trees per site) results in a 28% increase in the

odds of finding *A. flavipes* at a site. Finally, a 5% increase in rock cover results in a 30% increase in the odds of finding *A. flavipes* at a site.

Discussion

Forest structure had a strong influence on the distribution of *A. flavipes*. The species showed a positive response to the cover of coarse litter, the cover of rocks and the density of trees with hollows. The key finding of this study is that *A. flavipes* is more likely to occur at sites with greater structural complexity.

Habitat associations

The cover of coarse litter was present in all top-ranking models, had the greatest influence of all variables and the strongest independent contribution to explaining the distribution of *A. flavipes* in Rushworth Forest. This variable was used as a surrogate for several measures of litter; as coarse litter increases at a site the cover of fine litter and depth of the litter layer also increase. Why is litter an important habitat component? The diet of *A. flavipes* consists predominantly of invertebrates, and also small vertebrates (Menkhorst 1995). We hypothesise that increasing amounts of litter in box–ironbark forests leads to a

Table 3. Results of model-averaging for each explanatory variable used to examine the occurrence of *A. flavipes*

Model-averaged coefficients, standard errors and the sum of Akaike weights (predictor weights) are shown for each explanatory variable

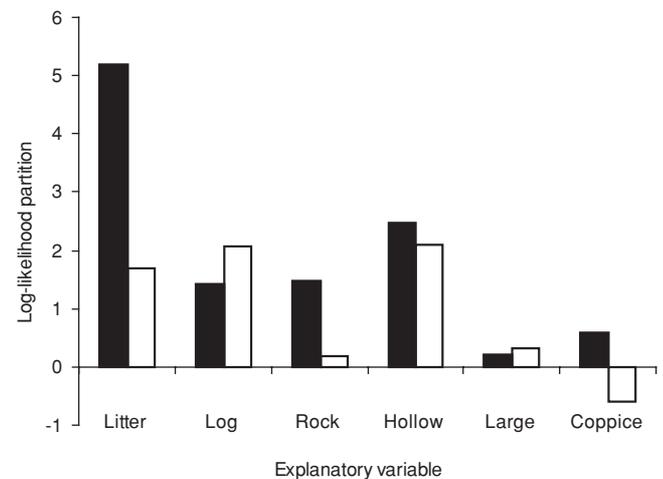| Variable	Coefficient	Standard error	Predictor weight
Litter	0.091	0.036	0.97
Rock	0.053	0.044	0.65
Hollow	0.083	0.089	0.57
Coppice	0.039	0.070	0.38
Log	0.012	0.034	0.30
Large	−0.017	0.116	0.25

Fig. 1. Results of hierarchical partitioning analysis for each variable used to examine the occurrence of *A. flavipes* in Rushworth Forest. Black columns indicate independent contribution, and white columns indicate joint contribution.

greater abundance of preferred prey, and therefore increased food availability for the species. *A. flavipes* was detected by 64 hair-tubes (21%) placed at ground-level, indicating that it regularly forages in the litter layer.

Greater densities of trees with hollows increased the likelihood of occurrence of *A. flavipes*. Tree hollows are a key nest site for this species (Dickman 1991) and an increase in the number of hollow-bearing trees probably represents increased availability of nest sites. Coates (1995) reported that *A. flavipes* in box–ironbark forest in north-eastern Victoria utilised hollows >2 m above the ground for raising young, whereas hollows close to the ground were used primarily for communal nesting. This may explain the weak explanatory power of the variable representing the number of trees with coppice hollows (Coppice). Hollows for raising young may be more limiting than ground hollows, which leave individuals more vulnerable to ground-dwelling predators.

Large trees have been found to have a positive association with the distribution of *A. flavipes* (Lada *et al.* 2007). Large trees are more likely to contain hollows and also provide a valuable foraging substrate for small, arboreal mammals (Dickman 1991; van der Ree 2003). In this study, after taking into account the presence of hollow-bearing trees, large trees had little explanatory power. This supports the contention that the availability of hollows is a key resource provided by large trees for this species. Large trees generally are scarce in box–ironbark forests owing to the history of land use; it is likely that a stronger relationship between *A. flavipes* and large trees may occur where there are higher densities of large trees.

Rock cover had a positive influence on the species occurrence and hierarchical partitioning showed that it functioned largely as an independent variable. *A. flavipes* has been recorded nesting in rocky crevices (Menkhorst 1995) and the positive relationship found here is consistent with captures of the species amongst rocky outcrops in open forest in the Australian Capital Territory (Dickman 1980). Stokes *et al.* (2004) highlighted that *A. flavipes* prefers structurally complex microhabitats characterised by rock crevices (and logs), and suggested that the species perceives such areas as having lower predation risk. Interestingly, we recorded *A. flavipes* at each of six sites in the proximity of higher-elevation rocky areas, such as Mount Black and Mount Ida.

Other studies have shown a strong relationship between the abundance of *A. flavipes* and the amount of fallen timber, but in this study log density was not a strong explanatory variable. In floodplain forest in Victoria, research investigating the volume of wood loads has highlighted the positive relationship between *A. flavipes* and fallen timber (Mac Nally *et al.* 2001; Mac Nally and Horrocks 2007). Experiments have shown that densities of *A. flavipes* rise significantly as wood loads reach >20 t ha^{-1} and that high breeding success was associated with wood loads of 80 t ha^{-1} (Mac Nally and Horrocks 2007). We suggest that in this study area also, logs provide cover, nest sites and foraging sites. However, across much of the box–ironbark region wood loads are at relatively low levels (ECC 2001). For example, in Rushworth Forest our survey sites had an average log volume of 2.5 m^3 ha^{-1}, with the highest volume at a site of 12.6 m^3 ha^{-1}. This is markedly lower than the volume of fallen timber to which the density of the species responded positively in flood-

plain forest (33.3 m^3 ha^{-1} or 20 t ha^{-1}). It is likely that (1) in this study area we were not able to include a sufficiently high range of wood loads required to demonstrate a positive relationship with logs, and (2) a stronger relationship with logs may have been more apparent if rocky sites (that potentially offer similar attributes to logs) were not included in the survey.

This study has examined the influence of habitat structure on the distribution of *A. flavipes*, but several other factors, such as predation, competition, disturbance and climatic variability, can also influence the distribution of small mammals (Fox 1996; Letnic *et al.* 2004). Habitat structure explained a substantial amount of the variation in the distribution of *A. flavipes* (global model $R^2 = 43\%$), but much remained unexplained. We hypothesise that predation may also be important. The red fox is a significant influence on native mammals in Australia (Wilson and Friend 1999), and opportunistically preys on *Antechinus* sp. (Brunner *et al.* 1975; Triggs *et al.* 1984). Foxes were recorded by hair-tubes at 13 sites, suggesting that they are relatively common, and potentially could have a negative influence on *A. flavipes*. Competition with other species may also influence the distribution of *A. flavipes*. Other mammals in the area that utilise tree hollows for nest sites include *P. breviceps*, *P. norfolcensis* and *P. tapoatafa* (ECC 1997), and were also recorded in this study. Climatic conditions and disturbance events are also likely to be an important influence, particularly in relation to how they influence invertebrate prey available to the species (Mac Nally and Horrocks 2007). Establishing clear links between forest structure and the invertebrate prey available to *A. flavipes* would be a productive area for future research.

Management implications

A. flavipes was widespread in Rushworth Forest, being located at 24 of 60 survey sites. A previous survey across the entire box–ironbark region recorded the species at only 12 of 80 sites (ECC 1997; A. Bennett, unpublished), suggesting that Rushworth Forest may be an important area for this species. The study area has a greater proportion of forest with a relatively high density of large, hollow-bearing trees compared with much of the remaining box–ironbark forest across the region (Parks Victoria 2006). It also has several areas with rock cover, such as Mount Black and Mount Ida, with which *A. flavipes* is associated.

Much of the remaining box–ironbark forests and woodlands has undergone extensive change and now are dominated by small coppice regrowth with a simplified ground layer (ECC 2001). Our results suggest that these changes have reduced the amount and quality of habitat components favoured by *A. flavipes*. Local habitat requirements are met by a complex ground layer and the presence of hollow-bearing trees. The presence of large trees is a key element: management that retains and enhances their prevalence will also result in greater numbers of tree hollows, higher densities of logs and a more complex litter layer. Management for these structural features will also benefit the threatened species, *P. tapoatafa* and *P. norfolcensis*, that inhabit box–ironbark forests in the region.

Acknowledgements

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