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Nesting requirements of the endangered Swift Parrot (*Lathamus discolor*)

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Abstract. Declines in avian biodiversity are being reported worldwide. A better understanding of the ecology of many species is fundamental to identifying and addressing threatening processes and developing effective mitigation measures. The Swift Parrot (*Lathamus discolor*) is listed as endangered and is an obligate migrant that breeds only in Tasmania, wintering in mainland Australia. The species nests in tree-hollows and forages primarily on flowers of the Tasmanian Blue Gum (*Eucalyptus globulus*) and Black Gum (*Eucalyptus ovata*) during the breeding season. Surveys for Swift Parrot nests conducted over three consecutive breeding seasons identified 130 Swift Parrot nests in 117 trees. Sites were between 12 and 130 ha in area with up to 49 nests found at an individual site. Swift Parrot nest-trees were characterised as being large eucalypts (mean diameter at breast height = 105 cm) with five or more potential hollows (mean = 8.6) and showing clear signs of senescence. Reuse of nests was uncommon over the 3 years and the infrequency of reuse was most likely related to poor flowering of Tasmanian Blue Gums around nesting sites in years following recorded nesting. To protect the species, conservation actions need to account for the spatiotemporal variation in the availability of Swift Parrot breeding habitat and recognise there may be several years between the use of a particular site. Given the number of nests found at individual sites this will require the management or reservation of suitable forest stands with old-growth characteristics across the landscape, rather than focussing on individual trees or historical nesting sites.

Additional keywords: hollow-nesting, nectarivore, nest-tree, parrot conservation.

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Introduction

The Swift Parrot (*Lathamus discolor*) breeds only in Tasmania, between September and January, in tree-hollows of eucalypts (Brown 1989). After breeding, Swift Parrots migrate to mainland Australia where they winter until returning to Tasmania in early spring (Brown 1989). The breeding season of the Swift Parrot coincides with the flowering period of the Tasmanian Blue Gum (*Eucalyptus globulus*) and Black Gum (or Swamp Gum)[A] (*E. ovata*). The nectar from these flowers is the primary food resource during this time (Brown 1989; Brereton 1997).

The known breeding distribution of the Swift Parrot in eastern Tasmania falls within the natural range of *Eucalyptus globulus* (Williams and Potts 1996; Brereton 1997). The Swift Parrot also breeds in north-western Tasmania, outside the natural range of *E. globulus*, where they rely largely on *E. ovata* and planted *E. globulus*. (Brown 1989; Mallick *et al*. 2004). Although *E. globulus* is recognised as key foraging habitat for the Swift Parrot, spatiotemporal patterns in flowering are not well understood and it may be several years between flowering events at multiple spatial scales (Brereton *et al*. 2004; Mallick *et al*. 2004). There is little information on how these patterns of flowering affect the distribution of Swift Parrot nesting from year to year.

Brereton (1997) provided the most detailed description of the nesting sites of Swift Parrots, based on 46 nesting sites observed between 1981 and 1995, although detailed information was available for only 24 of these. Information from a further 17 nests was obtained from data on Swift Parrots in the egg collection of R. H. Green (Brown 1989). Nests were predominantly in Stringybark (Messmate) (*Eucalyptus obliqua*), White Peppermint (*E. pulchella*) and *E. globulus* with a diameter at breast

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[A] The common names of eucalypts in this paper are the preferred common names in Tasmania (see http://www.dpiw.tas.gov.au/inter.nsf/Publications/LJEM-6JL5QM?open). We recognise there are inconsistencies in common names throughout Australia; however, given the management implications of this study are primarily applicable within Tasmania, scientific names are used throughout to avoid confusion.

height (DBH) >70 cm (mean 120 cm, range 50–305 cm). Brereton (1997) noted examples of up to five pairs nesting close together and suggested that selection of nesting sites in any particular year was related to the proximity of foraging sites.

Swift Parrot breeding habitat has been reduced in area and quality through clearance for agriculture, timber harvesting and urban development (Garnett and Crowley 2000; Swift Parrot Recovery Team 2001). The most recent population estimate of Swift Parrots is <1000 breeding pairs (Swift Parrot Recovery Team 2001). The species is listed as endangered nationally under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999.

Over the decade up to 2010, protection of foraging habitat was the major focus of Swift Parrot conservation efforts in Tasmania (e.g. Brereton *et al*. 2004; Mallick *et al*. 2004; Munks *et al*. 2004). Activities regulated through the Forest Practices System in Tasmania were required to protect known Swift Parrot nesting sites through the application of a 1-ha reserve around a known nest (Brereton 1997; Jackson and Munks 1998). In recent years, the protection of known nesting sites has been considered on a case-by-case basis. The public and private reserve system in Tasmania has also provided protection to some known nesting sites.

Given the paucity of data on the breeding habitat requirements of the Swift Parrot, the aim of this study was to provide a detailed assessment of the characteristics of nesting sites, focussing on tree-level descriptions that can be used to assist field workers in the identification of potential nesting habitat. We also investigated frequency of reuse of nesting sites.

Materials and methods

Survey of nesting sites

Targeted surveys were conducted in south-eastern Tasmania within the natural range of *Eucalyptus globulus*. Nesting sites used historically by Swift Parrots were visited early in the breeding season (September–October) and sites for survey were selected based on the presence of Parrots. Surveys for nests were conducted during November and December for each of three breeding seasons, 2004–06. In 2004, two sites where Swift Parrots were present (Fern Tree and Maria Island) were intensively surveyed for nests (Fig. 1), searching ~50 ha of forest over 3 weeks at Fern Tree, and 12 ha of forest over 2 days on Maria Island. In 2005, nesting trees were checked for reuse at Fern Tree and Maria Island and two additional sites were surveyed for nests (Bruny Island and Meehan Range), searching ~90 ha of forest over 3 weeks on Bruny Island, and 130 ha over 4 weeks in the Meehan Range. Time constraints limited the area searched on Maria Island. Permission to access private property and the distribution of trees with potential hollows influenced the extent of the area searched at all other sites. In 2006, a sample of nest trees were checked for reuse at all sites.

At all sites, the forest comprised a range of tree age-classes from young regrowth (<50 years) to senescent or dead trees (>200 years). The main forest types at each site were (Harris and Kitchener 2005):

- Fern Tree – dry *Eucalyptus obliqua* interspersed with dry *E. pulchella* forest;
- Maria Island – wet and dry *E. obliqua* forest, with *E. globulus* and White Gum (or Manna Gum) (*E. viminalis*) trees subdominant or locally dominant in some patches;
- Bruny Island – dry *E. pulchella* forest or woodland with *E. globulus* trees subdominant or locally dominant in some patches;
- Meehan Range – dry *E. pulchella* and dry *E. globulus* forest and woodland, with dry Silver Peppermint (*E. tenuiramis*) and dry Black Peppermint (*E. amygdalina*) forest or woodland common in the surrounding area.

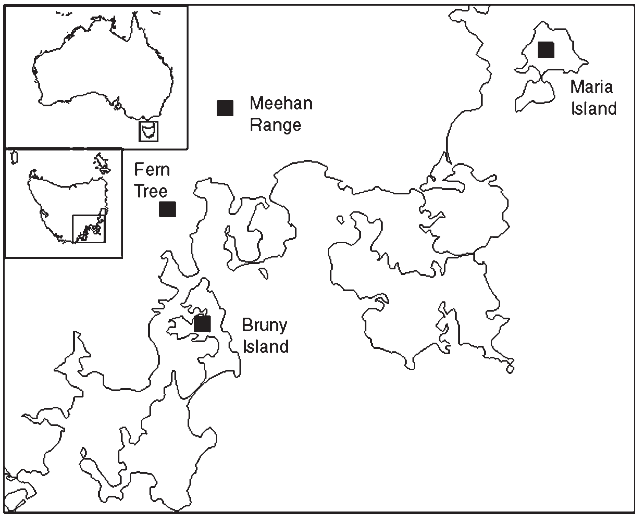

Fig. 1. Location of the four study sites in south-eastern Tasmania, Australia, where Swift Parrot nest surveys were conducted.

Sampling protocol

Within each survey site (Fern Tree, Maria Island, Bruny Island, Meehan Range), an area of ~100-m radius around sampling points was surveyed for 3.5 h. Within this area all trees were searched (depending on visibility and terrain) for evidence of Swift Parrot nesting. Once finished at a sampling point, an adjacent sampling point ~200 m from the previous point was surveyed nests. This was repeated until all trees in each site were sampled. In 2004 and 2005, searches for nests were abandoned once large numbers of Swift Parrot fledglings appeared in late December. At Fern Tree, Bruny Island and the Meehan Range, further searches for nests were conducted along a point transect-line on a meandering traverse away from each intensively searched sampling points. The location of transects was determined by the presence of trees with potential hollows. The direction and length (0.5–3.5 km) of each transect was determined by land tenure and the distribution of trees with potential hollows.

A tree was considered a nesting tree when one or more of the following behaviours were observed:

- An adult female was fed by a male and returned directly to a hollow where she remained.
- A single adult bird was seen entering a hollow (showing no interest in any other hollow) on more than two occasions.
- Chicks were observed being fed by an adult at the entrance to a hollow.

Nests were checked for reuse following the above protocol. Up to three nests were checked for reuse during a 3.5-h sampling period, providing all hollow entrances were in clear view. While checking for reuse of nests, the presence of Swift Parrots at the site determined by sight or call was recorded in the year or years following recorded nesting.

Selection of paired non-nest trees

For each nesting tree, a non-nest tree' was selected as a case control to compare selected variables. The selection protocol for non-nest trees followed the methods outlined in Manning *et al.* (2004). In brief, the first non-nest tree selected was the nearest tree to a nesting tree with DBH >50 cm on a compass bearing of 0°. Each subsequent tree selected was on a bearing 30° more than the previous non-nest tree. If a tree was not located on the compass bearing the next tree in a clockwise direction was selected.

Tree variables

The findings of previous studies on occurrence and use of hollows by vertebrate fauna (e.g. Saunders *et al.* 1982; Lindenmayer *et al.* 2000; Gibbons and Lindenmayer 2002; Manning *et al.* 2004) were used as a basis for the selection of tree variables to measure and methods used in this study. Variables measured for all trees are:

- Species of tree
- Diameter of stem at breast height ~1.3 m above ground level (DBH)
- Height of tree (measured using an inclinometer and range finder)
- Number of potential hollows observed from all angles from the ground using binoculars (with an estimated entrance size of ≥4 cm)
- Fire scars (0 = none, 1 = burnt bark, 2 = damage to vascular cambium, 3 = large hollow in base of tree)
- Presence of dead branches or limbs >15 cm in diameter
- Percentage of dead branches (all sizes) in crown (1 = 0–5%, 2 = 5–20%, 3 = 20–50%, 4 = >50%)
- Tree form (1 = apically dominant or rounded crown, 2 = distinct gaps in crown, 3 = dead limbs penetrating a disjunct crown, 5 = dead limbs penetrating almost dead crown, 6 = dead stag)
- Aspect (N, NE, E, SE, S, SW, W, NW)
- Topographic position (gully, lower slope, mid-slope, upper slope, ridge)
- Slope of ground (1 = 0–5°, 2 = 6–10°, 3 = 11–15°, 4 = >15°)

Potential hollows were any knotholes, branch stubs and fissures, and any spouts or limbs (>15 cm diameter) with the end broken off. Several studies have reported inaccuracies associated with estimating number of hollows from the ground (see Gibbons and Lindenmayer 2002) and this variable can often result in an overestimate of hollow abundance. The count of potential hollows was therefore treated as an index of hollow abundance and no attempt was made to distinguish between 'real' and 'blind' entrances.

Statistical analysis

Because the design employed has the form of a case-control study the analysis is based on differences in characteristics of the paired trees (i.e. each tree that contains a nest is compared with the neighbouring matched tree that does not have a nest). Each matched pair becomes a unit in a stratum and with two distinct levels of comparison, within-pair and between-pair comparisons. It is the within-pair differences that are of interest in this study. The response is binary (i.e. nest presence or absence) and the aim was to determine the extent to which the odds of a tree having a nest is related to the recorded characteristics of the tree. Thus, logistic regression analysis is an appropriate method to use. However, standard (unconditional) logistic regression analysis is not appropriate because it requires independent selection of trees (i.e. a one-stratum design). The method appropriate for a case-control design is known as conditional logistic regression analysis (Breslow and Day 1980), which makes separate comparisons of nest and non-nest trees within each pair.

The analysis used the NOMREG procedure in SPSS ver. 17 (SPSS for Windows, SPSS Inc., Chicago, IL) to fit conditional logistic regression analysis. Likelihood ratio tests were employed to test for evidence of a relationship between the odds of a tree having a nest and an explanatory variable. Because the analysis is based on differences, the use of qualitative explanatory variables with more than two levels is precluded. Such variables were transformed into two or more contrasts for inclusion. Thus, the qualitative explanatory variables reported in Table 1 were necessarily grouped into binary variables. Stepwise regression

Table 1. Results of conditional logistic regression analysis testing for differences between nesting trees and non-nest trees
Only explanatory variables having a $P < 0.01$ are included

Variable	Significance from logistic regression test	Estimated odds ratio	95% confidence interval for odds ratio	
			Lower limit	Upper limit
Number of hollows	0.000	3.2	1.8	5.7
DBH	0.000	1.05	1.03	1.1
Tree form: 1, 2, 3 *v.* 4 and 5	0.000	16.7	6.1	45.9
% dead branches: <20% *v.* ≥20%	0.000	6.1	3.1	11.9
Hollow from fire scar: yes *v.* no	0.000	5.9	2.9	11.9
Dead limb or tree: present *v.* absent	0.000	14.0	4.3	45.2
Fire scar: none *v.* some	0.000	7.0	2.5	20.0
Height of tree	0.000	1.12	1.05	1.2

analysis is based on a likelihood ratio statistic for inclusion and exclusion.

Results

Characteristics of nesting trees

A total of 130 Swift Parrot nests, in 117 trees, was identified over the three breeding seasons. Nesting trees that were reused between seasons or trees with more than one nest or nesting hollow were included only once in the analysis of tree characteristics. The mean number of potential hollows per nesting tree was 8.6 (range 2–22) and 2.1 (range 0–11) for non-nest trees (Fig. 2). The mean DBH of nesting trees was 105 cm (range 33–202) and 76 cm (range 50–174) for non-nest trees (Fig. 3). Mean height of nesting trees was 23 m (range 10–45), whereas that of non-nest trees was 20 m (range 12–35). Although height of trees was a significant variable, there was considerable overlap in the distribution of heights (Fig. 4). Sample sizes were large enough only for *Eucalyptus obliqua*, *E. pulchella* and *E. globulus* to be included in the analysis of tree species. Aspect was omitted from the analysis because the aspect of non-nest trees was correlated with the aspect of the paired nesting tree. Nesting trees were found on all aspects, with 43% on southern or south-western facing slopes. The higher incidence of these aspects was related to a sampling bias towards these aspects. Frequencies of other qualitative variables are shown in Table 2.

The relative likelihood of a tree containing a Swift Parrot nest was significantly associated with seven of the 10 variables when modelled individually (Table 1). A tree was 3.2% more likely to be a nest-tree with each additional potential hollow. A tree was 1% more likely to contain a nest for every 1 cm increase in DBH. Trees with dead limbs penetrating a disjunct crown or an almost-dead crown were, on average, 16.7 times more likely to contain a nest than other tree forms. Trees with >20% dead branches in the crown were, on average, 6.1 times more likely to contain a nest. Trees with at least one dead limb (including dead stags) were, on average, 14 times more likely to contain a nest. Trees were, on average, 7 and 5.9 times more likely to contain a nest if they were fire scarred or had a hollow base from fire scarring. With every increase in tree height of 1 m trees were 1.1% more likely to contain a nest.

The stepwise fitting of explanatory variables found no additional information is added to the model beyond the number of hollows. This implies there is a high level of correlation among variables.

Nest-hollows

A total of 128 nest-hollows was described from the 117 nesting trees. Nest-hollows were more often in branches (70%) than the trunk (30%), and more often in hollows with entrances of knot-holes or branch stubs (68%) than spouts (16%) or fissures (16%). The aspect of entrances to nest-hollows ($n = 127$) were fairly evenly distributed. A summary of the characteristics of nest-hollows is in Table 3. Mean height of the entrance to the nest-

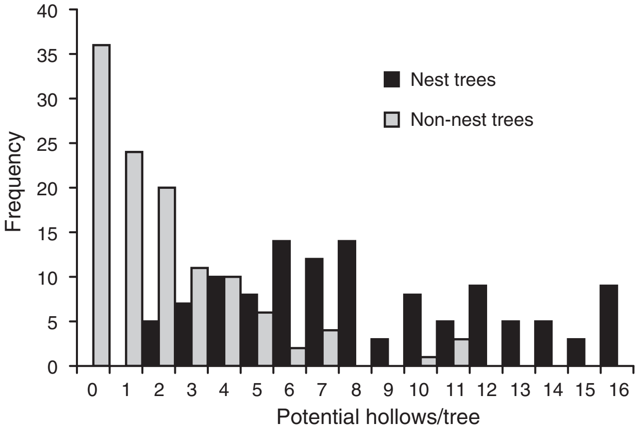

Fig. 2. Frequency distribution of potential hollows per tree for nesting trees and non-nest trees.

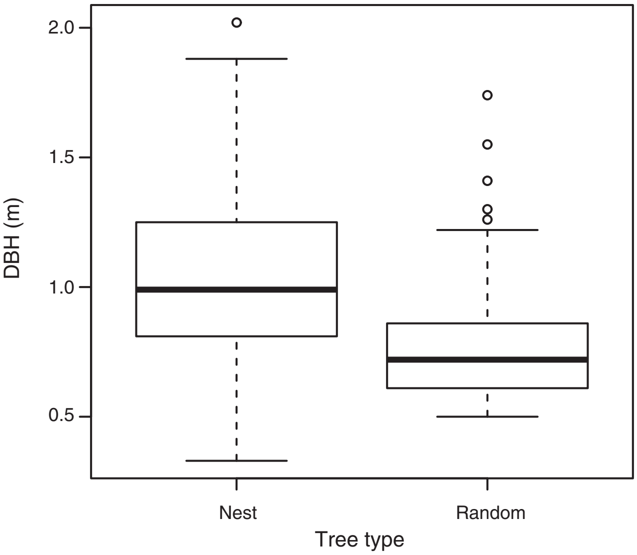

Fig. 3. Diameter at breast height (DBH) of Swift Parrot nesting trees and non-nest trees. The box length is the interquartile range, the thick black line is the median and the circles are outliers.

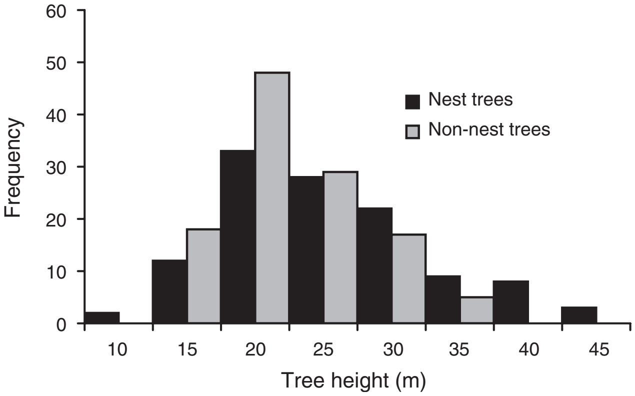

Fig. 4. Frequency distribution of tree-heights for nesting trees and non-nest trees.

Table 2. Frequency table of qualitative variables for 117 paired nesting and non-nest trees

Variable	Non-nest tree	Nest tree
Species		
Messmate (*E. obliqua*)	32	25
Tasmanian Blue Gum (*E. globulus*)	40	31
White Peppermint (*E. pulchella*)	36	41
Manna Gum (*E. viminalis*)	0	4
Silver Peppermint (*E. tenuiramis*)	2	2
Black Peppermint (*E. amygdalina*)	4	0
Dead stag	3	14
Dead limbs		
No	43	4
Yes	71	99
Dead trees	3	14
% dead branches in crown		
0–5%	37	1
5–20%	48	33
20–50%	25	43
>50%	7	40
Tree form		
Apically dominant or rounded crown	25	0
Distinct gaps in crown	46	8
Dead limbs penetrating crown	41	76
Dead limbs penetrating almost dead crown	2	19
Dead tree	3	14
Fire damage		
No damage	32	8
Presence of burnt bark	24	8
Cambium showing clear signs of fire	23	19
Large hollow burnt through base of tree	38	82
Topographic position		
Gully	3	13
Lower slope	15	8
Mid-slope	15	12
Upper slope	52	49
Ridge	32	35
Slope (degrees)		
0–5°	25	24
6–10°	28	30
11–15°	32	36
>15°	32	27

hollow above the ground was 14 m (range 5–40), with 82% of entrances between 6 and 20 m above the ground.

Tree Martins (*Hirundo nigricans*), Green Rosellas (*Platycercus caledonicus*) and Australian Owlet-nightjars (*Aegotheles cristatus*) were observed using nest-hollows vacated by Swift Parrots and in years following recorded breeding when not in use by Swift Parrots.

Distribution of nests

In 2004, there were 26 Swift Parrot nests at Fern Tree, and 10 on Maria Island. In 2005, there were 40 nests on Bruny Island and 49 in the Meehan Range. Three new nests were found on Maria Island while checking for reuse of nests from 2004. The spatial arrangement of nest-trees at each site is shown in Fig. 5. Flowering *Eucalyptus globulus* trees were common within several kilometres of each site, wherever nests were found, except for one reused nest where no flowering was observed.

Table 3. Characteristics of Swift Parrot nest-hollows ($n = 128$)
Aspect is shown as standard compass directions (the aspect of one nest hollow could not be determined)

Variable	Number of nests
Type of hollow	
Spout	20 (16%)
Knothole or branch stub	87 (68%)
Fissure	21 (16%)
Position in tree	
Branch	90 (70%)
Trunk	38 (30%)
Aspect	
N	17 (13%)
NE	15 (12%)
E	18 (14%)
SE	7 (5%)
S	22 (17%)
SW	8 (6%)
W	9 (7%)
NW	12 (9%)
Vertical	19 (15%)

Reuse of nests

All nests identified in 2004 were checked for reuse in 2005. Of 26 nest hollows at Fern Tree from 2004, only one was reused. No other Swift Parrots were observed at Fern Tree while surveying for reuse of nests in 2005 and no flowering *Eucalyptus globulus* were observed. Of 10 nests on Maria Island from 2004, only one was reused, although three new nests were identified, all within 100 m of the 2004 nesting sites. Swift Parrots were regularly observed on Maria Island while checking for nest reuse and flowering *E. globulus* trees were abundant at the site and in the surrounding area.

In 2006, 63 of the 130 nests (48%) found in 2004 and 2005 were checked for reuse: 14 at Fern Tree, 10 on Maria Island, 20 on Bruny Island and 19 in the Meehan Range. None of the nests checked were in use by Swift Parrots. No Swift Parrots or flowering Tasmanian Blue Gums were observed at any site.

Discussion

Nesting trees

The nesting trees of Swift Parrots were characterised by having five or more potential hollows, a DBH >80 cm, dead limbs penetrating the crown, and showing clear signs of senescence. The relative probability of a tree being used as a nesting tree by Swift Parrots increased with the number of potential hollows and DBH. The number, size and diversity of hollows in eucalypts are significantly correlated with tree diameter (e.g. Bennett *et al*. 1994; Lindenmayer *et al*. 2000; Harper *et al*. 2005). Our results reflect those of other studies that show that as the size of trees (and number of hollows) increases, so does the probability of a hollow being suitable for a particular species (Gibbons and Lindenmayer 2002; van der Ree *et al*. 2006). Health, form and fire damage of trees are recognised as predictors of the occurrence of hollows in eucalypts and these attributes are often closely correlated with DBH (e.g. Saunders *et al*. 1982; Inions *et al*. 1989; Gibbons and Lindenmayer 2002). Manning

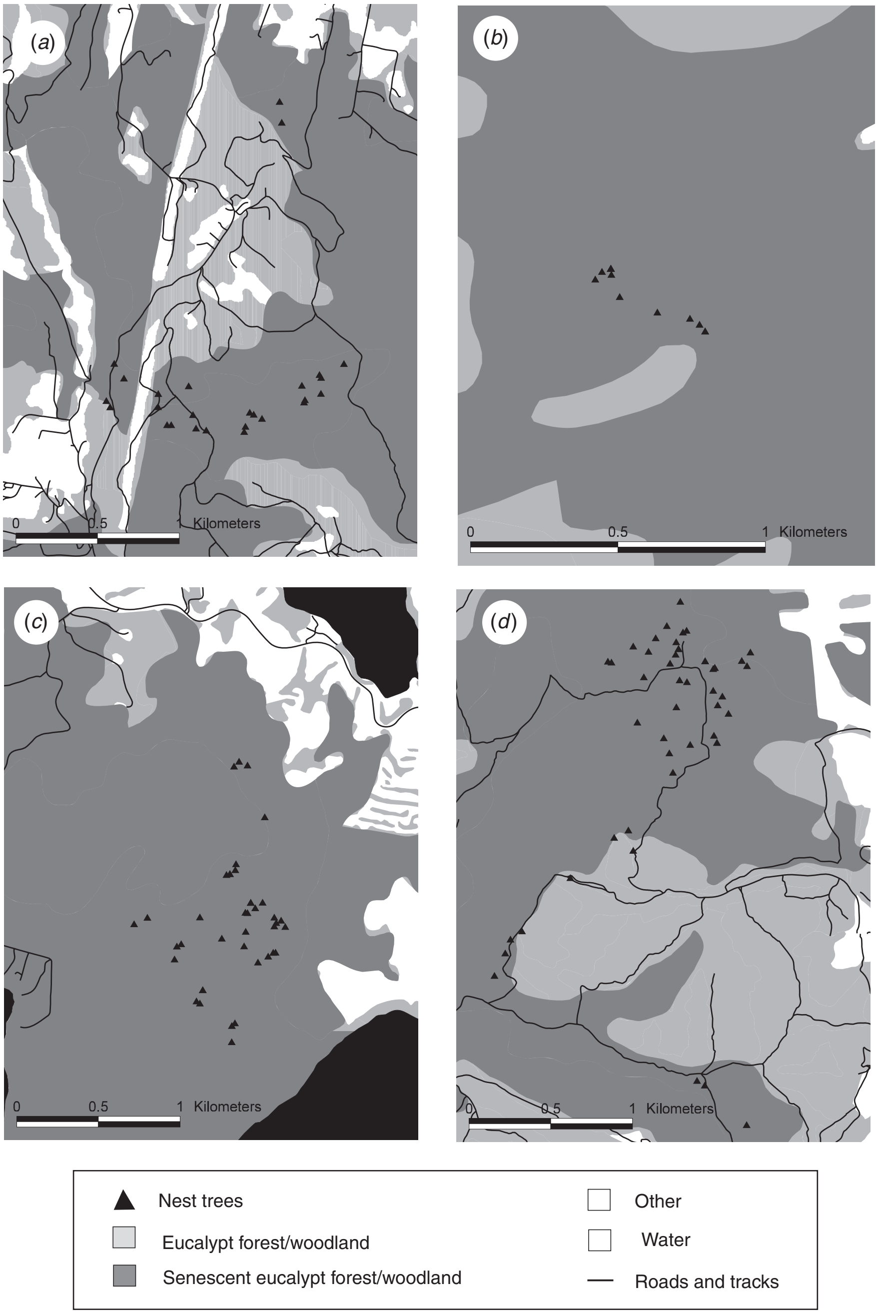

Fig. 5. Spatial distribution of nesting trees and age of forest at the four study sites: (*a*) Fern Tree; (*b*) Maria Island; (*c*) Bruny Island and (*d*) Meehan Range. The mapping layer of eucalypt senescence was obtained from the Tasmanian RFA Forest Senescence Data Layer (Commonwealth of Australia and State of Tasmania 1996). Forest and woodland mapped layers are derived from TASVEG 2.0 (Department of Primary Industries Parks, Water and Environment 2009).

et al. (2004) suggested that DBH alone is a useful field predictor of nesting trees of Superb Parrots (*Polytelis swainsonii*). In our study, stepwise regression analysis suggested the explanatory variables for Swift Parrot nesting trees are similarly correlated.

The high incidence of nesting trees on slopes with southerly and south-westerly aspects is in contrast to the results of Brereton (1997), who reported a high incidence of nesting trees on north-facing slopes. Considering that nests were found in several species of *Eucalyptus* and forest types, selection of nesting trees is most likely to be related to the presence of hollows and proximity to a foraging resource.

We provided quantitative evidence that the number of potential hollows per tree, tree diameter, and characteristics relating to health and form of trees are appropriate field methods for identifying potential nesting trees for Swift Parrots. Counting potential hollows may be suitable for assessing small numbers of trees but when assessing potential nesting habitat at the forest-stand level we suggest the most efficient method is through a visual audit of the diameter of trees, and the form and health of trees. Given that most trees used for nesting were located in dry forest, verification of these results in wet-forest types may be required if the results are to be extended to these forest types.

Nest-hollows

Brereton (1997) reported Swift Parrots were more likely to use hollows facing a northerly direction. In contrast, our study suggests the birds will use hollows with entrances facing any direction. The higher incidence of nesting hollows in branches is probably related to a greater abundance of hollows in branches. Similarly, the greater incidence of nests in knotholes and branch stubs is most likely to be related to the availability of these types of hollows. The mean height of nest-hollows (14 m) is similar to that reported by Brown (1989: 13.4 m) and Brereton (1997: 15 m). As suggested by Manning *et al*. (2004) mean heights of nest-hollows may simply be a function of the size of trees available. For example, tree heights at Maria Island were generally larger than at other sites, and the mean height of nest-hollows was 22 m compared with the overall mean of 14 m.

Distribution of nests

The area surveyed for nests at each survey site comprised only part of larger forest patches (>500 ha) mapped largely as senescent eucalypt forest (Commonwealth of Australia and State of Tasmania 1996). This mapping assessed tree-crown attributes using features described by Jacobs (1955), such as shrinking crowns, bayonet branches and missing branches. These features are indicators of the presence of tree-hollows. Therefore, there was potentially several hundred hectares of nesting habitat immediately adjacent to the recorded nesting sites that were not surveyed for nests. Assuming that Swift Parrot nests occurred through at least part of this unsurveyed forest, a large proportion of the population may have nested in the larger forest patches surrounding the study sites.

The densities of avian nectarivores are often closely correlated with patterns of flowering intensity of eucalypts in Australia. However, measuring eucalypt flowering at a scale relevant to many nectarivores can be difficult (Mac Nally and McGoldrick 1997). Although this study did not attempt to quantify eucalypt flowering, general observations of flowering of *Eucalyptus globulus* trees differed dramatically between years at each site. Hundreds of *E. globulus* trees were in heavy flower at each site when nests were first recorded. When each site was checked for reuse in the following year or years virtually no flowering was observed except at Maria Island where abundant flowering was observed in 2004 and 2005. The lack of reuse of nests was most likely (at least in part) a result of these dramatic differences in the availability of *E. globulus* flowering. The reuse of one nest at Fern Tree in 2005 was the only record of Swift Parrots present at a site where flowering conditions were apparently poor.

Management implications

Swift Parrots generally nest in trees with DBH >80 cm, containing five or more potential hollows and trees that show clear signs of senescence. Nesting trees occurred across a range of forest types but their use by Swift Parrots in any given year is correlated with the proximity or quality of preferred *Eucalyptus* flowers. Where there is an abundance of food and suitable nesting trees, large numbers of Swift Parrots can nest in close proximity to each other. When this occurs, management prescriptions for nesting habitat that rely in large part on identifying specific nesting trees are unlikely to provide adequate protection. With considerable survey effort in each breeding season this management approach may be partly effective. However, the resources required to undertake intensive and effective annual surveys are unlikely to be available to nature conservation agencies and land managers.

Published information on hollow formation in eucalypts in Tasmania (e.g. Koch *et al*. 2008) and similar studies from mainland Australia suggest that the recruitment of Swift Parrot nesting trees, and thus the management of nesting and associated foraging habitats, needs to be considered on a time scale of hundreds of years.

Our results highlight the importance of microhabitat characteristics for selection of nests by Swift Parrots. Understanding how these factors influence the species at the landscape scale should be considered an urgent research priority for this species. A landscape-scale conservation management strategy for breeding habitat of Swift Parrots currently being developed by the Tasmanian government will need to address annual spatiotemporal variation in the distribution of nesting (including congregations of nesting birds), the availability of nesting habitat relative to foraging habitat and their proximity to each other, and the long time-scale required to replace suitable nesting trees. This will require the management or reservation of forest stands with old-growth characteristics across the breeding range and recognition that there may be several years between the use of any particular location by nesting Swift Parrots. Where hollow-bearing forest is scarce relative to foraging habitat, retaining the existing hollow resource may be of particular importance.

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