

Conservation of the Nesting Habitat of the Grey Goshawk (*Accipiter novaehollandiae*) in Tasmanian State Forests

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Abstract

This study aimed to identify and characterise the nesting habitat of the grey goshawk (Accipiter novaehollandiae) in Tasmania. Twenty-six nests were located throughout the range of the species in Tasmania, and the nest sites and surrounding habitat were described. Preferred nest sites were in blackwood trees located in wet forest adjacent to a watercourse or in swamp forest. Assessment of nest-site occurrences in relation to provisions of the Forest Practices Code showed that 38% of the nests were located in streamside reserves. Forest types utilised for nesting are readily identifiable and it is therefore possible to assess how much suitable habitat is outside streamside areas. This information will assist in making decisions on further conservation requirements of the grey goshawk.

Introduction

The grey goshawk (*Accipiter novaehollandiae*) inhabits a variety of wet forest types in eastern and northern Australia and New Guinea and its neighbouring islands. In Australia, its range extends from Tasmania, through south-eastern Australia, along the east coast and across the north of Australia to the Kimberley area in the north-west (Blakers *et al.* 1984).

In Australia, the grey goshawk (*Accipiter novaehollandiae novaehollandiae*) has two colour morphs, one white and one grey. The white morph (Photo 1) predominates in the eucalypt

forests of Tasmania, south-eastern Australia and the north-west of Australia (Mooney and Holdsworth 1988; Readers Digest 1988). The grey goshawk also exhibits extreme reversed sexual dimorphism (Photo 2), with the females being almost twice as heavy as males (Baker-Gabb 1984; Olsen *et al.* 1990). Tasmanian individuals appear to be larger and more dimorphic than mainland birds.

The grey goshawk is generally uncommon throughout its range, although it can be locally common. In Tasmania, it is classified



Photo 1. The grey goshawk.

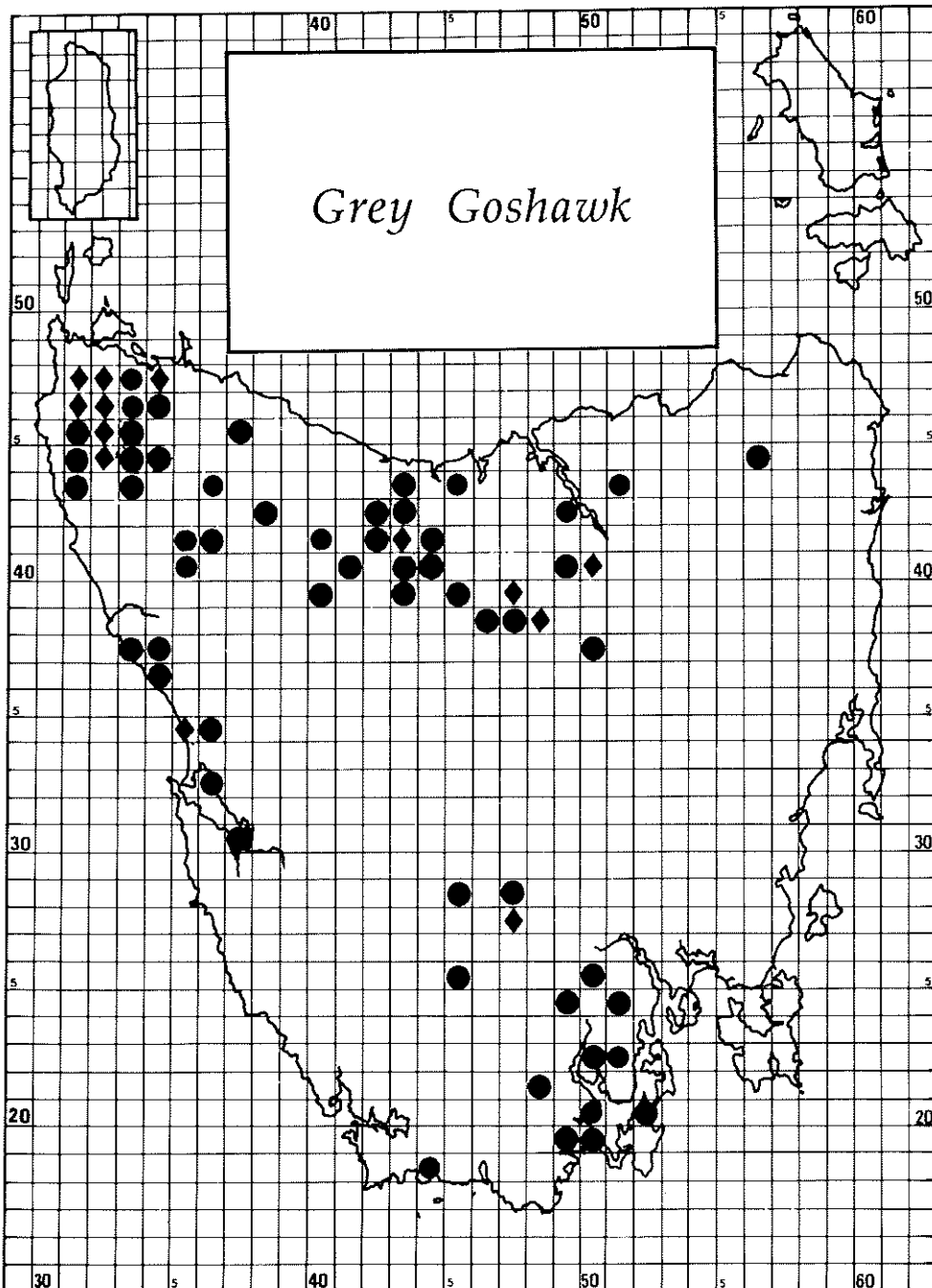


Figure 1. The distribution of grey goshawk nest sites used in this study (diamonds) and predicted distribution of breeding pairs (circles) in Tasmania (Mooney and Holdsworth 1988; unpublished data).

as rare (Vertebrate Advisory Committee 1994) and it is estimated that there are probably less than 110 pairs (Mooney and Holdsworth 1988). They are concentrated in the north and west of the State but there is also a small

population in the south-east, containing less than 15% of the population, and an even smaller population in the north-east (Thomas 1979; Mooney and Holdsworth 1988). Breeding appears to be confined to wet,

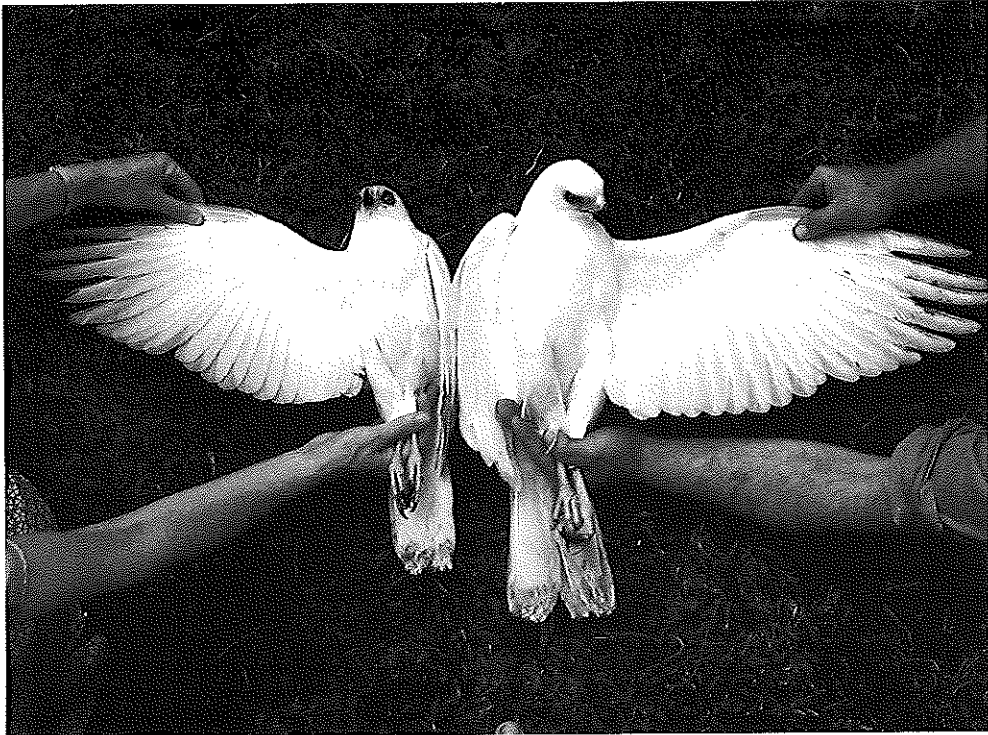


Photo 2. Dimorphism in the grey goshawk. Females are larger than males.

oldgrowth forests and nest sites are almost always associated with watercourses or swamps (Mooney and Holdsworth 1988). Most breeding starts in September/October, with the young leaving the nest by February (Mooney 1987). Figure 1 shows the distribution of breeding grey goshawks in Tasmania.

The aim of this study was to characterise the nesting habitat of the grey goshawk in Tasmania and to assess the extent to which nests occur within areas protected under the streamside reserve prescriptions of the *Forest Practices Code* (Forestry Commission 1993). The study was part of a project which examined the habitat requirements of the south-eastern Tasmanian population of the grey goshawk (Brereton 1993).

Methods

Locations of nest sites were obtained mostly from records kept by the Parks and Wildlife

Service in the Department of Environment and Land Management, Tasmania, but some were obtained from local naturalists. Two new nest sites were found while the authors were checking known sites. In all, 26 nest sites were used in the study (Figure 1) and all but four were visited: appropriate data had already been collected for these four sites (N. Mooney, unpublished data).

Nest-tree variables collected at each site included the species of tree, its height, height to the nest and height to where the first major branch leaves the trunk. The height to the first major branch was used as a measure of the height to the base of the canopy. The diameter at breast height over bark (DBHob) of the nest tree was measured and used in this study to arbitrarily classify trees as oldgrowth or regrowth, with a diameter of 100 cm being selected as the threshold value for oldgrowth eucalypts and 70–80 cm for non-eucalypts. The distance from the closest watercourse was also measured.

Nesting habitat was assessed by visiting nest sites. Habitat variables included slope, aspect and a description of vegetation floristics and structure. The diameters of a sample of the dominant tree species at each site were also measured to assist in the determination of the age of the forest. The position of the nest, either in an upright fork or on a horizontal branch, was also noted. Information on nest site and habitat was collated and the occurrence of nest sites in relation to streams was noted.

The relevant District planning staff from the Forestry Commission, Tasmania, were consulted on the width of streamside reserves which would have been retained if these sites had been subjected to logging. On a few occasions, the widths were greater than those prescribed by the *Forest Practices Code* due to site factors.

Results

Distribution of nest sites

Nearly all the nest sites were in the north and west of the State. Only one was located in the south, at Russell Falls Creek in State forest, just outside Mount Field National Park. They ranged in altitude from 5 m to 440 m above sea-level (a.s.l.). Of the 15 nest sites at altitudes of less than 100 m a.s.l., all but two were associated with blackwood forests in the north-west. Of the 11 sites above 100 m, 10 were on watercourses flowing from ranges in the north of the State and the other site was on Russell Falls Creek.

Most nest sites were associated with large areas of forest (> 100 ha). However, six nest sites (23%) were in forest patches surrounded by farmland. These included two on Quamby Brook, one on the Duck River, two south of Redpa and one near Claude Road. Some of the forest remnants were quite small: the patch of bushland on the Duck River was approximately 2 ha. No isolated trees were used for nesting. The site data for the 26 nests are listed in Appendix 1.

Nest use

Twelve of the nest sites had been used sometime in the last three years; the remaining 14 had not been used for three years or more. The nests no longer existed at some of the older sites and for two of these the nest tree no longer exists. Nest sites were clustered in some areas and, at Togari, where there were three nest sites approximately 300 m apart, the nests had been used at different times. There were also another two nest sites 3 km away. There were two nest sites close together south of Redpa, two on the Arthur River, two lots of two in the Liffey Valley and two close together at Quamby Brook. In each area, the nests had been used in different years.

Nests and nest trees

Most nests were approximately 50 cm in diameter and 25 cm deep. Seventeen nests (68%) were in non-eucalypt tree species: twelve (48%) were in blackwood (*Acacia melanoxylon*), two (8%) in myrtle (*Nothofagus cunninghamii*), two (8%) in swamp paper-bark (*Melaleuca ericifolia*) and one (4%) in a woolly tea-tree (*Leptospermum lanigerum*). Of the eight nests in eucalypts, four were in stringybark (*Eucalyptus obliqua*), three were in white gum (*E. viminalis*) and one was in a swamp gum (*E. ovata*).

The shortest nest tree was an 11 m woolly tea-tree (which also contained the lowest nest at 8 m) and the tallest nest tree was a 50 m stringy-bark. The highest nests were at 28.5 m (white gum) and 28.2 m (blackwood).

The heights of the blackwood nest trees ranged from 18 m to 33 m, the mean being 24.4 m (Table 1). The mean height to the nests was 19.8 m and the mean height to the first branch was 12.6 m; thus, the nests in blackwoods tend to be in the upper part of the canopy. This trend is also evident in the other non-eucalypt species (Table 1). The heights of the eucalypt nest trees ranged from 29 m to 50 m, with the mean height being 34.6 m. The mean height to the nests was

Table 1. Height and diameter (DBHob) measurements of nest trees. Values are mean \pm SD (range).

Tree species	Height of tree (m)	Height to nest (m)	Height to first branch (m)	DBHob (cm)	n
Blackwood	24.4 \pm 4.9 (16-33)	19.8 \pm 5.0 (12-28.2)	12.6 \pm 3.0 (9-18)	53 \pm 10 (38-68)	12
Paper-bark/tea-tree	20.4 \pm 8.2 (11-28)	15.9 \pm 6.6 (8-22)	8.3 \pm 5.3 (4-16)	45 \pm 11 (35-54)	4
Myrtle	25.0 \pm 0.0 (25)	18.5 \pm 2.1 (17-20)	12.0 \pm 0.0 (12)	88 \pm 11 (80-95)	2
All non-eucalypt species	23.6 \pm 5.5 (11-33)	18.8 \pm 5.1 (8-28.2)	11.6 \pm 3.8 (4-18)	55 \pm 16 (35-95)	18
Eucalypts	34.6 \pm 7.1 (29-50)	24.1 \pm 3.8 (21-28.5)	17.8 \pm 5.9 (9-27)	101 \pm 33 (51-162)	8

24.1 m (Table 1), and the mean height to the first branch was 17.8 m. Therefore, unlike the non-eucalypt tree species, the nests in eucalypts tended to be in the lower part of the canopy.

The DBHob of blackwood nest trees ranged from 38 cm at Quamby Brook to 68 cm in riparian blackwood forest near the Arthur River, with the mean DBHob being 53 cm. The tallest blackwood had one of the smallest diameters (45 cm DBHob). The two myrtles had the largest DBHob of the non-eucalypt nest trees (95 cm, 86 cm). The DBHob of the eucalypts ranged from 51 cm to 162 cm (mean 101 cm), with six of the eight trees having a diameter of 90 cm or more.

The threshold diameter for classifying eucalypts as oldgrowth was selected as 100 cm and, thus, based on their large diameters, most of the eucalypt nest trees could be classified as oldgrowth or older regrowth. The other trees used as nest sites, with the exception of myrtle, are not as long-lived as the eucalypts nor are their potential diameters as great. Therefore, non-eucalypt trees with a DBHob of 50+ cm could be considered as older regrowth trees in terms of their life-span and those with a DBHob of 70–80 cm could be considered as oldgrowth. On this basis, the two myrtles and two of the

swamp paper-barks are classed as oldgrowth trees and some of the larger blackwoods (50+ cm) are classed as older regrowth trees. Of the five blackwoods less than 50 cm DBHob, four were greater than 40 cm, approaching the older regrowth category. Apart from the smallest tree on Quamby Brook, these blackwoods are still within the same height range (25+ m) as the blackwoods with the larger diameters (Table 1).

Twenty-two nests were assessed for aspect. Eight were on the west side of the tree, six on the south, five on the north and two on the east. At one site, the nest was in the centre of the tree and had no aspect. Aspects for the other nest sites were not measured because either the nest was no longer present or the site was not visited and the information was not available. Only two nests were found on branches and both were in stringybarks, one on the Duck River and one at Togari in blackwood swamp forest.

Habitat of nest trees

Eight of the ten nests in non-eucalypt species and two of the nests in eucalypts were in blackwood swamp forest. Three of the nest sites were in riparian blackwood forest, one was in mixed forest in a riparian situation, nine were in wet sclerophyll forest close to

Table 2. Minimum streamside reserve widths (from the Forest Practices Code).

Class	Watercourse type	Minimum horizontal width from streambank to corresponding outer edge of reserve
1	Rivers and Lakes—waters which are important for town water supplies or recreational use.	40 m
2	Creeks, streams and other watercourses from the point where their catchment exceeds 100 ha.	30 m
3	Watercourses carrying running water most of the year between the points where their catchment is 50 and 100 ha.	20 m
4	All other watercourses carrying water for part or all of the year for most years. A class 4 watercourse should have features which identify it as a watercourse rather than a depression or drainage line which may only carry surface water during rainfall.	No logging machinery within 10 m of the streambank except at defined crossing points.

watercourses, two were in damp sclerophyll forest close to watercourses (less than 40 m) and one was in damp sclerophyll forest nearly 100 m from the nearest waterway (Quamby Brook 3, Appendix 1). Damp sclerophyll is used here to describe plant communities with an understorey comprising a mixture of species typical of wet and dry sclerophyll forest.

Eight of the nest trees in blackwood swamp forest were associated with mixed-age stands, where there were some elements of oldgrowth forest and some older regrowth vegetation (50+ years). The remaining two nest trees were in oldgrowth forest.

All of the nest sites were in the vicinity of permanent and non-permanent watercourses or swamps, with most being associated with permanent streams. Sixteen nest sites were associated with watercourses of varying sizes, ranging from small streams which flow only after rains to large rivers (e.g. Mersey River). Two of these were adjacent to waterways in blackwood swamp forest and one was in riparian blackwood forest. Eight of the remaining nest sites were in swamp forest

and two were in riparian forests in the north-west, which are flooded for part of the year. The swamp forest nest sites were on the flat valley floors of the Montagu and Welcome Rivers whilst the riparian forest sites were near the Arthur River. Nest sites associated with streams ranged from 1 m to 93 m from a watercourse (Figure 2).

Nest sites in streamside reserves

The watercourses were classified according to the system used in the *Forest Practices Code* which places streams into four classes according to catchment size (Table 2). There were three sites in class 1, five in class 2, four in class 3 and four in class 4.

The three nest sites adjacent to the class 1 streams all fall within the streamside reserves for this class of watercourse as defined in the *Forest Practices Code* (Figure 2). Only one of the five nest sites on class 2 watercourses is outside the defined streamside reserve width (70 m; a tributary of the Arthur River). Of the four sites on class 3 watercourses, one is outside the streamside reserve (93 m; Quamby Brook 3). The four nest sites on

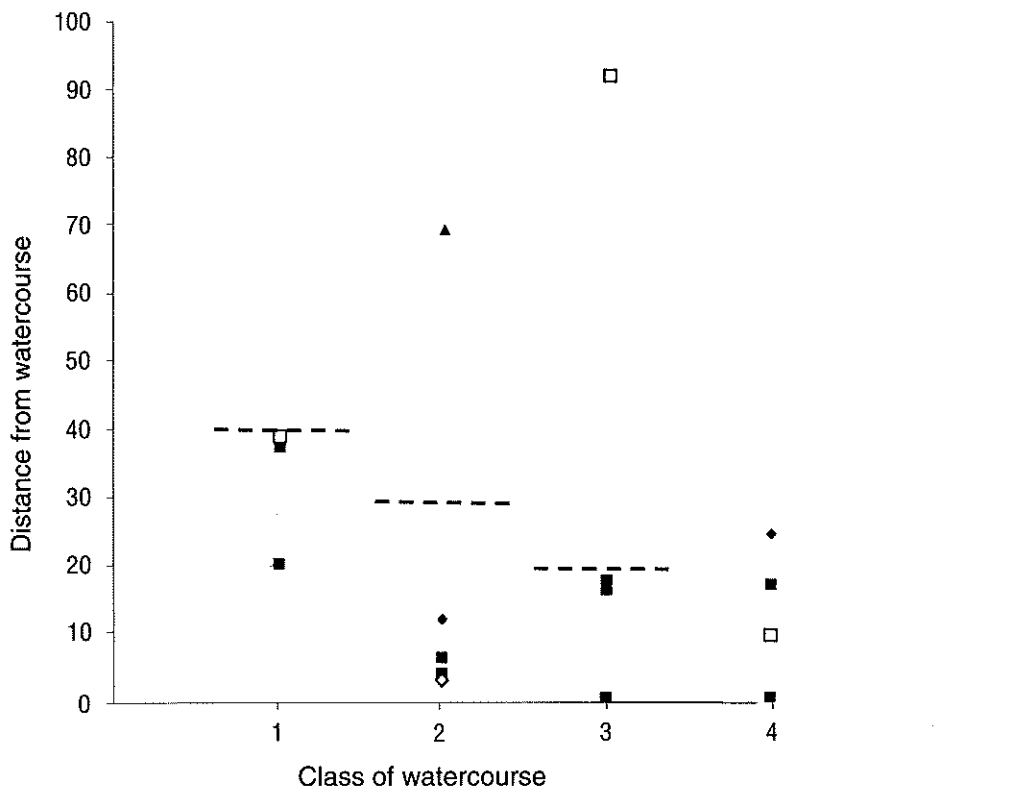


Figure 2. Distance of nest site from watercourse. Dotted lines indicate the standard width of streamside reserves for each class of watercourse. (■ = wet sclerophyll forest; □ = damp sclerophyll forest; ◆ = blackwood swamp forest; ◇ = mixed forest; ▲ = riparian blackwood forest)

class 4 watercourses would not be protected from logging by streamside reserve prescriptions.

Under the streamside reserve provisions of the *Forest Practices Code*, ten of the sixteen nest sites adjacent to watercourses would be protected from logging. However, the remaining six nest sites and the ten nest sites in the blackwood forests not adjacent to a defined watercourse would not be protected from logging. Thus, only 38% of the nest sites are covered by the streamside reserve provisions in the *Forest Practices Code*.

Discussion

The results indicate that grey goshawks prefer blackwoods as nest trees, followed by

eucalypt species. A smaller number of other non-eucalypt species were used. Oldgrowth, or at least older regrowth trees (as defined by diameter for the purposes of this study*), were generally preferred as nest sites. This supports the findings of Mooney and Holdsworth (1988) who reported that the grey goshawk nested in a range of tree species, usually oldgrowth or older trees of that species.

The location of the nests in trees was generally determined by tree structure. For example, nests in blackwoods tended to be placed near the top of the tree where the canopy is denser. This trend was also seen

* Oldgrowth is normally defined either by an age limit (> 110 years) or by the undisturbed character of the forest (RAC 1992).

with nests in swamp paper-barks. For eucalypts, where the canopy is deeper, nests were more often placed nearer the base of the canopy.

Nest sites were all at altitudes lower than 440 m above sea level. They were generally associated with wet forests although three nest sites were in damp sclerophyll forest. All the forests were considered oldgrowth or older regrowth containing some old trees. The wet forest types included mixed forest, blackwood swamp forest, riparian blackwood forest and wet sclerophyll forest. Blackwood swamp forest and riparian blackwood forest comprise those wet forests containing blackwoods as described by Pannell (1992). Blackwood swamp forests are widespread in the north-west of Tasmania and occur in poorly drained situations on the flat valley floors of the Duck, Montagu and Welcome Rivers (Pannell 1992). Riparian blackwood forest occurs on better drained sites and can be found along creek lines, on the floodplains of rivers and on gully slopes. In the north-west, the most extensive areas of riparian blackwood forest are on the flood-plains of the Arthur River (Pannell 1992).

The results generally support the earlier findings of Mooney and Holdsworth (1988) who concluded that breeding of the grey goshawk was restricted to wet, oldgrowth forests at low to medium altitudes. However, the findings of this study suggest that grey goshawks will nest in mixed age forests and even in young regrowth if there are oldgrowth trees present. They will also nest in remnant patches of forest.

For those nest trees on slopes, shelter from the sun and wind appears to be important since over half of these nests were on east-facing slopes. This concurs with the findings of Mooney (1987). There appears to be little or no influence of aspect on the placement of the nest in the canopy. The preferred nesting site in the tree appears to be an upright fork of three or more branches, with nests rarely being placed on a horizontal or upwardly angled branch.

The grey goshawk appears to use more than one nest in a breeding territory as shown by the clustering of nest sites. It is not known why they change nest sites. Possible causes might be the replacement of one of the birds in a breeding pair, other nest sites becoming more suitable over time, or an unsuccessful breeding attempt at a nest site (Newton 1980).

The only known nest site in the south (Russell Falls Creek) is no longer used. However, adults are resident in the area and almost certainly still breed nearby. There are also regular sightings of adult birds from other areas in the south during the breeding season (Mooney and Holdsworth 1988; Brereton 1993) and the pattern of sightings suggests that there are other breeding pairs in southern Tasmania, especially in the lower Channel area.

Grey goshawk conservation and forestry

The grey goshawk is a top-order predator utilising oldgrowth forests and as such it may have a role in forest management as an indicator species. Management indicator species are those which are sensitive to a particular land-use activity and whose presence is also likely to indicate high quality habitat for a range of other species or communities (Landres *et al.* 1988). Generally, good indicator species are sedentary, specialised species, or those at the top of food chains, needing large territories or home ranges. Conserving grey goshawk habitat may also benefit other species which depend on the same resource and which may be affected adversely by timber harvesting.

A large proportion (62%) of the total nest sites found in Tasmania are not protected by the streamside reserve provisions of the *Forest Practices Code*. Most of those not protected are in the blackwood swamp forests and the riparian blackwood forests in the north-west, which are prime grey goshawk habitat. The unprotected nests outside the blackwood forests include those outside the minimum streamside reserve widths and those on class 4 watercourses.

The watercourses in blackwood swamp forest are diffuse and do not follow defined drainage lines. As a result, it is not possible to define and classify these watercourses for protection under the *Forest Practices Code*. Riparian blackwood forest on flood plains extends beyond the streamside reserve boundary and thus nest sites occur outside the protected area. Fifty per cent of the known nests were recorded from these forest types but only one nest site falls within a streamside reserve: the remaining 12 are not covered by the streamside reserve provisions of the *Forest Practices Code*.

Work is required to determine how much suitable nesting habitat in the north-west is covered by reserves, such as Recommended Areas for Protection (RAPs), wildlife habitat strips, streamside reserves and Forest Reserves and how much is affected by forestry operations. An assessment could then be made on how well grey goshawk nesting habitat is protected by current forest planning in the Forestry Commission's Circular Head District. It should be noted that six of the nest sites in the north-west are in existing RAPs (five in the Togari RAP and one in the Arthur River RAP). However, these six sites probably only represent three breeding pairs.

Ten of the nest sites are in Mersey District in the north of the State. Eight of these are near waterways which run along the base of the Great Western Tiers, one is on a waterway to the north of Mount Roland and one is on the Mersey River where it runs out of the Gog Range. Six of these are covered by the streamside reserve provisions of the *Forest Practices Code*. The results of the study indicate that grey goshawk nesting habitat in this area comprises wet sclerophyll forest along watercourses with some oldgrowth or older regrowth trees (50+ years), particularly blackwoods. Using this information, an estimate of the area of available grey goshawk nesting habitat in the Mersey District could be made, along with the proportion in reserves. An assessment could then be made on the impact of forestry activities on the grey goshawk.

The three remaining nest sites all fall within streamside reserves, one on the Henty River on the west coast, one on the Duck river in the north-west outside the blackwood forests and one on Russell Falls Creek in southern Tasmania.

If an assessment of grey goshawk nesting habitat shows that it is not well represented in reserves, including streamside reserves, the upgrading of some class 4 watercourses to class 3 (20 m) may be one option to be considered to retain suitable nesting habitat. Three out of the four sites on class 4 watercourses are within 20 m of the drainage line (the class 3 streamside reserve width). Class 4 watercourses suitable for upgrading could be identified by an assessment of nest site potential; that is, the presence of wet sclerophyll forest with some oldgrowth or older regrowth trees (50+ years), particularly blackwoods or other suitable tree species (e.g. myrtle, paper-bark).

Although there is only one known grey goshawk nest site in southern Tasmania, there does appear to be a larger breeding population of grey goshawks present and efforts need to be made to locate the nests. This information is needed to determine whether grey goshawks are nesting in State forests and, if so, whether they are using the same nesting habitat that is being used by populations in other parts of Tasmania. A survey to find nest sites would best be carried out in late September and October, when pairs are displaying, and from late November to January, when the parents are feeding young and are making many trips to and from the nest. The survey should concentrate on those areas which have been identified from the sightings data as possibly supporting breeding pairs.

There is little information on habitat use in the south. The known nest site is associated with a waterway and it is highly likely that the nesting habitat is similar to that in the Mersey District. However, before management prescriptions are adopted for the south, there is a need to undertake an

examination of suitable habitat as described in this paper to see how much is protected. An assessment could then be made on whether the grey goshawk is being adequately catered for in forest planning.

The conservation of nesting habitat does not mean that nest sites will continue to be used if an area is subjected to forestry activities. The grey goshawk is considered to be more tolerant of disturbance near the nest site than many larger raptors (N. Mooney, personal observation), for example the wedge-tailed eagle, *Aquila audax*, which is a notoriously shy nester (Mooney and Holdsworth 1991). The grey goshawk will breed in small patches of forest; for example, the Duck River nest is in a 2 ha patch of bushland surrounded by farmland on one side and low density rural housing on the other. However, this nest site and others like it in small bushland patches (e.g. Dasher River tributary, Quamby Brook 1 and 2) are isolated and relatively free from disturbance. Generally, there is little data on the impact of disturbance near the nest site and as more information becomes available, nest site prescriptions may change.

This paper has discussed only breeding habitat. The grey goshawk forages over a wide range of habitats and access to foraging habitat is equally important for its conservation. However, for adults, hunting is focussed on oldgrowth wet forest (Mooney and Holdsworth 1988; Brereton 1993). The modification of oldgrowth forests by forestry

operations and clearing for agriculture and urban expansion may have implications for the future survival of this species. Thus, information is required on the use of oldgrowth forest by grey goshawks particularly on a small scale to enable planners to incorporate its habitat requirements into land-use planning.

In addition to habitat disturbance, persecution is a major threatening process. It affects the grey goshawk primarily in developed areas in Tasmania, even though the bird is classified as rare (Vertebrate Advisory Committee 1994) and is protected by law. Abatement of this threat would mean greater security for the population.

Acknowledgements

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Appendix 1. Nest tree and site data.

Site no.	Location	Altitude (m)	Nest tree	Height of tree (m)	Height to nest (m)	Height of first branch (m)	DBHob (cm)	Aspect of nest in canopy (°)
1	Whisky Jim 1 (Liffey Valley)	380	<i>Acacia melanoxylon</i>	24.0	21.0	9.0	60	S (170)
2	Whisky Jim 2 (Liffey Valley)	360	<i>Acacia melanoxylon</i>	16.0	12.0	13.0	67	SSE (160)
3	Lockarts 2 (Liffey Valley)	400	<i>Acacia melanoxylon</i>	28.0	17.0	15.0	45	WNW (300)
4	Togari 4	40	<i>Acacia melanoxylon</i>	33.0	28.0	18.0	56	W (270)
5	Togari 5	40	<i>Acacia melanoxylon</i>	25.0	19.0	15.0	58	SSW (200)
6	Redpa 1	40	<i>Acacia melanoxylon</i>	31.0	28.2	14.0	41	E (100)
7	Redpa 2	40	<i>Acacia melanoxylon</i>	25.0	23.0	15.5	45	NW (320)
8	Arthur River 1	40	<i>Acacia melanoxylon</i>	20.6	18.6	10.2	68	W (270)
9	Arthur River 2	60	<i>Acacia melanoxylon</i>	23.0	19.2	12.9	60	E (80)
10	Dasher River Tributary	220	<i>Acacia melanoxylon</i>	25.0	21.0	9.7	49	SW (240)
11	Quamby Brook 1	320	<i>Acacia melanoxylon</i>	18.0	14.0	10.0	38	SE (240)
12	Quamby Brook 2	320	<i>Acacia melanoxylon</i>	24.0	16.0	9.0	53	WNW (300)
13	Togari 1	40	<i>Melaleuca ericifolia</i>	28.0	22.0	16.0	54	NNNE (20)
14	Welcome River 1	40	<i>Melaleuca ericifolia</i>	26.4	20.7	7.0	54	NNW (340)
15	Welcome River 2	40	<i>Melaleuca ericifolia</i>	16.0	13.0	6.0	35	U/A
16	Henty River	5	<i>Leptospermum lanigerum</i>	11.0	8.0	4.0	35	U/A
17	Togari 3	40	<i>Nothofagus cunninghamii</i>	25.0	17.0	12.0	95	W (280)
18	Russell Falls Creek (Mt Field)	270	<i>Nothofagus cunninghamii</i>	25.0	20.0	12.0	80	WSW (250)
19	Lockarts 1 (Liffey Valley)	380	<i>Eucalyptus viminalis</i>	38.0	21.0	13.0	108	WSW (250)
20	Mersey River	100	<i>Eucalyptus viminalis</i>	30.0	28.5	17.7	89	U/A
21	Swains (Liffey Valley)	280	<i>Eucalyptus viminalis</i>	30.0	21.0	9.0	76	WSW (250)
22	Togari 2	40	<i>Eucalyptus obliqua</i>	50.0	28.0	27.0	92	NW (310)
23	Duck River	20	<i>Eucalyptus obliqua</i>	32.0	20.2	12.5	105	SSE (160)
24	Quamby Brook 3	440	<i>Eucalyptus obliqua</i>	30.6	24.4	22.0	51	NW (320)
25	South Arthur River	60	<i>Eucalyptus obliqua</i>	29.0	21.0	20.0	162	U/A
26	Barco	40	<i>Eucalyptus oata</i>	37.0	29.0	21.0	124	U/A

Appendix 1. Continued.

Site no.	Distance from watercourse	Class of watercourse	Slope at tree (°)	Slope at site (°)	Aspect at site	Forest type	Forest age	Last use of nest	Land tenure	Reservation status
1	1.0	4	25	25	E (90)	WSF	RG (15 yrs)	1992/93	Private	
2	17.5	4	25	25	E (90)	WSF	RG (15 yrs)	1980 (?)	Private	
3	17.6	3	25	23	S (190)	WSF	OG	1991/92	State forest	Streamside reserve
4	na	na	0	0	na	BSF	MA	1983/84	State forest	Togari RAP
5	na	na	0	0	na	BSF	MA	1984/85	State forest	Togari RAP
6	na	na	0	0	na	BSF	MA	1992/93	Private	
7	na	na	0	0	na	BSF	MA	1983/84*	Private	
8	na	na	0	0	na	RBF	OG	1991/92	State forest	
9	na	na	0	0	na	RBF	MA	1983/84*	State forest	Arthur River RAP
10	10.0	3	0	30	SE (140)	WSF	MA	1992/93	Private	Streamside reserve
11	2.5	2	0	0	N (0)	WSF	RG	1992/93	Private	Streamside reserve
12	6.3	2	0	16	NNE (30)	WSF	RG	1991/92	Private	Streamside reserve
13	na	na	0	0	na	BSF	MA	1983/84*	State forest	Togari RAP
14	12.0	2	0	0	na	BSF	OG	1986*	Private	Streamside reserve
15	na	na	0	0	na	BSF	MA	1983/84*	State forest	Streamside reserve
16	20.0	1	gentle	0	E (110)	WSF	OG	1983/84	Non-allocated crown land	Streamside reserve
17	na	na	0	0	na	BSF	MA	1992/93	State forest	Togari RAP
18	3.0	2	25	17	WSW (250)	MF	MA	1988/89*	State forest	Streamside reserve
19	17.5	3	14	11	N (110)	WSF	OG	Unknown	Private	Streamside reserve
20	38.6	1	0	0	W (270)	WSF	RG	1992/93	State forest	Streamside reserve
21	10.0	4	10	10	E (80)	DpSF	MA	1991/92	Private	
22	25.0	4	0	0	na	BSF	MA	1984/85	State forest	Togari RAP
23	39.0	1	0	0	na	DpSF	MA	1992/93	Private	Streamside reserve
24	93.0	3	13	13	NE (50)	DpSF	RG	1991/92	Private	
25	70.0	2	gentle		E (90)	RBF	OG	1984†	State forest	
26	na	na	medium		NE (40)	BSF	OG	1985†	State forest	

U/A = data unavailable
na = not applicable

Forest type
WSF = wet sclerophyll forest
RBF = riparian blackwood forest
DpSF = damp sclerophyll forest
BSF = blackwood swamp forest
MF = mixed forest

Forest age
RG = regrowth
MA = mixed age
OG = oldgrowth

Last use of nest

* nest no longer present
† nest site has since been logged

