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A snapshot survey of Painted Honeyeaters in Weeping Myall Woodlands in New South Wales

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The Painted Honeyeater *Grantiella picta* is a threatened, nomadic species of shrublands and woodlands in eastern Australia, but its use of available habitat is poorly understood. The species' spatial ecology in the endangered, highly fragmented Weeping Myall, Acacia pendula Woodlands of New South Wales, an important habitat for its foraging and breeding, was studied at the landscape scale. Quantity, quality and condition of such habitat was examined during surveys conducted from September–October 2020 at 355 locations spread across four regions in the western slopes and plains of New South Wales. Eighty-seven Painted Honeyeaters were recorded across 51 of the surveyed sites, with 80 individuals being sighted across 45 of the 143 sites in the two northernmost regions. Habitat cover and structural complexity and mistletoe prevalence appeared to influence the occurrence of Painted Honeyeaters. The findings highlight the importance of Weeping Myall Woodlands to this species. This survey sets a baseline for further monitoring of, and detailed research on, the distribution and abundance of Painted Honeyeaters.

Keywords: Painted Honeyeater; Weeping Myall Woodlands; survey; habitat assessment; *Acacia* cover and structural complexity; mistletoe prevalence.

INTRODUCTION

The Painted Honeyeater *Grantiella picta* is a nomadic mistletoe specialist of shrublands and woodlands in eastern Australia. It occurs from the Barkly Tablelands of the Northern Territory to central Victoria. It is listed as vulnerable under the *Environment Protection Biodiversity Conservation Act 1999* (*EPBC Act*) and the *Biodiversity Conservation Act 2016* (*BC Act*). Habitat loss is one of the chief threats to the species' long-term survival. Historical and ongoing land clearance has resulted in a severe reduction in suitable habitat across much of its range (DAWE 2020).

Painted Honeyeaters show a strong preference for specific types of shrubland, woodland and forest that contain mistletoe (particularly *Amyema spp*.), a key foraging and nesting resource which provides fruit, shelter and, to a lesser degree, nectar for both breeding and non-breeding individuals (Oliver *et al*. 2003; Barea 2008, 2012; Barea and Watson 2013). The Painted Honeyeater has been described as having a north-south migration, as well as being nomadic in parts of its range (Keast 1968; DAWE 2020). Painted Honeyeaters reputedly breed in the southern half of their range from October to February before dispersing into the northern portion (i.e. central and western Queensland and central Northern Territory) during the non-breeding season (Higgins *et al.* 2001; DAWE 2020), but there is limited direct evidence for such long-distance movements. The Painted Honeyeater's local movement patterns and use of habitat during both the breeding and non-breeding seasons are also poorly understood. Both space use patterns are likely to be influenced by temporal variation in resource availability (Barea and Watson 2007).

Weeping Myall Woodland, an endangered ecological community that occurs on alluvial plains in the central and eastern Murray-Darling Basin, is considered one of the Painted Honeyeater's most important breeding and foraging habitats (DAWE 2020). It typically comprises monotypic stands of Weeping Myall *Acacia pendula* which often contain Grey Mistletoe *Amyema quandang*. Land clearance for agriculture has removed 83-94% of Weeping Myall Woodland in New South Wales (NSW) and it currently exists as small, fragmented patches across much of its large range (TSSC 2009). Very little of this woodland is protected in conservation areas. Travelling stock reserves and road corridors contain some of the best remaining stands of the woodland, particularly in the southern and eastern parts of the Painted Honeyeater's range (DOEWHA 2008).

There have been no published landscape scale surveys of the Painted Honeyeater's use of Weeping Myall Woodland on the western slopes and plains of NSW, and consequently the relative importance of each of the restricted areas of suitable vegetation in this landscape for foraging and breeding is poorly understood. Improving our knowledge of this species' use of Weeping Myall Woodland and documenting the condition of this habitat type throughout the Painted Honeyeater's range are required for effective conservation management. Identification of areas of Weeping Myall Woodland that require better management or protection or where restoration work would be most beneficial are likely to be vital for the long-term persistence of both this ecological community and the Painted Honeyeater.

We conducted a survey of Weeping Myall Woodlands in NSW and the occurrence in them of Painted Honeyeaters during September-October 2020 to:

1. identify sites in this habitat in NSW that may be suitable for the long-term monitoring of Painted Honeyeaters
2. determine Painted Honeyeater presence/absence and abundance
3. assess the condition of this type of woodland in NSW, and qualitatively score the suitability of each survey site for Painted Honeyeaters based on the spatial extent and structure of *Acacia pendula* and the prevalence of *Amyema quandang*.

Secondary objectives of the survey were to locate Painted Honeyeaters that had been colour-banded at Ungarie, NSW between 2017– 2020 and thus extend our knowledge of their survival and movements, and to identify the most suitable sites for the establishment of new, targeted Painted Honeyeater banding stations. The ultimate rationale underlying the survey was to facilitate the initiation of a monitoring program to examine spatial and temporal variability in Painted Honeyeater abundance and identify important sites for this threatened species on the western slopes and plains of NSW.

METHODS

To address the objectives outlined above, Painted Honeyeater surveys and habitat assessments were conducted at sites in four regions on the western slopes and plains of NSW, namely the Riverina, the Central-West Slopes and Plains, the North-West Slopes and Plains and the Gunnedah–Bellata region.

Survey site selection

Survey sites were selected by examining satellite imagery (*Google Maps* and *SIX Maps*). Imagery in areas containing the greatest cover of remnant native vegetation, such as roadsides, travelling stock routes and adjacent watercourses, was examined for the distinctive bluish hue of *Acacia pendula*. Images sourced from *Google Street View* were then assessed to confirm the presence of this species where possible and all survey sites selected by this method were subsequently visited to confirm suitability for inclusion in the survey. Additional sites not identified during the desktop assessment were also included during field surveys if adequate cover of *Acacia pendula* or Yarran, *A. homalophylla*, another key habitat species, was present. Survey sites ranged from narrow strips of habitat on roadsides to locations within larger areas of continuous habitat. All surveys were conducted within two-hectare blocks in (often linear) patches of habitat two hectares or more in area.

Three hundred and fifty-five sites were selected for inclusion in the survey based on the presence of *Acacia pendula* (344 sites) or *A. homalophylla* (11 sites) (Fig. 1). The following four discrete areas in the western slopes and plains of NSW were surveyed from 21 September-3 October 2020:

1. North-West Slopes and Plains (21-25 September)

One hundred and six sites were surveyed in this area (hereinafter referred to as 'NWSP'); they were distributed between Girilambone, Gulargambone, Peak Hill and Tottenham in the Darling Riverine Plains Bioregion.

2. Northern Slopes and Plains (26-27 September)

Thirty-seven sites were surveyed in this region (hereinafter 'NSP'); they were distributed between Bellata, Rangari and Tambar Springs in the Brigalow Belt South Bioregion.

3. Riverina (30 September-3 October)

One hundred and thirty-seven sites were surveyed; they were distributed between Carrathool, Lake Wyangan, Methul and Yanco Creek at the Kidman Way in the Riverina, South Western Slopes and Cobar Peneplain Bioregions.

4. Central-West Slopes and Plains (28-30 September)

Seventy-five sites were surveyed in this area (hereinafter 'CWSP'); they were distributed between Lake Cargelligo, Condobolin, West Wyalong and Caragabal in the South-Western Slopes and Cobar Peneplain Bioregion.

Survey method

Ten-minute surveys were conducted by two observers (RA and MA) at each site, except for all 37 surveys in the NSP and 18 surveys in the CWSP where TH was also involved. The abundance of Painted Honeyeaters and all nectar-feeding bird species present at the sites was recorded. In instances where a Painted Honeyeater was detected during a survey, a further 10–20 min was spent counting the number of Painted Honeyeaters at the site and establishing whether any of them were colour-banded. The sex of the Painted Honeyeaters present was recorded from plumage differences where possible. All surveys were conducted during mild–warm conditions (5-25°C), at low-moderate wind speeds (<30 km/hr) and in the absence of rain. After the completion of the survey at each site, a brief assessment of vegetation and habitat characteristics was undertaken.

Habitat assessment

At each site the extent and projecting foliage cover of *Acacia pendula* and *A. homalophylla* and the relative levels of mistletoe infestation in these two species were assessed.

Scores of 1-9 ('habitat scores') were assigned to describe the spatial extent and structural complexity of *Acacia pendula or A. homalophylla*. In all cases only one of these two species was present and so a habitat score for just one of these species was assigned per site. Scores were based on the spatial extent and the cover of the specific *Acacia* species in each stratum within the site (see Table 1 for details). Scores of 0-9 ('mistletoe scores') were assigned to describe the relative prevalence of *Amyema quandang* (hereinafter 'mistletoe'), which was defined as the relative degree of infestation of live mistletoe on *Acacia pendula* or *A. homalophylla* (Table 2). The mistletoe score encompassed the size and abundance of mistletoes present relative to the cover of *Acacia pendula* or *A. homalophylla* at the site. For example, if there were only ten *Acacia pendula* at a site, a relatively high mistletoe score of 8 would be assigned if there was a very high degree of infestation of those ten trees, whereas a lower mistletoe score of 5 would be assigned where a site contained 100 *Acacia pendula* with approximately 1-2 mistletoes each.

RESULTS

Painted Honeyeater occurrence

Eighty-seven Painted Honeyeaters were recorded, comprising 47 in the NWSP, 33 in the NSP, three in the CWSP and four in the Riverina (Table 3). Only one or two individuals were recorded at most sites where Painted Honeyeaters occurred (43/51 or 84%), whilst a maximum of seven individuals in a site was observed east of Boggabri, NSP. Most observations were of vocal males that appeared to be establishing and/or

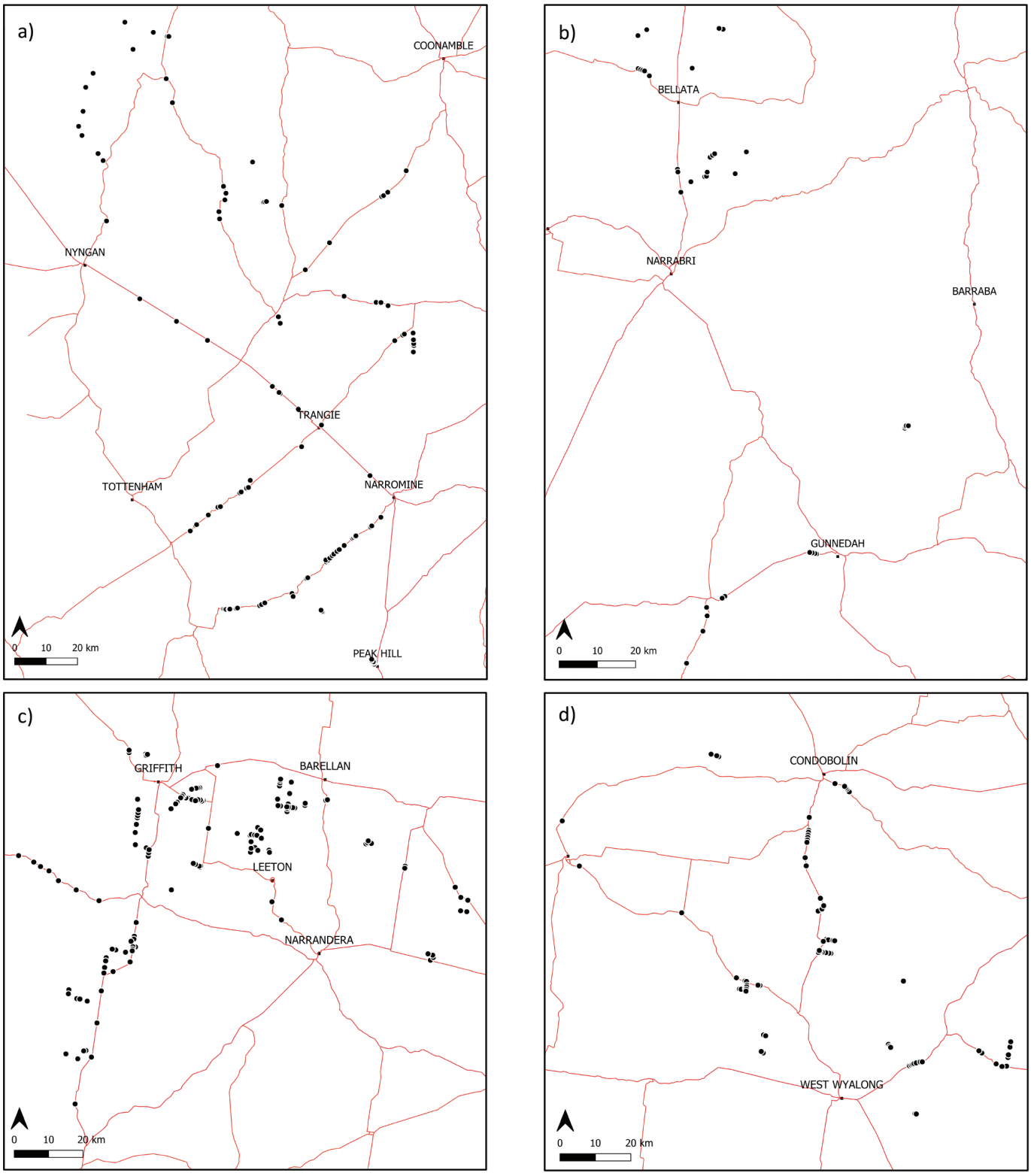

Figure 1. *Location of survey sites in a) the North-West Slopes and Plains (NWSP) (n=106), b) the Northern Slopes and Plains (NSP) (n=37), c) the Riverina (n=137) and d) the Central-West Slopes and Plains (CWSP) (n=75).*

defending territories. The survey was conducted relatively early in the period when Painted Honeyeaters typically occur in the surveyed regions and hence the peak seasonal number of birds at each site is unlikely to have been reached at the time of our survey. Sufficient views and/or photographs were obtained of 33 individuals to assess whether any were colour-banded, but no banded individuals were detected (N.B. 50 individuals were colour-banded at Ungarie, NSW between 2017 and 2020, but the number of these birds alive as of September/October 2020 when our survey was conducted was unknown).

Table 1

Description of habitat score categories used in assessing Weeping Myall Woodland.

Score	Description
1	Fewer than 5 stems in the site.
2	Approximately 5-15 stems in the site. Habitat typically present in one stratum in very narrow strips, including those characterised by major gaps. Includes sites where other shrub or tree species are dominant.
3	Narrow (usually roadside) strip of habitat less than 5 m wide, including those with large gaps between stems and typically restricted to one side of the road. Habitat generally restricted to just one stratum. Includes sites where other shrub or tree species are dominant.
4	Narrow, roadside strip of habitat approximately 5 m wide or patches of habitat that extend beyond roadsides, although typically with low cover. Habitat typically only present in one or two strata.
5	Roadside strips approximately 5-10 m wide or patches of habitat that extend beyond roadsides, although with low – moderate cover. Habitat typically present in one or two strata.
6	Roadside strips more than 10 m wide or patches of habitat that extend beyond the road corridor. Habitat generally characterised by moderate cover in at least two strata.
7	Habitat in wide road corridors or, more frequently, patches extending beyond road corridors characterised by moderate cover in three strata or high cover in two strata.
8	Very high cover throughout most of the site. High structural complexity in the form of high cover in all strata.
9	Extremely high cover throughout the entire site. Very high structural complexity in the form of very high cover in all strata.

Table 2

Description of mistletoe score categories used in describing mistletoe prevalence in Weeping Myall Woodland.

Score	Description
0	No mistletoe present.
1	Extremely low degree of mistletoe infestation. Approximately <1 mistletoe present per 20 trees.
2	Very low degree of mistletoe infestation. Approximately 1-5 mistletoes present per 20 trees.
3	Low degree of mistletoe infestation. Approximately 6-15 mistletoes present per 20 trees.
4	Below-average mistletoe infestation. Approximately 1 mistletoe present per tree.
5	Average mistletoe infestation. Approximately 1-2 mistletoes present per tree.
6	Above-average degree of mistletoe infestation. Approximately 2-5 mistletoes present per tree.
7	High degree of mistletoe infestation. Approximately 5-10 mistletoes per tree, including a few large mistletoes.
8	Very high degree of mistletoe infestation. Approximately 10-20 mistletoes per tree, including several large mistletoes.
9	Extremely high degree of mistletoe infestation comprising 20 + mistletoes per tree, including several large mistletoes.

Table 3

Summary of Painted Honeyeater survey results by region.

Region	Number of sites where Painted Honeyeater detected	Total number of Painted Honeyeaters recorded	Average number of Painted Honeyeaters recorded per site
CWSP	3/75 (4%)	3	0.04
NWSP	27/106 (25%)	47	0.44
NSP	18/37 (49%)	33	0.89
Riverina	3/137 (2%)	4	0.03
Overall	51/355 (14%)	87	0.25

Painted Honeyeaters were recorded at 14% of the sites surveyed (Table 3). The proportion of sites where they were detected was highest in the NSP (49%) and second highest in the NWSP (25%). In contrast, Painted Honeyeaters were only recorded at 4% of sites in the CWSP and 2% in the Riverina, the more southerly regions (Table 3). Painted Honeyeater occurrence at survey sites was particularly high in certain areas in the NSP and NWSP, such as north of Bellata (8/11 sites), Rangari Road (4/4), immediately west of Gunnedah (3/4) and the McGrane Way north of the Bogan River (8/18) (see Fig. 2), but low or zero in other areas in these two northern regions, such as the Collie (0/12) and Black Stump Way areas (0/6).

Twelve other nectar-feeding bird species were recorded at the 355 survey sites, the most abundant being the Noisy Miner *Manorina melanocephala* (527 individuals recorded at 154 or 43% of sites), Yellow-throated Miner *M. flavigula* (362 at 114 or 32% of sites) and Spiny-cheeked Honeyeater *Acanthagenys rufogularis* (173 at 79 or 22% of sites).

Figure 2. *Painted Honeyeater presence (red diamonds)/absence (white diamonds) and abundance at survey sites in the McGrane Way/Bulgandramine Road area of the NWSP on 21-22 September 2020. Note that this map corresponds to the survey area south-west of Narromine shown in Figure 1 (a).*

Habitat characteristics

1. *Acacia* spp. cover and complexity

A large majority of sites (294 or 83%) were assigned a high habitat score of 5-7 (Fig. 3). Thirteen sites were assigned a very high score of 8 based on the large extent of cover provided by, and the structural complexity of, *Acacia spp.*; these included seven sites in the NWSP and two each in the NSP, CWSP and Riverina. Very few sites were assigned a score of <4 (16 or 5%). This was primarily due to the site selection criteria used, in which the smallest stands with little structural complexity were excluded from the survey, and was not an accurate reflection of the true proportion of habitat in the landscape that had little structural complexity. Likewise, the non-random site selection method probably partly explains the similarity in the overall average habitat scores among the four survey regions. Photographs of a selection of survey sites are presented in the Appendix.

Variation in habitat scores among sites perhaps most strongly reflected whether habitat was restricted to road reserves and the width of those reserves. Stands of *Acacia spp.* restricted to road reserves varied in width from a few to approximately 100 m (or the width of the survey site). The NWSP region had the highest proportion of sites where *Acacia spp.* occurred both in and beyond road reserves, whilst suitable habitat in the CWSP and Riverina was typically restricted to narrow road reserves. Wider roadside sites were usually associated with Travelling Stock Routes.

One area of significant habitat dieback was observed. All *Acacia pendula* along a 1 km stretch of road near Marthaguy in the NWSP appeared to have been impacted by aerial crop spraying. In this area, all shrubs and trees were denuded and very little regrowth on the outer branches of *Acacia pendula* was observed. This represents a localised but apparently severe threat that has the potential to affect any Weeping Myall Woodland that occurs on roadsides in cropped land subject to aerial spraying.

2. *Mistletoe prevalence*

A substantial majority of sites (227 or 64%) were assigned mistletoe scores of 5-7, although there were 48 (14%) that had very little mistletoe (scores of 1-3) and 17 (5%) that had none (Fig. 3). Flowering was noted at most sites with mistletoe in all four regions, whereas mistletoe fruit was only recorded at a few sites in the NSP, a finding not unexpected given the timing of the survey and the favourable climatic conditions immediately prior to it. We noted that mistletoe fruit ripened earlier in the northern than in the southern regions. The average mistletoe score of sites was similar among the four survey regions; however, there was considerable variation in scores among sites and localities *within* regions (see Fig. 4).

Sites that contained the highest abundance of mistletoe included those on Irrigation Way (Riverina), Rangari Road (NSP), Lachlan Valley Highway (CWSP) and the McGrane Way (CWSP). At the 12 sites on Irrigation Way just east of Griffith,

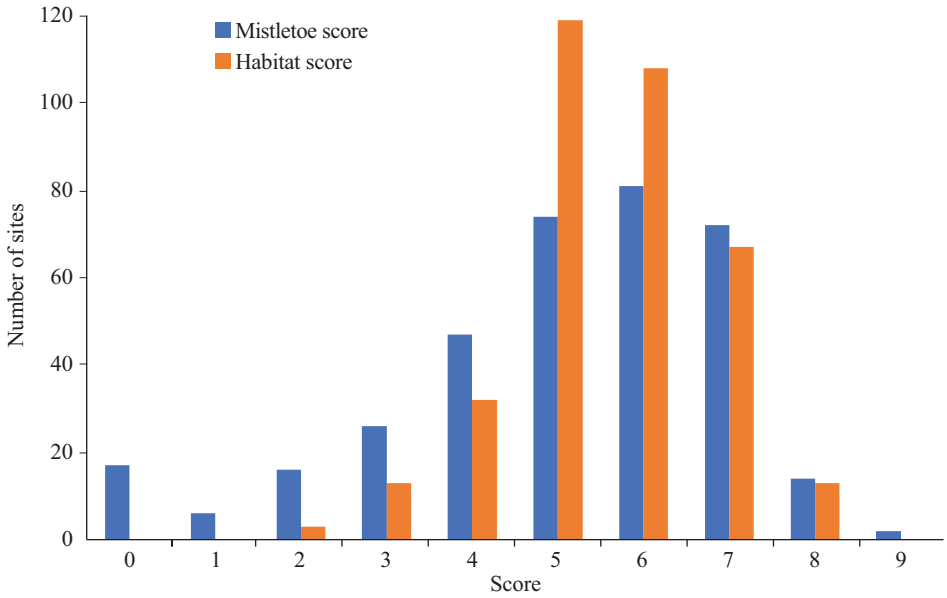

Figure 3. *Frequency of sites with various habitat and mistletoe scores.*

the average mistletoe score of 7.2 reflected the consistently high degree of mistletoe infestation throughout the relatively narrow, although structurally complex, stands of roadside *Acacia pendula* in this area. Three of the five sites in the Riverina assigned a mistletoe score of 8 were located within this 6 km stretch of roadside habitat. Fourteen of the 17 sites lacking mistletoe were in the Matong/Kamarah Road area in the eastern Riverina, despite this locality having large, mature *Acacia pendula* trees. The other three sites containing no mistletoe were on Merrengreen Road south of Ungarie (CWSP) and Irrigation Way just north of Whitton (Riverina). Interestingly, like the Matong/Kamarah Road sites, these localities contained mature stands of *Acacia pendula*. However, there were also some locations not included in this survey that were observed to have no or very little mistletoe, but which comprised young, regenerating or planted *Acacia pendula*.

DISCUSSION

Relationship between habitat quality and Painted Honeyeater occurrence

Painted Honeyeater occurrence was generally greater at NWSP and NSP sites in which the *Acacia* component was extensive and structurally complex and mistletoe was common than at sites lacking these characteristics (Table 4). Our observation that Painted Honeyeater occurrence across the NWSP and the NSP appeared to be positively related to *Acacia spp*. extent and complexity is consistent with the findings of a study on the western floodplain of the Culgoa River in 2001. In that investigation in an area containing Brigalow *Acacia harpophyllla*, Gidgee *A. oswaldii*, Rosewood *Alectryon oleofolium* and White Cypress Pine *Callitris glaucophylla*, Painted Honeyeaters occurred in sites that had more trees and greater canopy cover than sites not used by the species (Oliver *et al*. 2003).

In the present study, the observed difference in the occurrence of Painted Honeyeaters at sites with little or no mistletoe and those where mistletoe infestation was heavy is also consistent with previous findings and may explain why individuals (often very vocal males establishing /defending territories) were most frequently encountered during the survey period at resource-rich sites. The investigation of Oliver *et al.* (2003) found a positive relationship between the abundance of mistletoes per tree and per unit area and the presence of Painted Honeyeaters. Further, research conducted on the Painted Honeyeater's breeding biology at Binya State Forest near Griffith, NSW between October 2004 and February 2006 indicated that Painted Honeyeaters respond primarily to mistletoe abundance when selecting nest sites (Barea 2012). At this site mistletoe abundance was 2.8 × greater in areas around nest trees than in randomly sampled areas of the study site. The high level of occupancy of resource-rich sites in the NWSP and NSP in our study suggests that these sites may be the most preferred locations for breeding of the sites surveyed in these two regions.

However, Painted Honeyeaters were also occasionally observed at NWSP and NSP sites with very little mistletoe (i.e. mistletoe scores of 2 or 3) or those with limited or average habitat cover (i.e. habitat scores of 4 or 5) (Table 4). This highlights the importance of *all* areas of appropriate habitat in the survey regions, including *Acacia* stands currently deemed to provide low quality habitat. Such sites, including recently planted ones and areas of regeneration with few mature *Acacia,* could potentially become important sites for Painted Honeyeaters if habitat cover and complexity and mistletoe prevalence increase.

Spatial variation in Painted Honeyeater occurrence

The proportion of sites in which Painted Honeyeaters were detected and average Painted Honeyeater abundance were highest in the NSP and NWSP, where 80 of 87 sightings made during the survey were recorded. Painted Honeyeater occurrence was generally highest within these two regions in areas that supported large patches of high quality habitat, such as the Bellata area, Rangari Road, along McGrane Way and in sections of the Macquarie Marshes, although some sites that were deemed to comprise only average quality habitat also had Painted Honeyeaters. In marked contrast, there were no areas in the CWSP and the Riverina where Painted Honeyeater

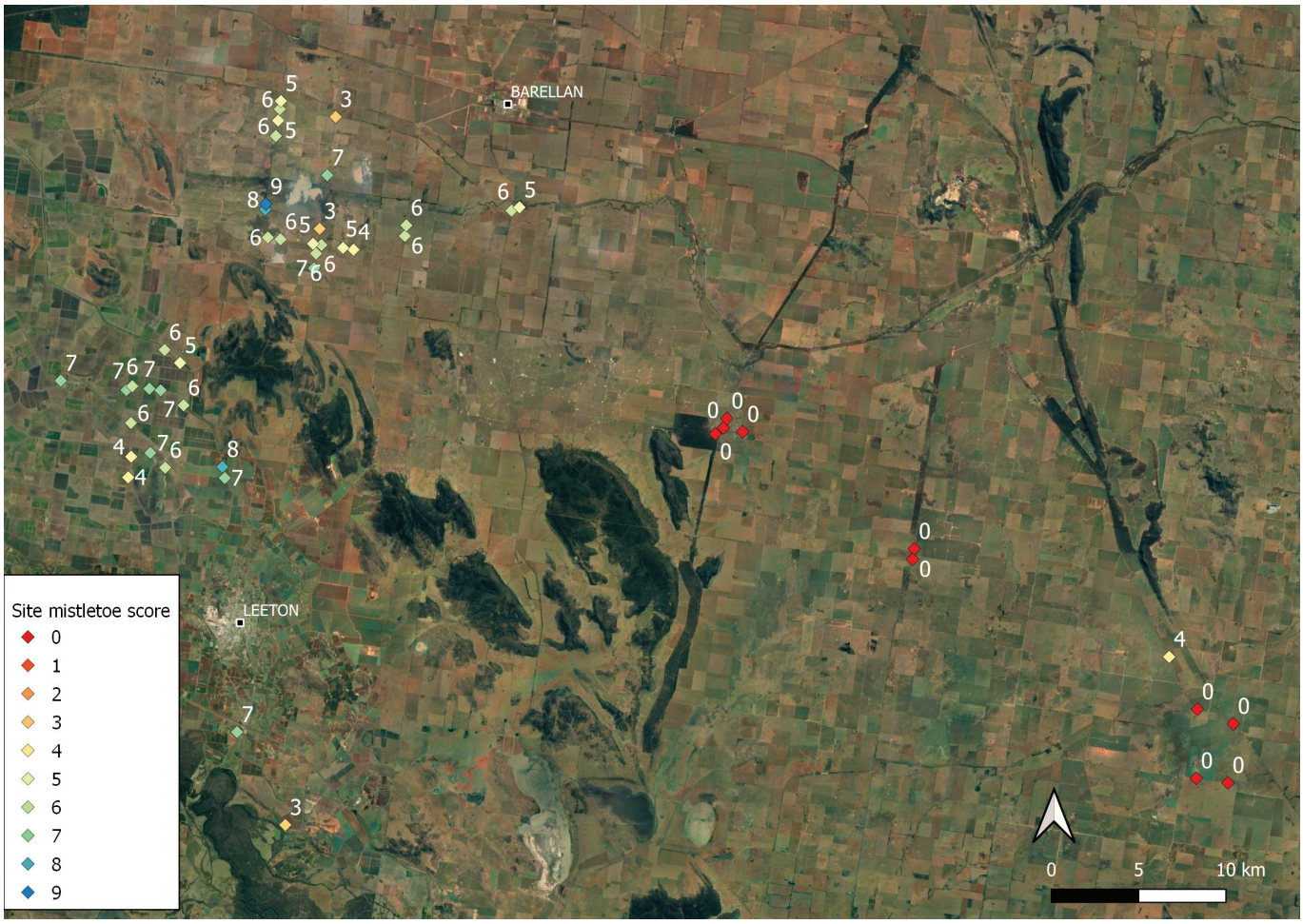

Figure 4. Mistletoe scores at sites in the eastern Riverina.

Table 4

Proportion of sites where Painted Honeyeater were recorded in the NWSP & NSP by habitat score and mistletoe score.

Mistletoe score	Habitat score 1	2	3	4	5	6	7	8	9	Total
0										
1		0/1	0/1			0/1				0/3
2			0/2	0/5	0/2	0/1	0/1			0/11
3			0/2	1/7 (14%)	0/3	0/3				1/15 (6%)
4		0/2	0/2	0/3	2/6 (33%)	2/9 (22%)	1/1 (100%)	0/2		5/25 (20%)
5			0/3	0/2	0/9	5/11 (45%)	3/5 (60%)			8/30 (27%)
6			0/2	1/3 (33%)	2/9 (22%)	4/11 (36%)	2/5 (40%)	1/1 (100%)		10/31 (32%)
7				0/1	2/5 (40%)	5/5 (100%)	4/4 (100%)	3/5 (60%)		14/20 (70%)
8						2/2 (100%)	4/5 (80%)	1/1 (100%)		7/8 (88%)
9										
Total		0/3	0/12	2/21 (10%)	6/34 (18%)	18/43 (42%)	14/21 (67%)	5/9 (56%)		

occurrence was high during the survey period. The disparity between the number of Painted Honeyeaters recorded in the two northern and the two southern regions is noteworthy, given the similarity in the percentage of sites designated as being of moderate or high quality (in terms of *Acacia spp*. cover and mistletoe prevalence) in all survey regions. The observed difference may be a result of a combination of factors not specifically related to site value. Painted Honeyeaters were not recorded during the survey at some sites in the CWSP and the Riverina which are known to be regularly used for breeding.

Given that the survey was conducted relatively early in the period when Painted Honeyeaters typically occur in the surveyed regions and that inter-annual variability in the timing of arrival in these regions is probable, the disparity in honeyeater abundance between the northern and southern regions could be partly due simply to a lag in the timing of movement from the northern to the southern regions during 2020. However, the distance between the Peak Hill, Tullamore and Trangie area (where 29 individuals were observed across the 50 sites from 21-22 September) and the northern section of the CWSP survey region (where only three individuals were recorded across 75 sites from 28-30 September) is only 100 kilometres. This relatively short distance, in the context of the factors discussed below, suggests that survey timing probably does not account for the considerable difference in observed Painted Honeyeater abundance north of the Bogan River and south of the Lachlan River. In a study conducted at Binya State Forest, near Griffith, NSW, male Painted Honeyeaters arrived in the first fortnight of September (three weeks before the first females) during both survey years (i.e. 2004 and 2005) (Barea and Watson 2007). If it is assumed that most birds present in NSW during the breeding season have dispersed southward from Queensland in early spring, the observations of Painted Honeyeaters throughout northern Victoria during the last fortnight of September 2020 may indicate that the very low numbers of birds observed in the CWSP and Riverina from 28 September–3 October 2020 were not primarily a function of survey timing.

The difference in the observed abundance of Painted Honeyeaters between the northern and southern survey regions in September/October 2021 is probably more closely related to recent climatic conditions than to real differences in the habitat quality of surveyed sites in the two regions. Spatial and temporal variability in climatic conditions probably influences the Painted Honeyeater's use of habitat across the four survey regions and elsewhere in its breeding range during each breeding season. Favourable environmental conditions encountered by individuals presumably moving south from Queensland into the NWSP and NSP regions immediately before the survey period in 2020 may have strongly influenced dispersing birds' decision-making with respect to where to establish territories, leading to the high observed occupancy rates across available habitat in these northern regions during September 2020. It is noteworthy that following an extremely dry period, during which 24-month rainfall totals in 2018-2019 were the lowest on record across all four survey regions, rainfall was far higher than average during the eight months leading into the September/October 2020 survey period across all survey regions (BOM 2021). For example, Trangie (NWSP) and Narrabri (NSP) respectively received just 55% and 63% of their annual mean rainfall in 2018, only 33% in 2019, but 150% and 126% respectively of their January–August mean rainfall during this period in 2020 (BOM 2021). It is possible that due to reduced Painted Honeyeater numbers across most of the species' range after the severe drought conditions in 2019-2020, there was so little competition for suitable breeding sites in the NWSP and NSP that further movement south by birds looking for unoccupied breeding space was not adaptive.

Also of interest are details of sightings (or the lack thereof) of Painted Honeyeaters in the survey regions after the September/October 2020 survey. After the very low numbers recorded during the survey in the CWSP and the Riverina (including at sites known to regularly contain individuals in late September and early October, such as key breeding locations at Ungarie and in the Griffith area), few honeyeaters were recorded in these areas throughout the 2020/2021 breeding season (M. Sullivan and T. Hunt, pers. comm.). These lower than average numbers of birds at these regular breeding sites may indicate that relatively few Painted Honeyeaters were present in these two regions during the 2020/2021 breeding season compared with other non-drought years. This anecdotal evidence supports the contention that the Painted Honeyeater's breeding range shifts according to seasonal conditions, as indicated by the documentation of breeding events in the far east of their range during severe drought (Lenz and Dabb 2003). A higher than average number of Painted Honeyeaters may have been breeding in the two northern survey regions in NSW in 2020/21. This may be a function of opportunistic identification of resource-rich areas, with returning males moving through the landscape until they encounter a sufficient (or at least developing) supply of fruit on mistletoe. Thus, many individuals may not have continued southward to other suitable areas of Weeping Myall Woodland in NSW during September and October 2020 as this was not necessary at that time.

Further monitoring of the Painted Honeyeater in Weeping Myall Woodlands in NSW during both drought and wetter-than-average years, and during different periods of the breeding season, would provide a clearer understanding of the influence of the factors discussed above on spatio-temporal variation in habitat use. Knowledge of the maximum extent of habitat that Painted Honeyeaters will use long-term and identification of the most regularly used sites would aid identification and protection of all remaining critical habitat and allow conservation managers to better target areas where revegetation works will have the greatest positive impact for this species.

Conservation implications and threats

The findings of the 2020 survey highlight the importance for Painted Honeyeaters of both roadside patches of Weeping Myall Woodland, many of which are extremely restricted in size, and Weeping Myall Woodland on adjacent private land. The most valuable sites for this species appear to be larger sites with the greatest structural complexity of *Acacia* and the highest incidence of mistletoe, but isolated patches of habitat are also frequently used by the species. The long-term persistence of Weeping Myall Woodland on roadside public land and adjacent private land may be vital for the survival of Painted Honeyeaters given this plant community's restricted, fragmented occurrence and current environmental pressures on it throughout the Painted Honeyeater's range. Roadside sites are particularly vulnerable to the side-effects of road maintenance (whether inadvertent, deliberate, illegal or legal) (see Appendix B) and other factors, such as grazing by stock during drought years, grass fires and habitat dieback. The latter three factors, in conjunction with vegetation clearance for agriculture, are likely

to be the key threats to Weeping Myall Woodland on private land in the survey regions. Such habitat was observed to typically consist of relatively open shrublands and woodlands (often with little regeneration), where retention of all existing habitat and recruitment of *Acacia pendula* are likely to be central to this ecological community's long-term persistence. Given the importance of Weeping Myall Woodlands in NSW as Painted Honeyeater habitat, ongoing assessment and management of these threats over and above current practices is required.

As there is currently no targeted Painted Honeyeater monitoring program and little information on the species' total range and density in occupied habitat, we suggest that there are inadequate data from which to infer that the Painted Honeyeater's total population comprises approximately 15,000 mature individuals and is stable rather than declining, as reported in *The Action Plan for Australian Birds 2020* (Watson *et al.* 2021). Given the non-systematic nature with which eBird data, and to a lesser degree Atlas survey data, are collected, the use of reporting rates associated with such datasets to assess this species' population status may not be sufficient for detecting true changes in the total population. We believe that the key threats to this species, such as habitat clearance and extreme heatwaves and droughts, put the long-term persistence of this species in jeopardy.

Further monitoring and research

We recommend that systematic monitoring of a subset of the sites that we surveyed during 2020 be undertaken during future breeding seasons to gather further, long-term information on Painted Honeyeater abundance and breeding at key sites. In addition to such a monitoring program, more detailed research should be conducted on Painted Honeyeater ecology in the survey regions, as monitoring and research will assist in, or allow:

1. the identification of which survey sites support breeding pairs and the relative importance of each site for the Painted Honeyeater in Weeping Myall Woodlands.
2. the assessment of Painted Honeyeater movements and habitat use; using colour-banding and tracking to complement surveys is vital for improving our limited understanding of this species' spatial ecology.
3. the examination of whether factors, such as patch size, habitat connectedness and the total proportion of habitat in the landscape, influence patterns of Painted Honeyeater occurrence.
4. the examination of whether the occurrence or abundance of Noisy Miners or other large honeyeaters influences site use by Painted Honeyeaters. Study of this potential threat would be particularly useful, given that the degree of competition between these species is unclear (DAWE 2020)
5. the existing total population estimate to be reassessed and refined.

In conjunction with further Painted Honeyeater surveys, monitoring of the condition of habitat at survey sites is important, given the potentially increasing pressure on Weeping Myall Woodlands arising from increasing temperatures and the ongoing threat of habitat clearance and degradation. Research into mistletoe phenology and the implications that this might have for Painted Honeyeaters would also be valuable.

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CONCLUSIONS

Our findings demonstrate the importance of Weeping Myall Woodlands to the Painted Honeyeater and suggest that ten-minute surveys may be an effective method of assessing the honeyeater's occurrence at the landscape scale during a period when males are highly vocal. Many Painted Honeyeaters were recorded in the two northernmost regions surveyed but few in the southern regions, potentially due to particularly favourable environmental conditions in northern NSW during 2020.

Further surveys are required to assess inter-annual variation in Painted Honeyeater occurrence and abundance and to determine the relative importance of surveyed sites for foraging and breeding. This survey indicated that a large proportion of the structurally complex roadside Weeping Myall Woodland that supports mistletoe in NSW is likely to be utilised by Painted Honeyeaters, and hence the long-term persistence of the honeyeater is strongly tied to the condition of this woodland. The 2020 survey achieved its aim of setting a baseline for further study of this species' landscape ecology and improving knowledge that is relevant to the conservation management and protection of this species.

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APPENDIX

Photographic examples of survey sites.

1. McGrane Way, NWSP (MCG07) – *Acacia pendula* score: 3, mistletoe score: 2.

2. Kidman Way, Riverina (KID17) – *Acacia pendula* score: 7, Mistletoe score: 4.

3. Irrigation Way, Riverina (IRR10) – *Acacia pendula* score: 6, mistletoe score: 8.

4. Rangari Road, NSP (RAN02) – *Acacia pendula* score: 8, mistletoe score: 8.

5. Example of clearance of critical habitat beside Lake Road, Ungarie, NSW.