POPULATION TRENDS OF WOODLAND BIRD SPECIES IN THE CLARENCE LOCAL GOVERNMENT AREA, SOUTHEAST TASMANIA

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(with two figures and one table)

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Monthly monitoring was initiated in 2015 and continued for 10 years at 20 peri-urban sites in the Clarence Local Government Area (LGA) in southeast Tasmania to identify the trajectories of bird populations. A total of 869 surveys were undertaken and 78 bird species recorded. The 2 ha survey sites were in a range of locations and monitored in the mornings for 20 minutes during the post-breeding season (January–April). There was a statistically significant decrease of 21% for the decade in the number of species recorded per survey, indicating a long-term decrease in species diversity at the survey sites. Nine of the 21 most frequently recorded species (43%) had relatively stable populations over the 10 years. The predominant trend of the remaining species was a decrease, with six species' decreases statistically significant. Three species increased, one statistically significantly. Of greatest concern was the decrease of two Tasmanian endemic species: dusky robin and black-headed honeyeater, with both decreases highly significant at greater than 70% for the decade. The strongly decreasing species were small insectivores, consistent with global trends, attributed to decreases in insect populations. Many factors associated with climate change and progressive forest degradation potentially contribute to these losses and may be particularly severe in the study area, which already has a below average rainfall. These decreases in species diversity and abundance in a local bird community are of alarming magnitudes and the cause(s) need to be identified and addressed.
Key Words: bird population trends, Clarence, Tasmania, endemic bird decreases, dusky robin.

INTRODUCTION

Many factors, both natural and anthropogenic, contribute to fluctuations in the abundance of bird populations. Short-term variations in response to changes in climatic conditions (e.g., rainfall and temperature) are a feature of stable bird populations, but over an extended period equilibrium is maintained for most species. Anthropogenic factors may destabilise bird populations, resulting in long-term changes, both decreasing and increasing, that are difficult to prove (Bennett *et al.* 2024). The impacts to populations can be direct (e.g., land clearing, habitat modification, disturbance and the introduction of exotic predators), or indirect anthropological activities (e.g., global warming). Newton (2013) provided a comprehensive overview of the complexity associated with understanding the dynamics of bird populations. For instance, a species may respond to favourable conditions by increasing its numbers locally or increasing its range. Species may be sedentary, migratory or locally nomadic resulting in seasonal differences of occurrence, further complicating the evaluation of survey results.

Bain *et al.* (2020) identified both decreasing and increasing trends in bird populations inhabiting remnant woodland patches in the Tasmanian Midlands by comparing the results of monitoring efforts 20 years apart. Ideally, such monitoring would be continuous to allow the distinction between short-term fluctuations and long-term changes to be identified. However, some species may take 15 or more years to return to equilibrium following extreme events such as the Millennium Drought 2000–2009 throughout southeast Australia (Bennett *et al.* 2024). While several long-term studies of seabird and shorebirds provide that longevity, there are few suitable studies of woodland birds in Australia.

In this paper, we examine evidence for long-term changes in bird populations in the remnant woodlands of the Clarence Local Government Area (LGA) in southeast Tasmania. This is a peri-urban landscape where changes in land use associated with expanding residential development were expected to influence the stability of local bird populations. We investigate the evidence of long-term population changes from anthropogenic factors superimposed on the natural rainfall-related fluctuations. To address the challenges described in Newton (2013), we evaluated annual differences in the frequency of observation of woodland bird species in the post-breeding season (January–April), when populations are at a maximum, over a period of 10 years.

METHODS

Morning surveys were conducted on one day/month at 20 x 2 ha surveys sites around the Clarence LGA (fig, 1), coinciding with the daily peak of bird activity. All observations were undertaken by the lead author, and the study is ongoing. The presence of all bird species seen and heard, including birds flying overhead, was recorded during the 20-minute surveys according to a standardised technique (https://birdata.birdlife.org.au/help/survey-techniques). Six sites were in uninhabited dry forest in the Meehan Range that are recovering from a wildfire in October 2006. Eleven sites were in dry woodland on large acreage residential properties on the western side of the South Arm Peninsula, and three sites were in coastal vegetation located in small reserves on the South Arm Peninsula (fig. 1). Presence data were presented as a Reporting Rate (RR), indicating the percentage of surveys in which a species was recorded, and used as a surrogate measure of species abundance. Mean list length/survey was used as the measures of species diversity and change in the total bird population in this study (Szabo *et al.* 2010).

The analyses presented here are based on presence data for the post-breeding season (January–April) for the 10 years. These sites were selected because they had been monitored for the 10-year period 2015–2024 inclusive, thus eliminating sampling bias. Linear regressions were conducted on species with RR ≥ 10% and present

FIGURE 1 — Map of the South Arm Peninsula showing the locations of the 20 sites monitored 2015–2024, inclusive. Meehan Range sites are shown in orange (n = 6), dry forest in yellow (11) and coastal reserves in purple (3). Scale bar shows 10 km.

throughout the post-breeding season, which eliminated summer visitors (e.g., cuckoo species) because they departed early and were only present for part of the post-breeding season.

All trend analyses and plots were undertaken using DataGraph 5.3 software (https://www.visualdatatools.com/DataGraph/). Statistical significance was assessed at 5% and 1% levels (Sokal & Rohlf 1995). The slopes of linear correlations were used to assess the decadal rates of population change and the Coefficient of Determination r^2 was used to identify candidate species for statistical testing as an indication of the extent to which annual variation was time-dependent.

RESULTS

A total of 869 surveys were undertaken and 78 bird species recorded. The annual post-breeding season (January–April) variation in the mean list length (number of species recorded/survey) showed a statistically significant ($0.05 > p > 0.01$) decreasing trend in the species diversity at the survey sites during the 10 years (fig. 2). The relative linear rate of decrease was 21% per decade, and 41% of the variation in the species list lengths over the 10 years was explained by year.

Linear regressions of the 21 most frequently recorded species (Reporting Rate ≥ 10%) were used to identify the species' population trends (table 1). Of the 21 species evaluated, populations of 13 species were decreasing, including six trends that were statistically significant ($p < 0.05$), including three highly significant trends ($p < 0.01$). Of the eight species with increasing trends, only one was statistically significant ($0.05 > p > 0.01$) (table 1).

Nine species had Coefficients of Determination of less than 0.1, indicating the long-term trend explained < 10% of the annual variation in Reporting Rate, and that their populations were relatively stable. For the remaining five species, four species' populations were decreasing and one was increasing. These species had elevated Coefficients of Determination (e.g., spotted pardalote 0.39 and forest raven 0.33), indicating the possibility of a change in population during the survey period, but not at a statistically significant level.

DISCUSSION

A mix of increasing, decreasing and relatively stable species, with a predominance of decreasing trends (13/21 species, 62%) was identified among the 21 species examined in this study. This predominance of decreasing populations is consistent with the overall statistically significant decreasing trend of 21% per decade for all species recorded during the surveys. These results indicate a decrease in the diversity of a local bird community of alarming magnitude in a relatively brief period of 10 years. Changes of such magnitude over brief periods require the causes to be identified and addressed urgently.

Decreasing species

The six species with statistically significant decreasing trends are relatively small-bodied insectivores. They exploit a range of foraging niches including the ground (scarlet and dusky robins), foliage and branches (golden whistler and black-headed honeyeater) and two aerial hawkers (grey fantail and dusky woodswallow). Their decadal rates of

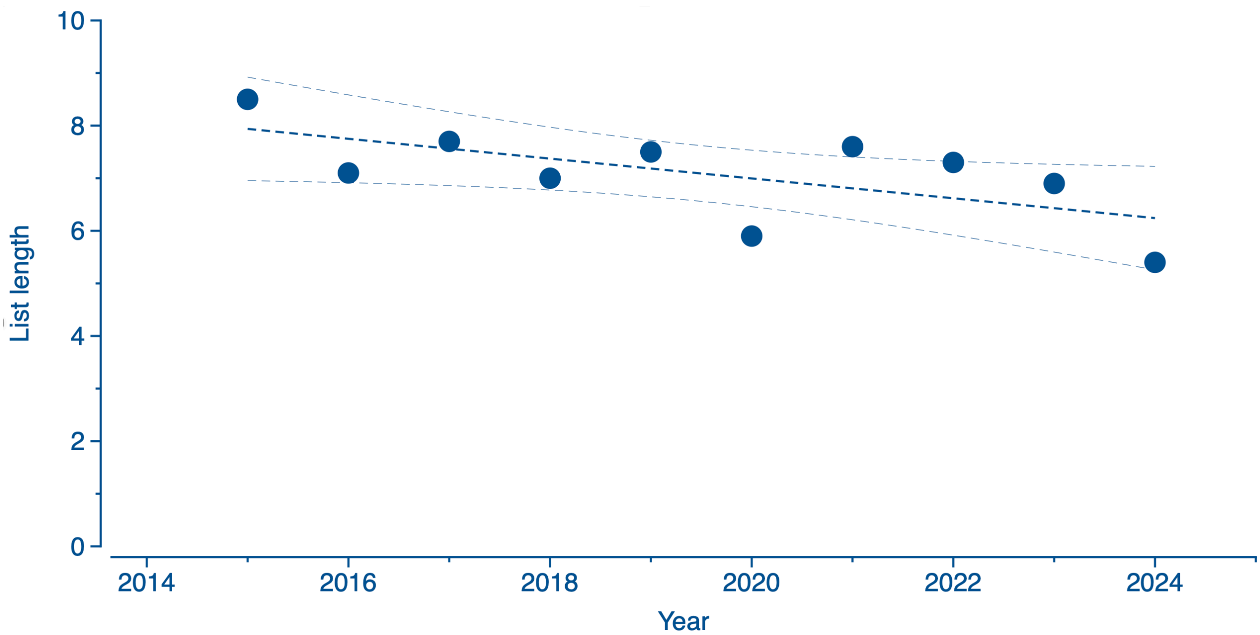

FIGURE 2 — Linear regression of the mean list length of species recorded in post-breeding season surveys in the Clarence LGA, southeast Tasmania.

TABLE 1 — Comparison of the post-breeding season annual Reporting Rate trends of the 21 most frequently recorded bird species (Total Reporting Rate ≥ 10%). The species are ranked on the rate of decadal decrease.

Bird species	Reporting rate (%)	Decadal change (%)	Coefficient of determination r^2	Statistical significance
Grey butcherbird *Cracticus torquatus*	12.8	166.7	0.41	S
Grey currawong *Strepera versicolor*	12.2	34.4	0.06	NS
Forest raven *Corvus tasmanicus*	54.4	33.8	0.33	NS
Common bronzewing *Phaps chalcoptera*	10.0	28.6	0.05	NS
Grey shrike-thrush *Colluricincla harmonica*	42.8	25.6	0.08	NS
Little wattlebird *Anthochaera chrysoptera*	20.3	10.2	0.02	NS
Yellow-throated honeyeater *Lichenostomus flavicollis*	77.1	4.0	0.02	NS
Silvereye *Zosterops lateralis*	12.9	0.2	0.00	NS
New Holland honeyeater *Phylidonyris novaehollandiae*	29.5	–10.2	0.05	NS
Green rosella *Platycercus caledonicus*	46.5	–14.1	0.08	NS
Superb fairy-wren *Malurus cyaneus*	34.1	–25.8	0.18	NS
Brown thornbill *Acanthiza pusilla*	40.9	–34.0	0.28	NS
Spotted pardalote *Pardalotus punctatus*	40.8	–37.0	0.39	NS
Laughing kookaburra *Dacelo novaeguineae*	10.2	–38.7	0.10	NS
Grey fantail *Rhipidura albiscapa*	41.7	–44.1	0.52	S
Striated pardalote *Pardalotus striatus*	22.7	–45.8	0.19	NS
Golden whistler *Pachycephala pectoralis*	21.2	–61.0	0.49	S
Scarlet robin *Petroica boodang*	16.1	–63.7	0.52	S
Dusky woodswallow *Artamus cyanopterus*	11.2	–70.9	0.69	HS
Dusky robin *Melanodryas vittata*	15.1	–90.0	0.86	HS
Black-headed honeyeater *Melithreptus affinis*	10.1	–96.8	0.64	HS

NS = Not significant $p>0.05$
S = Significant $0.05 > p > 0.01$
HS = Highly significant $p<0.01$

decrease exceeded 40%, an alarmingly high rate that could cause local extirpation unless addressed. Several other small insectivorous species also decreased over the 10 years, but the trends were not statistically significant. These included the canopy foraging spotted and striated pardalotes, brown thornbill and superb fairy-wren, the latter two species often foraging in association in understorey and ground vegetation, respectively. There was one exception to this generalisation, the laughing kookaburra, a large mainly carnivorous species, which decreased at a similar rate to the four previously mentioned species.

Increasing species

In contrast, the species that showed the most pronounced increasing trends over the 10 years, grey butcherbird (statistically significant), grey currawong and forest raven are all large-bodied and primarily carnivorous birds.

Stable species

The five species whose populations showed the greatest evidence for stability over the 10 years were an eclectic group. They included the most frequently recorded species, the yellow-throated honeyeater, a versatile endemic honeyeater that has adapted to exploit the bark-foraging opportunities afforded by the absence of treecreepers and sitellas in Tasmania (Davis 2013). Two other honeyeaters – little wattlebird and New Holland honeyeater – are primarily floristic species with a preference for *Banksias*. The green rosella, another frequently recorded species, and silvereye both have diverse diets and exploit a range of foraging niches.

Causes of long-term decrease

The predominance of arboreal foraging species in the guild of decreasing species has been reported internationally (e.g., Ramos *et al.* 2020, Pollock *et al.* 2022), nationally (Vesk & Mac Nally 2006, Franklin *et al.* 2023, Bennett *et al.* 2024) and in Tasmania (Bain *et al.* 2020). These decreases are often associated with corresponding increases in large-bodied bird species, a finding that was apparent to a limited extent in this study. In this study, the decreasing bird species were predominantly insectivores, and as other studies have shown, global decreases in insect populations are the cause of the observed decreases in insectivorous birds. Decreases in insect populations have been attributed to many factors including climate change-induced drying of the environment, pesticides, deforestation, and wild and fuel reduction fires (Sánchez-Bayo & Wyckhuys 2021, Wagner *et al.* 2021), all of which may be relevant to this study.

In the Clarence LGA, the importance of some of the above causative factors may be exacerbated. For instance, the study area is in a below average rainfall area on the southeast coast of southern Tasmania, where the impacts of climate change-induced drying might be expected to be amplified at a regional scale (Remenyi *et al.* 2020). While much of the LGA remains well-forested and is not subject to large-scale deforestation, urban development has caused and continues to cause progressive (and in some cases, accelerating) forest loss and fragmentation, particularly in the peri-urban areas of the South Arm Peninsula. Despite this deterioration, forest integrity remains sufficient to prevent the despotic noisy miner being a dominant influence on the composition of bird populations at the survey sites (Newman 2013, Bain *et al.* 2020). Areas involving low-density habitation result in progressive opening of the forest attracting avian nest predators (e.g., currawong) and exotic predators such as domestic and feral cats.

Species severely affected

The three species that had highly significant linear regressions with rates of decadal decrease exceeding 70% included two Tasmanian endemics: black-headed honeyeater and dusky robin. As black-headed honeyeaters are a preferred host of pallid cuckoos, any decrease in this species may potentially cause a concomitant decrease in the pallid cuckoo population within the study site, but this has not occurred to a similar extent (Newman 2021). This disparity may reflect the plasticity in species' nests parasitised by pallid cuckoos throughout southeast Tasmania (M Newman, pers. obs.).

Dusky robins exhibited a 90% decadal decrease during the study period. This alarming finding reflects similar trends in other datasets showing significant decreases in this species statewide and where habitat fragmentation has been identified as a contributing cause in observed population decreases. The finding supports the recent assessment of the dusky robin as meeting the criteria of Vulnerable under Tasmania's *Threatened Species Protection Act 1995* (Newman *et al.* 2021).

The third species showing a rapid decrease was the dusky woodswallow, a summer visitor to Tasmania with a nomadic disposition. Hence, the cause of their decrease may not be directly related to conditions within the study area but widescale environmental factors influencing their distribution at a national level.

Strengths, limitations and future application of the methodology

Limiting monitoring to the post-breeding season has the advantage of simplifying data analyses by eliminating seasonal biases. However, it does restrict the number of species that have sufficient data for statistically valid analyses (e.g., several summer migrants, including the cuckoos). The statistical power of the present study's methodology was enhanced by the longevity of the study (10 years) and the highly structured sampling regime (i.e., one observer conducting replicated standardised surveys at regular intervals). However, even 10 years may be insufficient for a species to reach equilibrium, particularly species with long generation times (Bird *et al.* 2020). Decadal trends are usually sufficient for small insectivorous species that have short generation times (Garnett & Baker 2021, Newman *et al.* 2021). In cases of climate instability, even longer time series population data may be necessary (Bennett *et al.* 2024), a situation that probably applies in this study. It is intended to extend this analysis to the evaluation of monthly surveys conducted throughout the year in future species-specific studies of priority species (e.g., dusky robin) for which for there is immediate conservation concern (Garnett & Baker 2021, Laroche & Taylor 2024, Wright 2024).

CONCLUSIONS

In this decade-long study undertaken in peri-urban habitat in the Clarence LGA, the dominant trend was for species to decrease in surveys at 20 sites for the post-breeding season, January to April. This was manifested in a 21% decadal decrease in the mean species list length, a measure of species diversity. Six species had statistically significant ($p < 0.05$) rates of decadal decrease, of which three were highly significant ($p < 0.01$) with decadal rates of decrease exceeding 70%; two of these three species were Tasmanian endemics (dusky robin and black-headed honeyeater). Only one species' population in the study increased statistically significantly.

Small insectivorous species dominated the guild of decreasing species, consistent with a global trend associated with diminished insect populations. Climate change is drying numerous habitats throughout Tasmania (Wright 2024), and habitat clearing and degradation associated with urban development (Laroche & Taylor 2024) are all significant contributing factors that stand out in the context of this study. These factors are in effect throughout Tasmania (Laroche & Taylor 2024, Wright 2024), and likely to be influencing bird populations to varying degrees elsewhere (e.g., Newman *et al.* 2022). Attributing the relative roles of anthropogenic and environmental influences on bird populations (Newton 2013, Bennett *et al.* 2024) is made more difficult with the synergies and interactions now in effect at a range of spatial and temporal scales (e.g., Bain *et al.* 2020, Lindenmayer 2022).

The long-term trends identified in this study are primarily attributed to anthropogenic influences associated with low-density urbanisation and the concomitant progressive loss of natural woodland and associated values, which is occurring elsewhere within the Clarence LGA. Habitat loss and modification arising from vegetation clearing and associated fire management have been compounded by the spread of exotic predators such as domestic and feral cats (*Felis catus*) and the establishment and subsequent expansion of carnivorous species such as grey currawong and grey butcherbird, both of which are known nest predators (Fulton 2018). It may be that natural influences, such as variations in annual and seasonal rainfall cause short-term population variations which are compounded with the effects of extended periods of warmer and drier conditions (Grose *et al.* 2023), leading to the observed instabilities of bird populations.

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