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Review

# Evaluating empirical evidence for decline in temperate woodland birds: A nationally threatened assemblage of species

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ABSTRACT

Quantifying the population trends of species is crucial to achieving effective conservation action. However, deriving accurate and reliable indices of change is difficult due to the paucity and complexity of population data. There is a growing need to assess the inferential status of reported trend estimates given their pertinence to evidence-based conservation policy and funding. In this review, we used a simple scoring system to assess the rigour of population assessments using Australian temperate woodland birds as a case study. These birds are widely considered to be in severe and ongoing decline at a national scale. However, we found relatively few studies that report population trends for woodland birds in the existing conservation literature (44 articles, 9% of total) and only 33 articles (7% of total) that actually attempt to measure change using population data. While we identified strong signs that the inferential status of population research on temperate woodland birds is improving, we detected serious limitations in the temporal coverage and statistical analysis of population data used in the majority (80%) of trend assessments, compromising any long-term inference about population persistence. Despite these limitations, the decline of woodland birds is referenced in over half of all Australian woodland bird conservation studies (53%), with most of the information on woodland bird status (49% of citations) sourced from relatively few, predominantly qualitative, studies of change. The paucity of research that can reliably detect trends to draw conclusions about species persistence is a concerning issue for conservation practitioners and policy makers.



**Contents**



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## 1. Introduction

Reducing rates of biodiversity loss relies heavily on our ability to track population trends (Collen et al., 2009). In particular, the detection of unwanted trends (*e.g.* native declines, invasive increases) is necessary for the diagnosis of ecosystems and species at risk (Meir and Fagan, 2000), and can provide insight to the processes threatening biodiversity (Rhodes et al., 2011). Furthermore, quantifying population change in response to conservation interventions can enhance the adaptive capacity of management (Smith et al., 2005). Thus, monitoring population trends can make a significant contribution to the development of effective conservation (Lindenmayer and Likens, 2010b).

In practice, quantifying trends of species' populations is fraught with challenges. Most prominent is a widespread lack of continuous, long-term survey data (Jenkins et al., 2003; Lindenmayer and Likens, 2010a; Wilson et al., 2011). It is a pervasive short-coming that adequate population data are often not available for many species, and across many regions, where biodiversity is thought to be declining and conservation action is considered imperative (Collen et al., 2009; Mace et al., 2008). In an attempt to compensate for incomplete population data, studies often rely on historical records as evidence of change through time. While such studies frequently report interesting and informative differences, the conditions under which past and contemporary records were collected can vary (Holmes, 2001). This is important because identifying sources of variability in population data is crucial for making sound inferences about species population growth (McNamara and Harding, 2004).

Even where systematic and continuous population data are available, eliciting robust indices of change is not a trivial exercise. This is because population data are complex (Clark and Bjornstad, 2004), with inherent variability presenting both a source of interest and error in analysis (McNamara and Harding, 2004). For example, observed changes in year-to-year population size can be driven by unmeasured environmental factors (Amano et al., 2012; De Valpine, 2003; Freckleton et al., 2006) or by statistical issues caused by sampling bias or error (Freckleton et al., 2006; Meir and Fagan, 2000). Failing to account for either is likely to compromise the accuracy and reliability of long-term trend indices (McNamara and Harding, 2004; Wilson et al., 2011). Indeed, some authors have explicitly demonstrated how failing to account for variation in population data can lead to tenuous, if not misleading, estimates of population change (e.g. Alford et al., 2001; Lonergan and Harwood, 2003; Shapiro and Swain, 1983).

Given these challenges, reviews of the empirical evidence behind documented trends in biota have proven useful for pinpointing the type and scope of data that limits understanding of species decline (*e.g.* Porszt et al., 2012; Reading et al., 2010). In this review, we examine the strength of inference that can be drawn from assessments of population decline in Australian temperate woodland birds. These birds are reported to be in severe (Mac Nally et al., 2009; Watson, 2011), widespread (Recher, 1999) and ongoing (Ford, 2011) decline at a national scale, due primarily to extensive modification of their native habitat (Hobbs and Yates, 2000). However, woodland birds are often highly mobile and exhibit large natural fluctuations in their abundances through space and time (Fleming, 1992; Lindenmayer and Cunningham, 2011; Mac Nally, 1996; Manning et al., 2007). Given these factors, it is especially difficult to disentangle changes in population size driven by habitat alteration from those driven by environmental and demographic stochasticity (Emlen et al., 2003). This makes woodland birds an excellent case study for reviewing the issues associated with the quantification of long-term population trends. However, to date, a quantitative review approach has not been applied to the issue of Australian woodland bird conservation, despite numerous qualitative reviews and essays on their decline (*e.g.* Ford, 2011; Ford et al., 2001; Recher, 1999; Reid, 1999; Robinson, 1993; Robinson and Traill, 1996).

Using this nationally threatened assemblage of species, we provide a quantitative approach for assessing the growth, scope and rigour of studies investigating decline. To establish the context for inference, we began our review by asking: (1) How pervasive has the acceptance of decline been in the ecological literature? And, (2) From where has the established knowledge of decline been derived? We then critically reviewed studies that directly investigate population change. Specifically, we asked: (3) What was the spatial coverage of population studies? (4) What was the temporal coverage of population studies? And, given the inherent variability of population data, (5) What proportion of studies allowed for rigorous inference about population decline? While our focus for this review is on Australian temperate woodland birds, our quantitative approach may be applied to any nation that seeks to define and counter species population declines, particularly in modified landscapes.

## 2. Background: global bird declines and Australia's temperate woodlands

Tracking biodiversity loss is particularly important in areas subject to land-use change. The primary threat to terrestrial fauna populations is agricultural expansion and intensification (CBD, 2010), which has been linked specifically to bird declines worldwide (BirdLife International, 2013; Ford et al., 2001; Krebs et al., 1999; Newton, 2004; Murphy and Moore, 2003). Consequently, a diverse suite of conservation interventions, with significant associated costs, are undertaken to secure bird populations in these systems (Lindenmayer et al., 2012b; McCarthy et al., 2012). The effectiveness of such interventions is crucially informed by monitoring national or continental biodiversity trends (Kleijn et al., 2011).

In Australia, land-use change has been particularly severe in temperate regions of the continent. Almost 90% of Australia's temperate woodlands have been cleared for agricultural development