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Adapting global biodiversity indicators to the national scale: A Red List Index for Australian birds

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ABSTRACT

The Red List Index (RLI), which uses information from the IUCN Red List to track trends in the projected overall extinction risk of sets of species, is among the indicators adopted by the world's governments to assess performance under the Convention on Biological Diversity and the United Nations Millennium Development Goals. For greatest impact, such indicators need to be measured and used at a national scale as well as globally. We present the first application of the RLI based on assessments of extinction risk at the national scale using IUCN's recommended methods, evaluating trends in the status of Australian birds for 1990–2010. We calculated RLIs based on the number of taxa in each Red List category and the number that changed categories between assessments in 1990, 2000 and 2010 as a result of genuine improvement or deterioration in status. A novel comparison between trends at the species and ultrataxon (subspecies or monotypic species) level showed that these were remarkably similar, suggesting that current global RLI trends at the species level may also be a useful surrogate for tracking losses in genetic diversity at this scale, for which no global measures currently exist. The RLI for Australia is declining faster than global rates when migratory shorebirds and seabirds are included, but not when changes resulting from threats in Australia alone are considered. The RLI of oceanic island taxa has declined faster than those on the continent or on continental islands. There were also differences in the performance of different jurisdictions within Australia.

1. Introduction

Under the Convention on Biological Diversity (CBD) governments recently adopted a new strategic plan for reducing biodiversity loss, including 20 targets to be met by 2020 (Secretariat of the Convention on Biological Diversity, 2010). Monitoring progress towards, and achievement of, these goals and targets requires indicators (Balmford et al., 2005; Jones et al., 2011). Indicator sets have been adopted for the United Nations Millennium Development Goals (MDGs; United Nations, 2011), the CBD's previous 2010 target (Walpole et al., 2009; Butchart et al., 2010), and have been proposed for the 2020 targets (Secretariat of the Convention on Biological Diversity, 2010). For maximum effectiveness, such indicators need to be implemented at multiple scales, including both global and national.

One prominent indicator in both the MDG and CBD recommended indicator sets is the Red List Index (RLI; Butchart et al., 2004, 2005, 2007). The RLI measures trends in the overall extinction risk of species, and is based on data from the IUCN Red List (IUCN Standards and Petitions Subcommittee, 2010), which is widely considered the most objective system for evaluating extinction risk at national or global scale (Hambler, 2004; Miller et al., 2007). It uses standard criteria with quantitative thresholds for population and range size, structure and trends to assign species to categories of extinction risk, ranging from Least Concern through Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct. Those species with insufficient data to apply the criteria are listed as Data Deficient (IUCN, 2001; IUCN Standards and Petitions Subcommittee, 2010). Assessments must be supported by quantitative data, as well as justifications, sources and estimates of uncertainty and data quality. The Red List categories and criteria can be used to assess extinction risk at global, regional and national scales, with guidance available for sub-global assessments in order to take account of potential interchange with populations beyond the scope of assessment (IUCN, 2003).

The RLI is based on the number of species in each Red List category, and the number that change categories between assessments owing to genuine improvement or deterioration in status. It excludes changes in category resulting from improved knowledge, taxonomic changes or revisions to Red List criteria (Butchart et al., 2004, 2007). The RLI can be calculated for any set of species

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that has been assessed for the Red List at least twice (Butchart et al., 2004, 2007). To date, global RLIs have been published for birds (1988–2008; BirdLife International, 2008; Butchart et al., 2010), mammals (1996–2008; Butchart et al., 2010; Hoffmann et al., 2011), amphibians (1980–2004; Stuart et al., 2004) and corals (1998–2008; Carpenter et al., 2008). It is particularly useful for comprehensively assessed taxonomic groups (e.g. birds, mammals, amphibians, corals), for which cautions expressed about the use of the IUCN Red List to assess trends in biodiversity because of biases in species selection and knowledge limitations are largely inapplicable (Possingham et al., 2002).

This is the first national RLI to be published using the methods as originally designed. While a national RLI was published for a number of taxa in China (Xu et al., 2009), the trends are difficult to interpret because genuine improvements and deteriorations in status between assessments were combined with those resulting from improved knowledge or taxonomic changes, and because non-threatened taxa were excluded, contrary to recommended methods (Butchart et al., 2007; Bubb et al., 2009). National RLIs based on national-scale assessments of extinction risk allow more sensitive tracking of biodiversity trends (because more species move between Red List categories between assessments when the categories are assigned using national rather than global extinction risk) and hence are of greater utility at the national scale, which is where the decisions are made that have greatest influence on biodiversity trends. Furthermore, the development of national RLIs will likely lead to greater ownership and uptake by national governments.

The present study assesses recent trends in the extinction risk for birds in Australia by calculating an RLI based on national-scale assessments undertaken in 1990, 2000 and 2010. It also examines trends at both the species and subspecies level and on geographical, political and taxonomic subsets of the data. Since countries sharing taxa interact at the policy level we calculated RLIs both including and excluding status changes that resulted from threats acting outside the Australian part of a visiting taxon's distribution, in order to quantify the extent to which national biodiversity trends are driven by external threats.

2. Materials and methods

2.1. Red List assessments

We based our evaluations of the extinction risk of Australian bird taxa, both at the species and subspecies level, on assessments undertaken in 1990 (Garnett, 1992), in 2000 (Garnett and Crowley, 2000) and in 2010 (Garnett et al., 2011) using the IUCN Red List criteria pertaining at the time of assessment. Following recommended methods (Butchart et al., 2007, 2010; Hoffmann et al., 2010), we retrospectively corrected categorisations for 1990 and 2000 using current (2010) knowledge. We conservatively assumed that the current category applied to these earlier assessments, except where there was evidence that the species had undergone a genuine improvement or deterioration in status of sufficient magnitude to cross the Red List category thresholds. Such evidence included, for example, documented population trends and distribution declines, known trajectories of habitat extent or quality, and dates and outcomes of efforts to eradicate invasive alien species or to translocate populations of target species. In order to assess extinction risk nationally, we followed the IUCN guidelines to account for potential source and sink effects that result from interchange with populations beyond the national borders (IUCN, 2003, 2008; IUCN Standards and Petitions Subcommittee, 2010).

The geographic scope of the assessments was Australia and its overseas territories (Christmas, Cocos (Keeling), Norfolk, Lord Howe, Macquarie and Heard Islands), as well as the Australian Fishing Zone, which extends 370 km off the coastline of both the continent and the offshore islands. Taxonomy followed Marchant and Higgins (1990, 1993), Higgins and Davies (1996), Higgins (1999), Schodde and Mason (1999) and Christidis and Boles (2008) at the subspecies level and BirdLife International (2011) at the species level. We assessed all 725 species and 1238 ultrataxa (929 subspecies plus 309 monotypic species *sensu* Schodde and Mason, 1999) resident or occurring regularly in Australia or its territories, excluding introduced and vagrant taxa, and also visiting seabirds with no breeding Australian populations. For the 58 taxa with both breeding and visiting populations, we used the status of the breeding population, which in all cases was the same as, or more threatened than, that of the visiting population.

2.2. RLI calculations

For the calculation of RLIs we followed the methods of Butchart et al. (2007). We followed recent practice (e.g. Butchart, 2008, 2010; Hoffmann et al., 2010, 2011) in using 'equal steps' weights for each Red List category (0 for Least Concern, 1 for Near Threatened, 2 for Vulnerable, 3 for Endangered, 4 for Critically Endangered and 5 for Extinct and Critically Endangered taxa tagged as Possibly Extinct *sensu* IUCN (2010)) rather than weights based on relative extinction risk, as the latter approach makes the index much less sensitive to changes in status of less threatened taxa (see Butchart et al., 2004, 2005 for further discussion). The number of taxa in each IUCN Red List category was multiplied by these weights and the sum expressed as a fraction of the maximum possible sum (equating to all taxa having gone extinct). Taxa listed as Extinct or Possibly Extinct in the first year of assessment (1990) were excluded. Calculations were made using Microsoft Excel 2007.

2.3. Disaggregating Red List Indices

To understand underlying patterns and identify subsets of species for which extinction risk has changed most rapidly, the RLI can be disaggregated (Butchart et al., 2004, 2005). For the RLI to be used to assess the performance of a country it should first be calculated only for taxa threatened by processes within that country, even if they occur elsewhere. We therefore first calculated the RLI including only the changes in status that resulted from processes occurring within Australia. We used this dataset for analysis of geographical variation, assessing the RLI separately for taxa occurring on oceanic islands (listed above), continental islands (including Tasmania) that were connected to the Australian mainland during the last glacial period, and those on the Australian continent. Some taxa occur on both the continent and on continental islands ($n = 460$), on continental and oceanic islands ($n = 15$) or on all three ($n = 20$). These taxa were included on each of the respective lists. We also used this dataset to show trends in extinction risk for taxa relevant to particular policy mechanisms. To do this, we disaggregated taxa on the basis of jurisdiction (six states: Queensland, New South Wales, Victoria, South Australia, Western Australia and Tasmania and two territories: Australian Capital Territory and Northern Territory). In each list we included breeding taxa and non-breeding migrants, but did not include vagrants or taxa living on oceanic islands administered by the states (i.e. Macquarie and Lord Howe Islands); some taxa occurred in multiple jurisdictions.

To understand the extent to which national trends in taxon status are driven by external threats, we recalculated RLI including all status changes regardless of the location of threat. We also used this dataset to show trends in extinction risk for particular taxonomic groups, calculating trends for the five most speciose orders individually and for the remainder of species as a group.