An Evaluation of Methods for Accounting for the Condition of Regional Native Bird Communities

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Summary

A trial of an environmental asset condition methodology, *Accounting for Nature* (Wentworth Group of Concerned Scientists 2008), tested three approaches for assessing the condition of birds to determine their suitability as an indicator for regional asset condition accounting purposes. These approaches included state and change in species abundance, state and change in species richness, and state and change in species status.

Each of these approaches were assessed against a standard set of criteria (relevant, simple, sensitive, measurable, timely and aggregative (Parkes 2012). Currently there is not a single indicator or metric that satisfies all criteria and each indicator or metric presents different strengths and weaknesses. Assigning a condition score based on monitoring data, status information and expert analysis may be the best available option at present. There is significant scope for the utility of other approaches if improved in identified areas.

Introduction

For over a decade, successive national, state and territory State of the Environment reports have reported that information on individual fauna species or groups of fauna species remains poor (State of the Environment 2011 Committee 2011). As a result, it is difficult to determine trends in condition of Australia's native fauna in order to understand, manage or conserve our unique fauna.

Human-induced or other pressures on native fauna are likely to occur at local or regional scales, and management must be informed by data on changes to fauna that has been generated at those scales (Department of the Environment 2009). At present there is no standardised set of indicators for measuring the condition of fauna, and jurisdictional reports differ from one another in terms of indicators used, approaches taken, and styles and periods of reporting (Australian Centre for Ecological Analysis and Synthesis (ACEAS) n.d.). Defined indicators are used in formal conservation listing processes; however, the major weaknesses of the formal lists as a basis for tracking change are their incompleteness: they deal with a relatively knowledge-rich subset species, particularly vertebrates.

Because of this, some taxa and groups are not well represented, there is no formal mechanism to conduct reviews, the listing processes are not sensitive to small changes in populations and not all species on the lists are monitored so changes in status are not necessarily detected (Department of the Environment 2009).

A method which accounts for all known species in a regional (sub-national) jurisdiction at regular intervals would be ideal, but this is impractical for several reasons. The first is that not all species have been identified and described. The second is that it is impossible to monitor most species. Invertebrates constitute the majority of species of fauna, but relatively few have been identified and described. Vertebrates are the only faunal group in which most species have been identified and described. Therefore they are the obvious candidates for use in environmental accounting. Many Australian mammals, amphibians and reptiles are cryptic and nocturnal, making them difficult to detect and, in some cases, identify. Many species may only be monitored by trapping and handling. To do this requires ethics approvals and

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appropriate state/territory approvals. Setting up region-wide monitoring schemes for mammals, amphibians and reptiles would be a logistical nightmare and a prohibitively expensive exercise.

Birds, however, are conspicuous, have been well studied, are relatively easy to identify without catching and handling and do not require official permits to observe. We therefore propose the use of birds as a suitable indicator group for the environmental asset, fauna. This working paper examines the suitability of various metrics for providing regional birds accounts.

While official bird counts in some parts of the world go back centuries, in Australia bird survey data started with many good annotated bird lists from specific localities, published in the journal *Emu* and in other regional natural history journals from 1900. Australia is the only continent over which two bird atlases have been conducted (1977-1981 and 1998-2002). BirdLife Australia, through volunteers, collects data on birds from a wide range of localities, although the continental coverage is limited (Birdlife Australia 2014). Technological advances such as Eremaea eBird (Audubon Society and Cornell Lab of Ornithology 2014) currently produce 8,000 bird lists a month from volunteers around the continent.

These data on birds in specific locations provide an opportunity to determine the most suitable method for assessing the condition of native avifauna at the regional scale. A review of the literature on bird 'condition' suggests metrics which assess abundance and richness are important (**Table 8**) and have yielded seven possible approaches for regional environmental asset condition accounting, primarily focusing on state and change in species abundance and richness. Our case study compares and contrasts these approaches to assess whether any particular measure can assist regional management authorities to determine the condition of their bird communities (as a subset of a native fauna account), and how this might be applied to other native fauna accounts into the future.

Methods and Results

Seven approaches for assessing the condition of bird assets were examined based on whether they were assessing change in abundance, richness or status (**Table 8**). We assessed each of these approaches (metrics) against a standard set of criteria for indicator selection criteria (relevant, simple, sensitive, measurable, timely and aggregative (Sbrocchi 2013), see **Table 9** as a means of discussing the strengths and weaknesses of each approach.

Table 8: Possible metrics for assessing change in condition of fauna.

Indicator	Metric
State and change in Species Abundance	• List length analysis (Szabo *et al.* 2010)
State and change in Species Richness	• Long-term observational records • Species-accumulation approach (Goldney *et al.* 2007; Tulloch *et al.* 2012; Tulloch and Szabo 2012)
State and change in Species Status	• Red list index (Szabo *et al.* 2012) • Status index • Assigned condition score – expert judgment • Assigned condition score – expert judgment and abundance change

Table 9: Criteria for indicator selection.

C1 Relevant	C2 Simple	C3 Sensitive	C4 Measurable	C5 Timely	C6 Aggregative
The indicator is measure or surrogate of the condition of an environmental asset or system	The indicator is easily interpreted, monitored, and appropriate for community use	The indicator is able to detect change in the condition of the environmental asset	The indicator can be statistically verified reproduced and compared	The indicator shows trends over time, provides early warning of potential problems and highlights future needs of issues	The indicator is amenable to combination with other indicators to produce more general information about environmental conditions

State and Change in Species Abundance

List Length Analysis

This metric attempts to quantify the decline in a species based on the analysis of multiple bird lists from a particular region. These declines are detected by analysing species lists collected by observers over time to see if there are some species that are recorded less despite the same length bird list (a surrogate for effort) (Szabo *et al.* 2010). Declines in prevalence of species on lists are assumed to reflect a decline in the abundance of that species in that region. This approach can use the Atlas of Australian Birds database and many other unstandardised lists of bird species, such as those available from natural history or community groups. This method has been applied to data collected over eight years in the Mount Lofty Ranges area of South Australia and revealed dramatic decreases in some species, such as the Superb Fairy Wren Malurus cyaneus and the Striated Thornbill Acanthiza lineata (Szabo *et al.* 2011).

State and change in Species Richness

Long-term Observation Records to Measure Species Richness

Species richness, the number of species occurring in a particular area, provides some context to the overall state of birds in the area. Species richness metrics can utilise bird data recorded in surveys, databases such as the Atlas of Australian Birds as well as other atlases, historical records and records of individual landholders. Reference benchmarks are relatively simple to construct: comparison of local bird lists to those from a wider geographic area will provide an indication of which species are likely to occur in the area. This list of expected species, combined with expert advice on what species might be extinct from the region, could constitute a robust reference condition for species richness. For example, long-term observations (1903-1979) in the wheatbelt of Western Australia show that of the historical 191 bird species recorded (excluding vagrants), all still occur somewhere in the region, yielding a species richness of 100% (Saunders and Doley 2013). Another example in the Central West region of NSW demonstrates that 306 (99%) of 310 bird species recorded from the region still remain (Goldney *et al.* 2007). An additional analysis that could stem from this approach is a 'modern extinction' metric, which would help to assess the degree of human cause in extinction (Department of the Environment 2009).

Species-Accumulation Curves Using the Atlas of Australian Birds

The Species-Accumulation approach produces a species-richness metric by analysing survey datasets. It accumulates the species detected as the number of surveys, or the amount of effort, increases (Figure 11). If all expected bird species at a location are still present (none are extinct), then the curve should reach the asymptote at the reference benchmark, indicating that no more species will be detected even with increased survey effort. This method also detects the minimum survey effort (number of surveys required to detect all bird species at a location).

We undertook a trial to determine if we could establish a reference condition from the Atlas of Australian Birds data and whether we could use the surveys to compare to that reference condition over a period of 10 years to build a metric of condition. We have developed this approach to allow the use of these data while avoiding the spatial and temporal bias of survey intensity expected with volunteer-based surveys. For example, in one area there might be 50 surveys one year and five in another. Equally, it is necessary to compare between two areas that are consistently surveyed at different intensities; for example, some places close to the city compared with those further away (Tulloch and Szabo 2012) to address background levels of variability.

Our results indicated there was significant variation in species richness between years. What we could not establish was whether this variation was real, due to sampling bias, due to differences in the skill and preference of observer (Tulloch *et al.* 2012), or due to other environmental variations such as rainfall. For this reason we were unable to determine with confidence that the indicator would detect change in the environmental asset on a short-term basis (C3, Table 14). Due to the variation in results (ie some years high and some years low) this metric would not provide a good early warning system, with the real trend perhaps obscured by these other factors (C5).

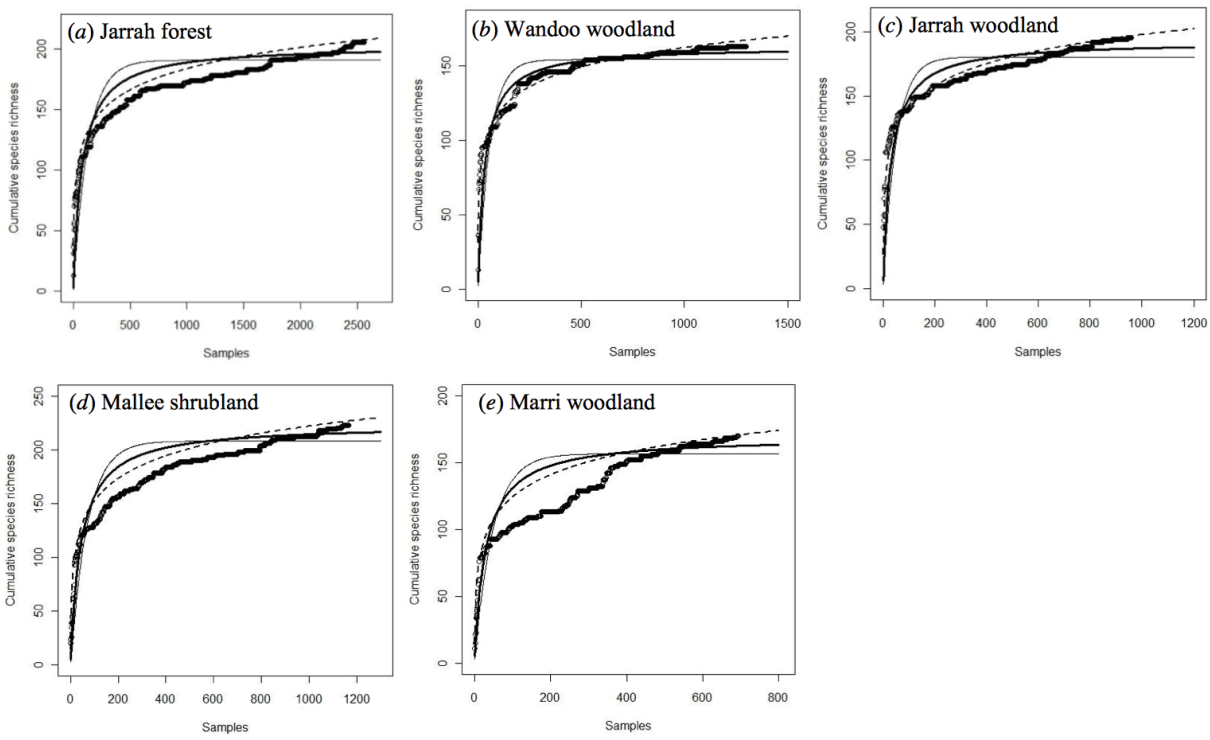

Figure 11: Species accumulation curves using the Birds Australia data (1997-2008) for different habitat types in South-Western Western Australia (Tulloch and Szabo 2012).

State and Change in Species Status

Red List Index

The Red List Index is an internationally recognised index that has been used to show global trends in species decline, and can be used to generate a national indicator of the changing condition of threatened species (**Figure 12** and **Figure 13**) (Butchart *et al.* 2004; Szabo *et al.* 2012). The index is calculated by measuring the proportion of all listed species moving between threat categories, weighted according to category. For example, Near Threatened = 1, Vulnerable = 2, Endangered = 3. The final index is the inverse of this number, scaled between 0-100, the first assessment in 1988 was set at 100. It measures the proportion of species under different threat categories of the IUCN (**Figure 12** and **Figure 13**) (Butchart *et al.* 2004; Szabo *et al.* 2012). The focus of this index is at national and international scales, and thus not applicable at a sub-national (regional) scale.

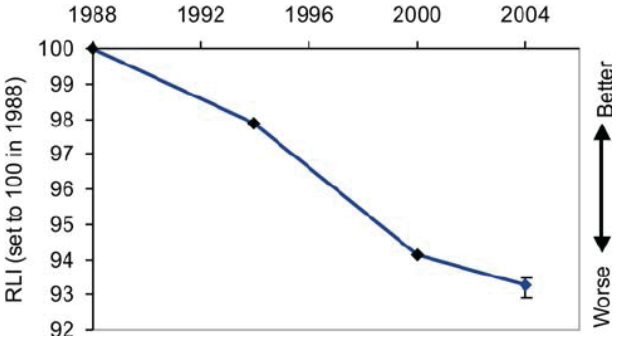

Figure 12: The decline in global bird status as measured by the global Red List Index

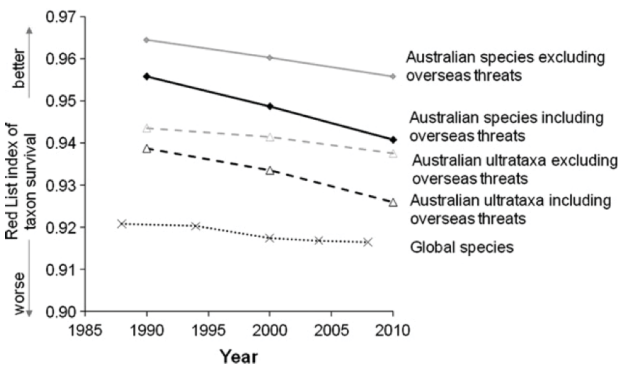

Figure 13: The decline in Australian bird status as measured by the Red List Index

Status Index

The Status Index is an attempt by the authors of this working paper to regionalise and simplify the Red List Index. The index measures the non-threatened species as a proportion of the total species to give an indication of what proportion of bird populations are not imperiled.

A trial of this method to calculate an index did reveal there to be significant differences between 10-year time frames and between regional groups (**Figure 14**) (unpublished data. However, as these indices use national threat categorisation adapted for a sub-national jurisdiction (a region), it may not in fact reflect the actual conditions within the region. For example, a species listed as vulnerable because of threatening processes on the east coast of Australia would receive an equally low weighting in regions in South Australia even though it may be abundant there.

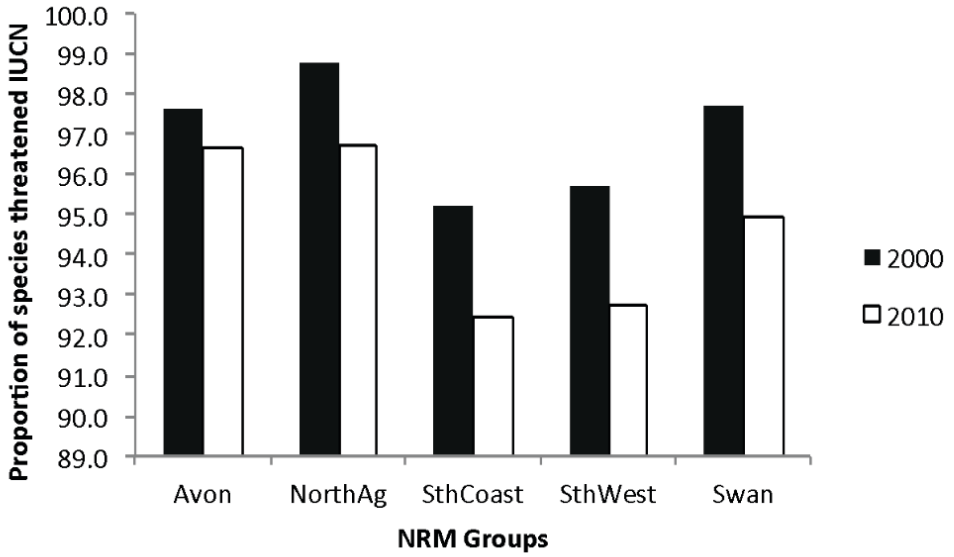

Figure 14: A status index trialed for five Western Australian regional groups between 2000 and 2010.

Regional Conservation Status Assessments

Regional assessments are essential to understanding the condition of native fauna at the landscape scale. Regional assessments provide more meaningful status statements than those based on state or national assessments. These assessments are often undertaken by experts, using multiple sources of information within a region: historical records, local bird observers, professional survey data, and expert opinion (Goldney *et al.* 2007; Saunders and McAleer 2012; Saunders and Doley 2013). This approach by the authors of this working paper then converts the regional conservation status into an index by assigning a condition score (0-100) according to the following criteria, broadly based on the IUCN criteria for determining threat status:

Category	Description	Condition score
Least concern (LC)	Species is widespread and abundant in the region	100
Near threatened (NT)	Species is likely to become endangered in the near future as a result of threats operating in the region	30
Vulnerable (VU)	High risk of endangerment of the species in the region i.e. threats operating are resulting in major declines in range and abundance	10
Endangered (EN)	High risk of species becoming extinct in the region	5
Extinct in the region (EW)	Species is regionally extinct (although may exist in other regions)	0

Table 10 provides an example of a bird account using this approach.

Table 10: Assigned Condition Score for a subset of birds of the NSW Central West region

Species Common Name	2007 Assigned Condition Score
Regional Score	30
Emu	70
Malleefowl	10
Stubble Quail	30
Brown Quail	70
King Quail	10
Magpie Goose	10
Plumed Whistling Duck	30
Wandering Whistling Duck	30
Blue Billed Duck	10
Musk Duck	30
Freckled Duck	10
Black Swan	70
Cape Barren Goose	10

Species Common Name (cont.)	2007 Assigned Condition Score (cont.)
Australian Shelduck	70
Australian Wood Duck	100
Pacific Black Duck	100
Australasian Shoveler	70
Grey Teal	70
Chestnut Teal	70
Pink Eared Duck	30
Hardhead	70
Australasian Grebe	70
Hoary-headed Grebe	30
Great Crested Grebe	30
Darter	70
Little Pied Cormorant	70

This information from the experts can be further supplemented with presence/absence observations, which cannot inform directly how the numbers of each species are changing, but changing abundance can be inferred from measuring how often the species is recorded compared to how often they could be expected to be recorded.

This approach was trialed using long-term observations from two large properties in the Northern Agricultural Catchments Council region of Western Australia (Saunders and McAleer 2012; Saunders and Doley 2013). A recording rate was derived from the total number of records for a particular species observed divided by the number of records for the species most recorded during that period. For example, in the first Bird Atlas period (1977-1981), Willie Wagtail had the most records (548) from the NACC region, so its recording rate was 1.00; Wedge-tailed Eagle had 181 records, resulting in a recording rate of 0.33 (181/548). In the second Atlas Period (1998-2002), Australian Raven had the most records (1,934) from the NACC region and its recording rate was 1.00, while Wedge-tailed Eagle had 466 records so its recording rate was 0.24 (see **Table 11** for a subset of data).

Table 11: An example of the recording rates of bird species for each atlas for the NACC region as well as the number of historical bird lists from the region each species was recorded on (maximum 12), and the recording rates for each species from long-term bird lists from two properties in the region Australia (Saunders and Doley 2013).

Common Name	Specific Name	Range	NACC	Koobabbie	Woopenalty	Birds Aust	Birds Aust
			List rate	AvRR	AvRR	Atlas 1	Atlas 2
			1903 - 1979	1988 - 2011	1987 - 2002	1977 - 1981	1998 - 2002
Willie Wagtail	*Rhipidura leucophrys*	NACC	12	0.97	1.00	1.00	0.96
Wedge-tailed Eagle	*Aquila audax*	NACC	11	0.75	0.72	0.33	0.24
Australian Raven	*Corvus coronoides*	NACC	12	1.00	1.00	0.71	4.00
Emu	*Dromaius novaehollandiae*	NACC	12	0.35	0.88	0.33	0.10
Hoary-headed Grebe	*Poliocephalus poliocephalus*	NACC	4	0.00	0.05	0.13	0.09
Australasian Grebe	*Tachybaptus novaehollandiae*	NACC	2	0.24	0.23	0.10	0.12
Little Pied Cormorant	*Phalacrocorax melanoleucos*	NACC	5	0.00	0.01	0.12	0.13
Peregrine Falcon	*Falco peregrinus*	NACC	4	0.04	0.01	0.01	0.03
Australian Hobby	*Falco peregrinus*	NACC	9	0.20	0.11	0.06	0.05

Assessments of change in occurrence of species between the two atlas periods have been made by comparing recording rates; any that differed by more than 30% between atlas periods, provided one was equal or more than 0.10, was deemed to be significant increases or declines, depending upon the direction of the difference (Saunders and McAleer 2012).

Comparing recording rates of species provides a further refinement of the assigned condition score approach. The recording rate assists in assigning condition score by providing indications of species declines or increases. For example, a decline in detection rate (the difference in recording rates between the two periods is greater than 30% and the rate is lower in the second period) is used in conjunction with other assessments of conservation value (State or Territory lists of conservation status, Garnett *et al.* 2011 and expert opinion) to assign the species a lower condition value. For example, in the NACC region Emu was widely distributed formerly, being recorded on every historical list from the region (Table 12). It had a recording rate of 0.33 in the first atlas period and 0.10 in the second. With a 70% (0.33-0.10/0.33*100) decline in recording rate between the two atlas periods, and confirmation of this decline from long-term lists on two properties and supported by expert opinion, Emu was assigned a condition score of 30 (regionally threatened) (Table 12).

Table 12: An example of the recording rates of bird species for each atlas and their corresponding condition score for the NACC region. In column "Change" * indicates no figure given as one of the recording rates was less than 0.10. In the column "other assessments" Federal, State and Territory and The Action Plan of Australian Birds (Garnett et al. 2011) classifications are taken into account to derive the condition score.

Common Name	Specific Name	Birds Aust Atlas 1 1977-1981	Birds Aust Atlas 2 1998-2002	Change (%)	Other assessments	Condition Score
Willie Wagtail	*Rhipidura leucophrys*	1.00	0.96	-4	Not of concern	100
Wedge-tailed Eagle	*Aquila audax*	0.33	0.24	-27	Not of concern	100
Australian Raven	*Corvus coronoides*	0.71	1.00	41	Not of concern	100
Emu	*Dromaius novaehollandiae*	0.33	0.10	-70	S&I declining; conservation significance	30
Hoary-headed Grebe	*Poliocephalus poliocephalus*	0.13	0.09	*	S&I declining; conservation significance	30
Australasian Grebe	*Tachybaptus novaehollandiae*	0.10	0.12	20	Not of concern	100
Little Pied Cormorant	*Phalacrocorax melanoleucos*	0.12	0.13	8	S&I declining; conservation significance	70
Peregrine Falcon	*Falco peregrinus*	0.01	0.03	*	WA Specially protected	70
Australian Hobby	*Falco longipennis*	0.06	0.05	*	S&I declining; conservation significance	70
Stubble Quail	*Coturnix pectoralis*	0.05	0.03	*	Not of concern	100
Black-tailed Native Hen	*Gallinula ventralis*	0.08	0.05	*	Not of concern	100
Australian Bustard	*Ardeotis australis*	0.10	0.01	*	S&I declining; conservation significance	10
Banded Lapwing	*Vanellus tricolor*	0.31	0.07	*	Declining; conservation significance	70
Carnabys Cockatoo	*Calyptorhynchus latirostris*	0.32	0.13	-59	Endangered: A1abc + 2abc; EPBC endangered	5
Galah	*Cacatua roseicapilla*	0.99	0.94	-5	Not of concern	100
Western Corella	*Cacatua pastinator*	0.14	0.11	-21	Not of concern	100
Inland Thornbill	*Acanthiza apicallis*	0.22	0.24	*	S&I declining; conservation significance	30
Chestnut-rumped Thornbill	*Acanthiza uropygialis*	0.12	0.24	100	S&I declining; conservation significance	30

Discussion

State and Change in Species Abundance

The benefit of this approach is that it will detect declines without having to wait for local species extinctions, and it can provide information at spatial scales relevant to managers. Unfortunately, a major drawback of this approach is the lack of appropriate baselines for these analyses (C6, Table 14).

State and Change in Species Richness

The advantage of using this approach is that it is relatively inexpensive (as it capitalises on volunteer efforts), the data are collected in standard, 20-minute two-hectare presence-absence surveys, and there is already a considerable archive of surveys dating back to 1998. It is reproducible on an annual basis, or at any other regular interval. Having said that, the number of surveys required, using volunteer-based lists, is often quite high and thus impractical for a short-term assessment. For example, in two locations in Western Australia, one required observations for seven years to detect all species (apart from vagrants) (Saunders and McAleer 2012) and another required observations for 12 years (Saunders and Doley 2013). A study in the Central West region of NSW showed that 7,500 records were required to reach 80% of all vertebrate species, and 23,000 records were required to achieve a 90% species count (Goldney *et al.* 2007).

Despite being informative in a broad sense, species richness is not suitable as a condition metric as it does not provide sufficient information on which management can rely. For example, a species richness metric for the Mount Lofty Ranges (South Australia) reveals that 112 of 120 bird species (93%) remain in the landscape. What the metric cannot tell you is that eight of these 112 remaining species are perilously close to extinction, which is not surprising given that less than 15% of the native vegetation in the area persists (Szabo *et al.* 2011).

State and Change in Status

Both the Red List Index and Status Index suffer from three major limitations: the listing process is slow, requiring approximately 10 years of data to detect change; they are broad-scale measures that currently are not generated at a sub-national scale; and they are less amendable to aggregation because the baseline is an arbitrary date (1985 for example), not a standard reference benchmark. Although the baseline issue could be remedied with a reworking of the index, the other issues such as the length of time to detect a trend (C5), and inability to reflect change at finer scales, makes this index inappropriate for regional condition accounts (C3).

The assigned condition score approach is a good approximation of actual bird condition given it supplements expert knowledge with two levels of information on status and change in abundance from surveys. However it does still require assigning values in broad bands (0, 5, 10, 30, 70 and 100), which makes it difficult to detect change between the bands (C5, Table 14).

The strength of this approach is that it does not rely on long-term data sets, although if this information is available it will support score assignment. The use of expert opinion also means measures can be generated at more timely intervals. It is also adaptive in that once more information is available the species condition scores can be updated. This approach, however, requires a substantial involvement from experts to undertake or coordinate the regional surveys on which these approaches are based, and to interpret the data and confirm the score assignments. The investment required is not insignificant.

Meaningful Groupings

So far the approaches have not differentiated the birds on the lists –a complete list of birds that may occur in a particular location are recorded. However, by including vagrants and exotic species in lists, the results can be substantially skewed. It is of greater importance for management to understand the condition of those birds that are native and are locally (regionally) valued. Therefore, it may be useful to sort the bird lists into more meaningful groups, based on their habitat usage. Saunders and McAleer (2012) suggest the following groupings based on their pattern of occurrence:

- Resident = apparently present all year;
- Regular Visitor = not present all year, but conform to a regular pattern of occurrence;
- Irregular Visitor = not present all year or every year, but when present, are present at similar times of year as previously;
- Vagrant = rare occurrence, conforming to no pattern of occurrence.

Assigned condition scores can be aggregated based on these groupings, providing a relevant index at spatial and functional scales (Table 13).

Table 13: Example of assigned condition scores grouped into functional categories of resident, regular visitor and irregular visitor for the Northern Agricultural Catchments Council region in Western Australia.

Asset	Northern Agricultural Catchments Council (WA)	Year 2012
Native Birds	Regional Assigned Condition Score	78
	Residents	71
	Regular Visitors	80
	Irregular Visitors	83

Statistical Analyses

Many of the analyses rely on assigning a conservation status with a numerical value. It is common practice to take the median of scores, particularly when using categorical data. Taking the median does not require the individual scores to be measured on a linear scale (so that the difference between a score of 90 and 100 is the same as a difference between scores of 0 and 10); however, the category band scores are insensitive to change. This means that the overall condition score will only reflect large changes in the scores of certain species. Only if species drop below the median score, or are raised above it from below, will the median change. Even in this case there would need to be a sufficient number dropping below (or being raised above) to make any change in the overall condition scores. An alternative would be to simply take the mean or average value of the scores. There is a disadvantage in that it might not reflect a skew in the data, but the advantage is that it will change if any value is changed.

Both measures will also be influenced by the number of species included on the list (including common species and those that are presumed extinct). In the extreme case of over half the species in a category being locally extinct, the median will automatically be zero. It is therefore recommended that overall scores (the average of all the assigned conservation scores in the groupings) be scaled according to the number of species in the group – a diversity weighting.

Conclusion

Based on the comparison of indicators it seems assigned condition score approaches are currently the best option for regional environmental accounting for native avifauna. These provide measures of abundance and quality at a reasonable scale.

These examples show how important and significant long-term monitoring can be. Unfortunately this approach is hampered by the availability of these long-term monitoring programs. Examples show that the maximum number of species (the benchmark for the area) can take 12 years to collect (Saunders and McAleer 2012). For this particular approach to work, a monitoring system needs to be in place for many years to obtain a condition score for one time period (C5, **Table 14**).

For these assessments to be repeated in the future, a program must be funded and initiated to collect these types of data, which are not widespread across the continent or which suffer from lack of support. However, these monitoring programs need not be complicated or onerous. Simple design and targeting the right surveyors (managers of large properties) can provide a wealth of excellent data towards regional assessments (Saunders and McAleer 2012; Saunders and Doley 2013).

To better account for native bird species (or any native fauna), funding must be made available for public programs to collect, collate, analyse and interpret long-term bird observation records.

We suggest that such a program could be initiated almost immediately with one to two full time equivalent positions and $50,000 a region to start work on collating and interpreting current datasets to provide regional information across the Australian continent on the condition of Australian native birds. Coupled with expert panel assessments roughly every 10 years, such as what has been undertaken in Northern Agricultural Catchments Council and Central West Catchment Management Authority, these results would allow natural resource managers to prioritise for conservation management, target revegetation programs, and assess the efficacy of management. Until such a system of monitoring and analysis is set up, we will continue to waste precious resources on natural resource management without any way of assessing how effectively those resources have been spent (Saunders and Doley 2013).

Table 14: Approaches to accounting for birds assessed against the criteria for indicators. Green indicates the criterion is met, red indicates the criterion is not met and grey indicates uncertainty.

			C1 Relevant	C2 Simple	C3 Sensitive	C4 Measurable	C5 Timely	C6 Aggregative
Indicator	Approach	Available data	The indicator is measure or surrogate of the condition of an environmental asset or system	The indicator is easily interpreted, monitored, and appropriate for community use	The indicator is able to detect change in the condition of the environmental asset	The indicator can be statistically verified reproduced and compared	The indicator shows trends over time, provides early warning of potential problems and highlights future needs of issues	The indicator is amenable to combination with other indicators to produce more general information about environmental conditions
State and change in Species Abundance	1. List length analysis	Yes	✓	✓	✓	✓	✓	X
State and change in Species Richness	2. Long-term observation records to measure richness and status	No	✓	✓	✓	✓	X	✓
	3. Species accumulation from Birds Australia Atlas	Yes	✓	✓		✓	X	✓
State and change in Species Status	4. Red List Index	Yes	✓	✓	X	✓	X	
	5. Status Index	Yes	✓	✓	X	✓	X	✓
	6. Assigning condition - expert	Yes	✓	✓	✓	✓	X	✓
	7. Assigning condition - expert and abundance	Yes	✓	✓	✓	✓	X	✓

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