

CHANGING THE FUTURE

SEEKING TO PREDICT AND PREVENT EXTINCTIONS

It is no secret that Australia has one of the worst records in the world for preserving biodiversity, having lost more mammal and plant species in the past 200 years than any other country. It's not over yet – a comparison of trends in recent extinctions, with current levels of threat, suggests that the rate of extinction is likely to increase. Researcher **Hayley Geyle** and a team at Charles Darwin University are identifying which species are at highest risk so that appropriate management actions can be implemented in an attempt to secure their future.



Bushfires are a major threat to the Endangered western bristlebird (*Dasyornis longirostris*), which researchers have estimated has a 16% chance of extinction by 2038. Photo: Mark Sanders/EcoSmart Ecology

FAST FACTS

Extinction is a naturally occurring process, but current estimates suggest that species are going extinct at about 1000 times the background rate. So dire is the situation in Australia, that in June of this year a Senate Inquiry into Australia's 'extinction crisis' was initiated, the second in six years.

Many of Australia's recent extinctions have been more or less predictable. Relevant agencies might even have been able to avert them had they been more aware of which species were in most imminent danger. To some extent, extinction risk is captured by a species' conservation status – species classified as Critically Endangered on the International Union for the Conservation of Nature (IUCN) Red List typically have a higher risk of extinction than those classified as Endangered or Vulnerable, so more immediate action is necessary to prevent their loss. However, many imperilled species have not yet had their conservation status formally assessed. A particularly valuable lesson can be learnt from the forest skink (*Emoia nativitatis*), a Christmas Island endemic. The last wild individual was seen a year before it underwent formal listing, despite recognition of a substantial population decline during the preceding decade (see 'The Last Stand' on p. 36 of WAM Vol 55 No. 1).

Fishy formal assessments

Formally assigned conservation status is an imperfect metric for assessing the likelihood of extinction because – although important and useful – these lists are far from comprehensive or up-to-date. In fact, entire taxonomic groups have been largely neglected, to their detriment, in legislative processes. For example, very few of Australia's endemic freshwater fish are listed under the Australian Government's *Environmental Protection and Biodiversity Conservation Act* 1999. But lack of formal listing doesn't always equate to low extinction risk – overall Australian freshwater fish have fared poorly in recent decades, with many suffering catastrophic declines. ▶



SMALL, DIVERSE AND EXTREMELY VULNERABLE

Many new species of Australian freshwater fish have been described or identified in the past decade, and many have a very insecure existence. Most of the newly recognised species are endemic galaxiids from the mountain streams of Victoria and New South Wales. Galaxiids are small, scaleless freshwater fish found only in the Southern Hemisphere and are the most diverse fish family in southern Australian streams. Several species occur in isolated populations above waterfalls and are highly susceptible to stochastic events such as floods, drought or wildfire. But climate and fire are the least of their problems. If brown trout (*Salmo trutta*, above) and rainbow trout (*Oncorhynchus mykiss*) are able to infiltrate their streams – a likely outcome, given the presence of trout below the waterfalls in almost all of the streams where galaxiids persist – then galaxiid extirpation is almost certain. There is already ample evidence of the devastating impact trout can have on populations: the Shaw galaxias (*Galaxias gunaikurnai*) and West Gippsland galaxias (*Galaxias longifundus*) at last count had estimated populations of fewer than 100 individuals, having undergone population declines of about 99% as a result of trout predation. The odds are not in their favour, but that doesn't mean we can't improve the outlook for each of these species. Installation of trout barriers and translocations to establish new populations are key to ensuring the survival of our unique freshwater endemics. Critical to this is establishing collaborations with recreational anglers, to improve knowledge and understanding of the issue and to empower them to advocate for, and contribute to, the sustainable management of native fish communities and recreational fishery resources.

The threat introduced trout pose to native galaxiids is exacerbated by the illegal translocation of trout by ill-informed anglers, or by disturbance increasing pathways for fish movement upstream. Many catchments are crossed by forestry tracks, allowing easy stream access. *Artwork: Brown trout, NOAA Great Lakes Environmental Research Authority*

available, it's typically only for well-known animals, which may risk further biasing our conservation efforts towards high-profile, better-studied species.

We started our assessment with Australian birds and mammals, assembling experts based on their research interests and contributions. A structured expert elicitation approach (shown to minimise many of the subjective biases associated with expert elicitation exercises; see box on p. 12) allowed each expert to assess the likelihood of extinction for each species and to rate their confidence in their predictions. We then collated those estimates and modelled responses for the most threatened birds and mammals, allowing us to rank species according to their likelihood of extinction within the next 20 years and to pool estimates across species to derive an estimate of the number of species likely to become extinct within that timeframe.

Our goal was not to produce a gloomy list of doomed Australian fauna, but rather to identify those species and situations for which intervention may be most pressing. This list can then forewarn responsible agencies and other conservationists, in the hope they can avert such extinctions.

Our results reveal that the task will be challenging. Under current management investment and direction, we predict that the long-established rate of extinctions in Australia is likely to continue, and indeed to accelerate. We predict that – unless management becomes more effective – seven mammals and ten birds will be driven to extinction in Australia over the next two decades.

Many of the species we found to be most imperilled are poorly known and have previously received little public attention or conservation investment. Fortunately, BirdLife Australia has taken up part of the challenge and is campaigning for some of these uncharismatic but much-troubled birds as part of their



Above: Described as a new species in 2013, the Endangered silver-headed antechinus (*Antechinus argentus*) may have a 20% chance of extinction within two decades. *Photo: Gary Cranitch.* Below: The Critically Endangered Carpentarian rock-rat (*Zyzomys palatalis*), described in 1986, ranks third for extinction risk among Australian mammals. *Photo: Michael J Barritt*



Furthermore, existing conservation status assessments are somewhat broad and don't effectively indicate how much time managers might have in which to act. For example, some species may remain Critically Endangered for decades, whereas others move rapidly through the categories from (presumably) secure to Extinct, meeting the criteria for Critically Endangered briefly before the last individual dies, and thus allowing little time for intervention. This suggests we need a better way to identify those species at greatest risk of extinction in order to prevent their ultimate demise.

What losses are looming?

Our research, led by ecologists from the Australian Government's Threatened Species Recovery Hub, seeks to identify the Australian fauna most at risk of extinction and to estimate the number of likely extinctions (assuming current management) in the near- to mid-future. In doing so, we can forewarn governments, conservation managers and the community about which species are most imperilled, so that emergency care may be implemented to prevent extinctions before it is too late.

Ideally, we should be able to predict the likelihood of extinction by using systematic mathematical models based on quantitative information on demography, impacts of threats, and effectiveness of management. Regrettably, there is little such information for most Australian species; where it is

We predict that – unless management becomes more effective – 7 mammals and 10 birds will be driven to extinction in Australia in the next two decades.

Preventing Extinctions program – needed attention given that our results suggest extinction risk is generally higher for birds than for mammals. This disparity may be because of substantial recent successes in stabilising and recovering imperilled mammals through predator-exclusion and/or translocations to predator-free islands. In contrast (with some notable exceptions), there has been less success in recent management for highly imperilled birds. Also, many of the most sensitive mammals have already been lost; now, the birds are in danger of catching up.

Table 1. Australian birds at greatest risk of extinction in the next 20 years

Rank	Species or subspecies	Probability of extinction (%)
1	King Island brown thornbill (<i>Acanthiza pusilla archibaldi</i>)	94
2	Orange-bellied parrot (<i>Neophema chrysogaster</i>)*	87
3	King Island scrubtit (<i>Acanthornis magna greeniana</i>)	83
4	Western ground parrot (<i>Pezoporus wallicus flaviventris</i>)*	75
5	Houtman Abrolhos painted button-quail (<i>Turnix varius scintillans</i>)	71
6	Plains-wanderer (<i>Pedionomus torquatus</i>)*	64
7	Regent honeyeater (<i>Anthochaera phrygia</i>)*	57
8	Grey Range thick-billed grasswren (<i>Amytornis modestus obscurior</i>)	53
9	Herald petrel (<i>Pterodroma heraldica</i>)^	52
10	Black-eared miner (<i>Manorina melanotis</i>)	47
11	Northern eastern bristlebird (<i>Dasyornis brachypterus monoides</i>)*	39
12	Mallee emu-wren (<i>Stipiturus mallee</i>)*	34
13	Swift parrot (<i>Lathamus discolor</i>)*	31
14	Norfolk Island boobook (<i>Ninox novaeseelandiae undulata</i>)*	27
15	Mount Lofty Ranges chestnut-rumped heathwren (<i>Calamanthus pyrrhopygia parkeri</i>)	24
16	Fleurieu Peninsula southern emu-wren (<i>Stipiturus malachurus intermedius</i>)	17
17	Helmeted honeyeater (<i>Lichenostomus melanops cassidix</i>)*	17
18	Cocos buff-banded rail (<i>Hypotaenidia philippensis andrewsi</i>)	17
19	Western bristlebird (<i>Dasyornis longirostris</i>)	16
20	Alligator Rivers yellow chat (<i>Epthianura crocea tunneyi</i>)*	15

^ Refers to Australian breeding population. Australia's Threatened Species Strategy (2016) includes ten birds from Table 1 as priority species (marked*).

Table 2. Australian mammals at greatest risk of extinction in the next 20 years

Rank	Species or subspecies	Probability of extinction (%)
1	Central rock-rat (<i>Zyomys pedunculatus</i>)*	65
2	Northern hopping-mouse (<i>Notomys aquilo</i>)*	48
3	Carpentarian rock-rat (<i>Zyomys palatalis</i>)	44
4	Christmas Island flying-fox (<i>Pteropus natalis</i>)*	41
5	Black-footed tree-rat (Kimberley and mainland NT) (<i>Mesembriomys gouldii gouldii</i>)	39
6	Gilbert's potoroo (<i>Potorous gilbertii</i>)*	36
7	Leadbeater's possum (<i>Gymnobelideus leadbeateri</i>)*	29
8	Nabarlek (Top End) (<i>Petrogale concinna canescens</i>)	29
9	Brush-tailed phascogale (Kimberley) (<i>Phascogale tapoatafa kimberleyensis</i>)	28
10	Brush-tailed rabbit-rat (Kimberley, Top End) (<i>Conilurus penicillatus penicillatus</i>)*	25
11	Western ringtail possum (<i>Pseudocheirus occidentalis</i>)*	25
12	Northern brush-tailed phascogale (<i>Phascogale pirata</i>)	23
13	Mountain pygmy-possum (<i>Burramys parvus</i>)*	22
14	Kangaroo Island dunnart (<i>Sminthopsis griseoventer aitkeni</i>)*	22
15	Brush-tailed rabbit-rat (Tiwi Islands) (<i>Conilurus penicillatus melibius</i>)*	21
16	Silver-headed antechinus (<i>Antechinus argentus</i>)	20
17	Southern bent-winged bat (<i>Miniopterus orianae bassanii</i>)	18
18	Black-tailed antechinus (<i>Antechinus arktos</i>)	17
19	Northern bettong (<i>Bettongia tropica</i>)	14
20	Tasman Peninsula dusky antechinus (<i>Antechinus vandycki</i>)	14

Australia's Threatened Species Strategy (2016) includes ten mammals from Table 2 as priority species (marked*).

Saving the forgotten flocks

In the past 200 years, 29 Australian bird species have gone extinct. BirdLife Australia is currently fundraising for their new Preventing Extinctions program, which will focus on Australia's most neglected and imperilled bird species. The 'forgotten birds' are those species or subspecies that lack active recovery programs and have previously struggled to attract resources for conservation management. Candidates include the King Island brown thornbill (*Acanthiza pusilla archibaldi*), King Island scrubtit (*Acanthornis magna greeniana*), Grey Range thick-billed grasswren (*Amytornis modestus obscurior*), northern eastern bristlebird (*Dasyornis brachypterus monoides*), Houtman Abrolhos painted button-quail (*Turnix varius scintillans*), western bristlebird (*Dasyornis longirostris*), Mt Lofty Ranges chestnut-rumped heathwren (*Calamanthus pyrrhopygia parkeri*) and the Fleurieu Peninsula southern emu-wren (*Stipiturus malachurus intermedius*). BirdLife's focus is on understanding the science behind why these species have become so endangered, including how and why some species are forgotten. They intend to work with communities, agencies and species experts to agree on conservation priorities, and to ensure funding is available to implement solutions. ▶

A CONSISTENT APPROACH TO FORECASTING EXTINCTIONS

We explored several options for identifying those species at greatest risk of extinction, including quantitative mathematical models based on life history data, population dynamics and threats. Even for birds and mammals – two of the most studied taxonomic groups – we found the models performed poorly due to data limitations. We soon realised we needed to take a different approach with less stringent data requirements – after all, if the data was too poor to model extinction risk in birds and mammals, how on Earth would we model extinction risk in butterflies?

We settled on using structured expert elicitation, particularly the ‘Delphi Method’. This approach has been developed in an attempt to reduce the incidence of commonly encountered biases in expert elicitation processes. Our adapted elicitation approach involved four main steps:

1. Experts (individuals invited to participate based on their research interests and contributions) were provided with a summary of relevant information on all of the species, including biology, habitat requirements, population parameters, geographic range, historical and predicted rates of decline and threatening processes. This ensured all participating experts had the same information when making assessments on extinction risk.
2. Experts were asked to provide an estimate of the probability of extinction of each species in the wild (scaled from 0–100%), assuming current levels and character of management. Experts also provided a level of confidence in each of their estimates, ranging from very low to very high.
3. Individual estimates of extinction probability were compiled and summary statistics provided (mean, median and range), so experts could compare their estimates to those made by the rest of the group. Major discrepancies between experts were highlighted and discussed. All experts were given the opportunity to justify a lower or greater extinction risk for each of the species considered.
4. Experts provided a second, final assessment of the probability of extinction (and their associated confidence), and these were combined and modelled to produce one estimate of extinction probability for each species.

This approach may be used for all taxonomic groups. The only assumption: that there is a group of experts knowledgeable enough to make assessments on extinction risk.



Above: Only 350–400 regent honeyeaters are estimated to survive in the wild, and some 75% of this bird's habitat has been cleared for commercial or agricultural use. Photo: Chris Chafer. Below: Populations of the Critically Endangered plains wanderer may have declined as much as 90% in Victoria and the NSW Riverina from 2000–2015. Photo: Laval Roy



Beyond birds and mammals

Our research continues; recently, we repeated the exercise for the most imperilled freshwater fish under the guidance of, and in collaboration with, the Australian Society for Fish Biology. The results were alarming. Many of the fish species rated to be at highest risk of extinction are not yet formally listed as threatened under Australian legislation, but the experts still rated freshwater fish as having a higher likelihood of extinction than most listed birds and mammals.

Further assessments are currently underway or proposed (including for reptiles, amphibians and some invertebrates) and we intend to compare the extinction probabilities for each group directly to provide insight into where we need to take action most urgently. Australia should not lose more species simply because we were ignorant of their plight. ■

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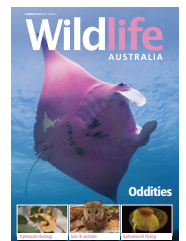
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