True Blue BIRDS

THE GENEALOGY OF AUSTRALIAN BIRDS

When ornithologists first studied the birds of Australia, they found an array of unusual and intriguing forms. In attempting to classify these newly found species, they tried to think of the most similar looking bird they knew from the Northern Hemisphere, and assumed that the Australian species would be most closely related to that species. In many cases this caused no problems. But more recent research, using DNA and protein testing, has thrown up some interesting and surprising results for our songbirds.

by Les Christidis and Allan Burbidge

Up to the 1970s, the prevailing view was that most songbirds of Australia, New Zealand and Papua New Guinea were simply curious relatives of Northern Hemisphere groups of birds such as robins and warblers. Nevertheless, the fact that they have been seen as 'curious relatives' encouraged a lot of research into the relationships and evolutionary history (the 'genealogy') of Australasian birds. Today, it is believed that Australian birds such as thornbills and honeyeaters evolved in Australia, have been around for a very long time, and are not closely related to any Northern Hemisphere 'look-alike' groups.

Morphology (shape, size, colour) is an obvious source of evidence for evolutionary relationships because we expect related plants or animals to be similar in structure. The traditional morphological approach for classifying Australia's birds was therefore sensible, but had problems.

DIVERGENT OR CONVERGENT

Closely related animals may, through evolutionary time, come to look very different from one another if they live in dissimilar environments and their bodies have to cope with different conditions, such as temperature or aridity. For example, seals have some obvious adaptations for living and hunting in water, but are more closely related to dogs than one would expect from outward appearances. This is called divergent evolution.

Conversely, unrelated animals can evolve to look very similar if they live in similar environments. This is known as convergent evolution. Our gliding possums, for example, are remarkably similar to flying squirrels from the Northern Hemisphere and the thylacine was extremely 'dog-like'. But the presence of a pouch reveals that possums and the thylacine are, in reality, more closely related to kangaroos and other marsupials. Therefore, interpreting evolutionary histories and relationships from morphology alone is subject to some serious pitfalls. If it were not for pouches, the early classifications of marsupials would have been difficult.

The evolution of Australia's songbirds is also a remarkable example of convergence, which parallels that of the marsupials. However, unlike the marsupials' pouches, no obvious features distinguish Australia's songbirds from their Eurasian counterparts.

DISTANT COUSINS?

The first ornithologists to study Australian birds were very familiar with Northern Hemisphere birds and naturally tried to 'pigeon-hole' any new bird they

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The singing honeyeater, one of the most common birds in Perth gardens, is typical of the birds that evolved in and are confined to the Australian region.
Photo – Jiri Lochman

Below: The western spinebill displays a nectar-feeding habit that has evolved independently in Australian honeyeaters.
Photo – Babs & Bert Wells/CALM

Bottom: The western thornbill is typical of the thornbill family, one of the major families that evolved in this region.
Photo – Babs & Bert Wells/CALM

Below right: Australian chats, like this spectacular orange chat, are known to be in the honeyeater family, but their exact realtionships are still being debated.
Photo – Babs & Bert Wells/CALM

encountered in the system they were using at the time—which was a classification of Northern Hemisphere birds. (It would be interesting to consider what would have happened if ornithology had started in Australia. The history of our knowledge of bird evolution and relationships may have been very different!) In determining the classifications of Australian birds, the ornithologists used the assumption that birds similar in behaviour and appearance were related, but this caused a number of anomalies. They also assumed that southern birds would be relatives of, and probably derived from, northern birds. In hindsight, they would have been better off starting from scratch.

Until quite recently, it was believed that Australia had received its birds from waves of immigration from the Northern Hemisphere, using the Indonesian islands as stepping stones. Our robins and warblers were supposed to be descendants of these early waves of migration from the north. Even such unique birds as lyrebirds and scrub-birds were thought to have been descendants from now extinct Northern Hemisphere forms. The idea that Australia may have had its own separate and diverse fauna that was not of Eurasian origin was anathema to most scientists. Some, however, speculated that convergent evolution may have been obscuring the true origins of Australia's birds.

BREAKING THE CODE

To overcome the problems of morphological convergence, researchers have turned to DNA and the genetic code—the building blocks and blueprints of life. It is reasonable to suggest that species with very similar DNA structures and genetic codes are more closely related. Conversely, species with very different DNA structures and genetic codes are unlikely to be related, even though they may look or behave similarly.

One method of analysing DNA is through hybridisation. In essence, what happens is that a solution of DNA is heated to near boiling so that the molecular structure—the two strands of the DNA double helix—are broken apart and float loose. If the solution is then cooled slowly, the complementary strands can find each other again, and the DNA is reconstituted.

Wrens, such as the red-backed fairy-wren, are not related to the Northern Hemisphere wrens; their closest relatives are our thornbills and honeyeaters.

The white-winged triller is a member of the cuckoo-shrike family. It is still not certain whether this group evolved in Australia or not.

Named the scarlet robin, because it reminded colonists of the European robin, this bird is actually from an entirely different family.

This rufous treecreeper is superficially like European treecreepers, but is more closely related to other bird families that evolved in Australia.
Photos – Babs & Bert Wells/CALM

This property of DNA makes it possible to form 'hybrid' DNA molecules from single strands of two different species, and therefore determine the degree of genetic similarity between them. If the DNA from two species are processed together, and the separated strands from each connect with one another, the degree to which they connect is an indication of how closely related the species are.

If they do connect, this also provides a measure of the genetic change in the two species since they diverged from a common ancestor. If DNA from two species combines to a greater extent than that from two other species, it is because the first two species have more similar DNA, and, therefore, are more closely related to each other.

TRUE BLUE AUSSIES

This technique has been used extensively to examine the relationships of the world's birds. Some of the most exciting results have involved Australia's songbirds. The DNA experiments provided the first clear evidence that our songbirds were not descendants from their northern 'look-alikes', but that they had, in fact, evolved independently on the Australian continent.

Despite not displaying any obvious similarities, our robins, wrens, honeyeaters, scrub-birds and treecreepers were all found to be more closely related to one another than to their northern name-sakes. Many of these findings have since been confirmed by the use of other techniques, such as the comparison of proteins in different species.

Above left: Golden whistler. Because of their general appearance and insect-eating habits, whistlers were once thought to be closely related to our robins. They are, in fact, more closely related to magpies and crows.

Above: This male redthroat is another member of the thornbill family—a large family of small insect-eating birds common in Australia.
Photos – Babs & Bert Wells/CALM

The DNA results have also encouraged a more critical look at the morphological evidence. The results of this 'fresh look' have often turned out to be consistent with the DNA evidence—it was simply that the early ornithologists had a Northern Hemisphere perspective and therefore came to erroneous conclusions. They were blinded by familiarity.

HOME-GROWN ANOMALIES

The role of convergence in obscuring the true relationships of birds is evident even within Australia. Our insect-eating robins, whistlers and shrike-thrushes were always classified together. DNA and protein data indicate that whistlers and shrike-thrushes are more closely related to magpies and crows, while our robins are related to nectar-feeding honeyeaters. Furthermore, we now know that honeyeaters evolved from the same insect-eating birds as the thornbills and scrubwrens. The nectar-feeding habit of honeyeaters evolved in Australia and was not a habit brought here by descendants of groups that also gave rise to the sunbirds of Africa and Asia. These new insights allow us to investigate further the intricate co-evolution between honeyeaters and Australia's unique plants.

Although we now have a clear picture of the origin of Australia's songbirds, many questions still remain. Within Australia, the relationships of bowerbirds, scrub-birds, treecreepers and lyrebirds are still controversial. They may represent the earliest groups of Australian songbirds. Robins, honeyeaters, wrens, thornbills and scrubwrens have evolved and remained on the Australian continent, but what of our flycatchers, cuckoo-shrikes and fantails? These occur also in Africa and Asia. Did they colonise these continents from Australia or vice-versa? Swallows and finches are relative newcomers to Australia, but may have evolved from earlier forms that originated here. Some scientists now believe that the southern continents were the place of origin for the world's songbirds, but much more evidence needs to be gathered to examine this controversial hypothesis.

To unravel some of these questions, DNA in birds is still being examined, but by the more refined technique of DNA sequencing. This method provides a direct reading of the genetic code. Exact comparisons of parts of the DNA code can then be compared across species. What is more important is that, for sequencing, DNA can be extracted from bones and museum skins, which means that extinct species can now be included in these exciting studies.

For professional and amateur ornithologists, the DNA evidence concerning Australian songbirds highlights the unique and important nature of Australian birds as a whole.

Bird groups such as pardalotes, thornbills, fairywrens and honeyeaters, which are common birds to us, are found only in Australia, New Guinea and New Zealand. They are not simply the quaint relatives of the major Northern Hemisphere groups. We can finally shed the idea that our birds are 'second-hand' derivatives from the north. They have a significant place in the evolution of the world's birds, and make an important contribution to world's biodiversity. They are an integral part of this continent and have evolved here in concert with the changing geology and climate of this land. It follows that Australia is the only place where these groups can be conserved effectively.

The Department of Conservation and Land Management (CALM) is, therefore, concerned that this important segment of the world's biodiversity is conserved in a way that will enable all Western Australians, as well as visitors to our State, to see as many of these unique species as possible in their natural environment. Research into the genealogy of our birds continues to help scientists understand the relationships and interdependencies the birds have with their environments. The results of such research can be enormously helpful in the planning of recovery programs for rare or threatened species, because the loss of these species would close a unique chapter in the history of bird evolution and severely diminish global biodiversity.

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Visitors can walk in the treetops along a series of walkways, platforms and stairways at the new Forest Heritage Centre in Dwellingup. (See page 10.)

A major survey of the Carnarvon Basin has recently been completed by staff from CALM, the WA Museum and the University of WA. What did they find? (See page 15.)

LANDSCOPE

VOLUME ELEVEN No. 2 SUMMER ISSUE 1995–96

It was a very good year in the Wildflower State. Find out just how good in our story on page 38.

Australia has its own families of songbirds that are very different from their European namesakes. See 'True Blue Birds' on page 45.

Quokkas were once widespread on WA's mainland, but the most visible populations are now found on just two islands. 'Where Have All the Quokkas Gone?' (See page 49.)

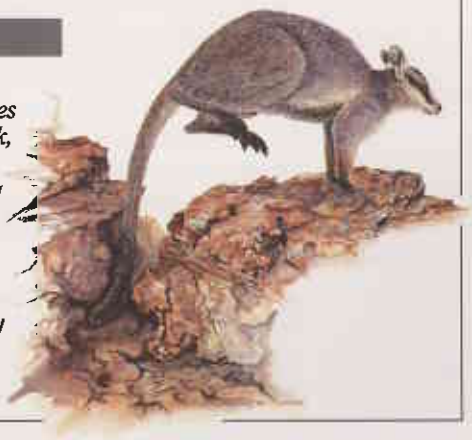
FEATURES

REGULARS

COVER

Western black-footed rock-wallabies are on the increase in Yardie Creek, thanks to a CALM fox-baiting program. Their numbers are being monitored by local tour operators Neil and Rhonda McGregor. See our story on page 36.

Illustration by Philippa Nikulinsky



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