Birds of a feather create new species together—and here's how

July 1 2013, by Thomas White

African starlings, such as this Superb Starling, have complex feather colours which drive evolution faster than their drab cousins.

Starlings have an image problem in Australia. These drab invaders are best known as pests of orchards and shopping centres. If you take a trip to see their African relatives though, you'll find starlings are some of the most colourful and diverse birds on the planet.

The rich palette on display is more than just eye-candy. In a recent study, researchers from The University of Akron showed this striking colouration has helped drive their split into dozens of species.

Building colour

Rapid bursts of diversification, known as adaptive radiations, are often spurred on by the evolution of key traits that allow organisms to interact with their environment in new ways. The highly changeable beak of Darwin's finches, for example, has allowed them to spread across the Galapagos Islands into entirely new habitats.

What interested lead researcher Rafael Maia was whether innovation in a purely ornamental trait – colours used for social communication – could similarly drive the emergence of new species.

There are two common ways in which animals produce colour:

1. The first is through pigments: complex molecules that selectively absorb light. From the melanins that darken our skin to the carotenoids that give goldfish their name, pigments are everywhere.

2. The second, non-exclusive, way is through structural colouration: tiny assemblies of organic material that selectively reflect light. When light strikes these structures, some of it is reflected back while some passes through. If they are ordered and stacked in just the right way, then the reflected waves of light may interact to produce some of the brightest and richest colours in the natural world.

Cape Glossy Starlings fighting. Credit: Dimitry B

Birds are masters of structural colouration, and African starlings are unique in using all four types of structure common among birds.

The simplest is a small, pigment-filled rod, called a melanosome. While melanosomes are found in all vertebrates, birds are the only group which has evolved different morphologies of melanosomes.

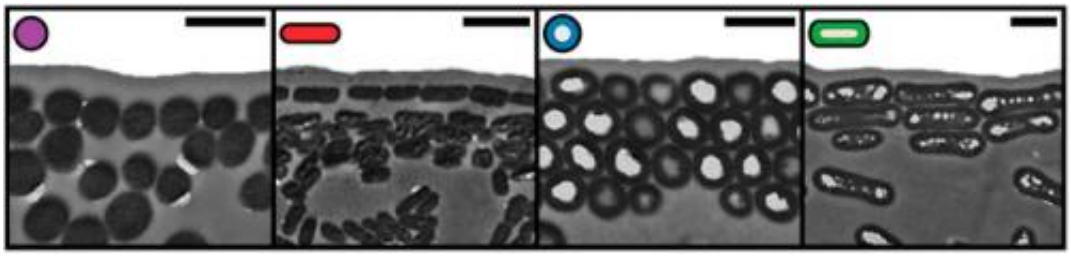
Some species have developed a flatter melanosome, while others have evolved hollowed-out forms. In other species still, evolution has favoured a combination of approaches resulting in melanosomes which are both flattened and hollowed out. The African starlings are the only group of closely-related species to present all of these modifications.

Only the healthiest, best-developed starlings are able to produce the most brilliant and rich colours. This information is essentially locked into an individual's plumage, which is valuable to potential mates and competitors.

New ways to communicate

By analysing the colours and evolutionary relationships of African starlings, Maia found melanosome evolution moves in only one direction. In other words, although more complex melanosome structures evolves several times, species never revert back to simpler forms.

This is because structural colours are easily tinkered with. Maia knew that only minor changes in the thickness or shape of a melanosome could create dramatic differences in appearance, opening up a whole new palette of metallic colours. And as the complexity of these structures increases, so to do the ways in which minor physical changes can produce entirely new colours.



The four types of melanosomes which structurally colour African starlings (from left): standard, flattened, hollowed-out, and flattened and hollowed-out. Credit: Maia et al. 2013

The evolutionary flexibility, or evolvability, of structural colours was

central to the starlings' radiation. Those species which had evolved more complex melanosomes not only used a wider range of colours, but they developed new colours more than 10 times faster than their morphologically simpler relatives.

The way in which these structures are tied to an individual's quality remains unchanged, which means starlings are free to experiment with new colours without changing the information encoded in their plumage.

So as populations naturally separated, any differences between groups could be amplified through the rapid evolution of new colours. Since these colours are vital for courtship and social communication, differences in colouration could readily act as a barrier between groups; the first stepping stone in the establishment of new species.

Unlocking innovation

Birds are not the only animals to widely adopt these colours. If you look at animals that have even more complex structures, such as butterflies, there is possibly even more room for innovation and tweaking the morphology to produce new colours.

So while this study reveals a powerful process at play in starling evolution, it also presents the tantalising possibility that these resplendent ornaments are a general key to innovation.

Source: The Conversation