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Feather colour indicates survival strategy in birds

Colourful plumage linked to immune response in tawny owls.

Matt Kaplan

The colour of a bird's feathers may by an indication of the strategy its immune system uses to beat pathogens, according to a new study.

Pigments in feathers have been linked to the overall health of birds before. The carotenoids that give the blue-footed booby's feet their distinctive colour, for example, are also antioxidants that are found in its food. So a booby that is suffering from infection or starvation will have less colourful feet than a healthy bird.

But now researchers in France have shown that female tawny owls (*Strix aluco*) with dark red plumage mount a more powerful response to infection than females with lighter feathers. However, this stronger response comes at a cost: darker females lost more weight over the course of the study than pale females.

The discovery suggests that rather than advertising overall health with their colour, females are advertising their immune strategy.

"We think these colours are being used in sexual selection," says Julien Gasparini of the Laboratory of Ecology and Evolution at the Pierre and Marie Curie University in Paris, who led the team.

If individuals are living in an environment in which disease is a big threat, Gasparini predicts that darker females might be preferentially chosen by males because their heavily protective, but energetically expensive, genes benefit offspring. In contrast, lighter females would be preferred in less infested areas.

Female tawny owls with dark red feathers have immune systems that respond more strongly to infection.

J. Gasparini

A colourful inheritance

Carotenoids only account for a small percentage of colouration. Melanin, another pigment, is very common and is often involved in camouflage colouration. But there has been little evidence that melanin is connected with the health of an animal and many species ranging from the red-tailed hawk (*Buteo jamaicensis*) to the southern platyfish (*Xiphophorus maculatus*) have melanin-related colouring for no obvious reason. This has left researchers wondering what the pigment does in these animals.

Gasparini and his colleagues decided to investigate the role of melanin in wild tawny owls. The team collected feathers from 102 egg-laying tawny owls, digitally photographed them, and used software to analyse their colour. They repeated the experiment on the 258 chicks that later hatched and found that colour was heritable.

The researchers then vaccinated roughly half of the adults with a cocktail of antigens from diseases such as tetanus and diphtheria. Between 6 and 38 days later, birds were recaptured and weighed, and samples of their blood analysed for antibodies to determine the strength of the immune response.

Reporting in the *Journal of Animal Ecology*[1], the researchers reveal that the degree of red in a female's feathers is closely linked to the amount of antibody that she produced against the vaccines, with dark red females maintaining a higher level of antibodies for a longer period than paler females.

Advertising strengths

Whether melanin is linked to the immune strategies of all birds in this way is not yet known. But the researchers suggest that colour could be signalling the presence of metabolic traits that would otherwise remain invisible.

"The combined usage of biochemistry, immunology, behavioural ecology and genetics in this study of animal colouration is unparalleled," says Kevin McGraw, who researches bird

conducted.

"It would be great if we could go beyond heritability and look at gene expression and map genetic differences between the colour morphs" says Geoffrey Hill, a biologist at Auburn University in Alabama.

References

1. Gasparini J. *et al. J. Anim. Ecol.* doi:10.1111/j.1365-2656.2008.01521.x (2009).

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