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Yellow and black Common Magpies *Pica pica*

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Abstract. Two yellow and black Common Magpies *Pica pica* were observed in Sømna, Norway, in 2014. The normally white parts of these birds were all evenly coloured yellow, while the black parts looked normal. Carotenoids are normally responsible for yellow colours in feathers, but Magpies are not among the bird species for which carotenoids have been identified and such colouration in Magpies is not described in the literature. After feedback from the public and investigation of more than 4000 Magpie pictures on the Internet, I found only a total of 10-11 yellow and black Magpies at seven locations (China, Denmark and Norway) between 1989 and 2015. One moulted feather from the birds in Sømna, analysed under a light microscope, showed that the colour came from the environment. A chemical analysis of the feather including 64 elements, showed increased levels of iron (Fe) when compared to a normal white and black feather. It is therefore probable that bathing in rusty water gave the Magpie this rare colour.

INTRODUCTION

Pigments deposited in the feathers when birds moult, pigments in the uropygial gland, structural mechanisms (iridescence), and staining can create bird coloration. The most common pigments are carotenoids and melanins (Andersson & Prager 2006). Carotenoids reflect long wavelengths of light as sharp red, orange, and yellow, while melanin creates black, brown, brick reds, and buff yellow colours (Owens 2006). Also porphyrin pigments create the brown and rufous coloured feather, like the ones of bustards and owls (McGraw 2006c). It is not always easy to determine whether a colour is based on carotenoid or melanin pigments only from the colour (Owens 2006). Both carotenoids and pterins (other pigments) can make yellow and orange-like colours that may be confused with similar colours created by melanin (McGraw 2006a,b,c). Almost all colours of bird feathers are acquired during moulting. However, it is probably possible to deposit carotenoids in the uropygial gland secretion which might then colour the feathers during application. This is presumably the reason why the Great Hornbill *Buceros bicornis* has some yellow feathers and Ross's Gull *Rhodostethia rosea* has pink wash on both the belly and the wings (Hill & McGraw 2006).

In addition to pigments, colours can also be created by structural mechanisms. This is caused by laminar interference (iridescence) in the nanometre scale layers in feathers or other structures (Andersson & Prager 2006; Prum 2006). It is also possible that birds can attain some colours by soiling, staining and abrasion. Such colouration in birds is rare and not fully understood (Montgomerie 2006). White is produced by incoherent scattering of all visible wavelengths from unpigmented feather keratin (Prum 2006).

Common Magpies *Pica pica* (hereafter Magpies) are not among the bird species for which carotenoids have been identified in feathers (McGraw 2006a). The black colour in the Magpie is made of melanin, as no other pigment is able to create black (McGraw 2006b). In the literature about Magpies, several abnormal colours are mentioned (Linsdale 1937; Coombs 1978; Birkhead 1991). However, none has dealt with abnormal colours on the typically white feathers. To my surprise, I received pictures and information about a Magpie that had the customary black feathers, but all the typical white parts were brown-yellow. All the yellow feathers were evenly coloured on this beautiful bird (Figure 1). The aim of this work is to find the reason for this colouration, and to investigate how common this phenomenon is.

MATERIAL AND METHODS

I was informed about and received a picture of a yellow and black Magpie from Sømna (Nordland, Norway) in July 2014. I went to the area and took pictures of two adult yellow and black Magpies and their two fledglings in addition to searching for moulted feathers. Many newspapers in Norway and at least one in Sweden wrote about the phenomenon, and I was interviewed about this observation on the radio, which resulted in feedback from others who had seen similar colouration in Magpies. Fortunately, I received one moulted, black and yellow primary Magpie feather from Sømna, which I could analyze.

The feather was analyzed under a light microscope, and the yellow part of the feather was analyzed for chemical components and compared with an ordinary white part of a feather from another Magpie. The chemical analysis was done using High Resolution − Inductive Couple Plasma − Magnetic Sector (HR−ICP−MS), with the instrument ELEMENT 2 from Thermo electronics. The procedure was certified with multi element calibration solutions, matrix matched concerning ion strength and acid. The solutions were verified against certified reference material in solution (SPS−SW2). Measurement uncertainty was verified against certified reference material as close to the

Figure 1. The yellow and black Common Magpie in Sømna, Norway, in 2014. Photo: Magne Husby

samples as possible. Contamination was verified with three blanks. In total, 64 elements were chemically analyzed.

To find out how common yellow and black Magpies really are, I searched for yellow and black Magpies on Google picture. I wrote the name of the Magpie in 41 different European languages, representing parts of a country, a country, or a region within several countries. I investigated more than 4000 different pictures, and if I found abnormal Magpies I followed any links provided in order to further the search for yellow and black birds.

RESULTS

The picture I received from Sømna in 2014 showed a Magpie that was black on all the typical black parts, and yellow-brown on all parts that are normally white. During my investigation in the area, I found two adult Magpies with yellow and black feathers (Figure 1). The yellow colour seemed to have faded relative to the pictures I received. The adults moult feathers at that time of the year, and by analysing the pictures I saw both old wing feathers that were all yellow on the typically white parts, and new feathers that were partly weak yellow and partly clear white. The inner parts were weak yellow, while the part closest to the feather tip was white. In addition, two fledgling Magpies that seemed to belong to the two yellow adults according to their behaviour, were almost totally white on the usual white parts. A few feathers had a little bit of yellow, but the colour was very weak and hardly visible on the pictures and not at all in the field.

I compared the black and yellow feather with a normal black and white feather under a light microscope. The black parts looked similar in both feathers. In the yellow part, both barbs and barbules looked normal, apart from being yellow. This was true on both the upper side and the lower side (the side pointing towards the ground during flight). However, the lower side of the shaft had a thin and uneven layer of the yellow-brown colour. It looked as though a yellow liquid had been running along the feather and later dried out; the shaft varied between the normal colour and the yellow layer. This indicated that the colour is from the environment and deposited on the feathers.

In the chemical analysis of 64 elements, there was a very marked difference in the iron content, Fe (atomic mass: 56), between the yellow and normal white Magpie feather. The concentration in the white feather was 331.86 µg/l, while it was 2982.13 µg/l in the yellow feather. Normally, increased levels of iron in nature correspond to an increased level of manganese, Mn (atomic mass: 55), but the manganese concentrations

found here were very similar in the two feathers; 7.94 µg/l Mn in the white feather and 9.11 µg/l in the yellow feather.

Yellow and black Magpies are not common, and only two were found among the more than 4000 Magpie pictures on the Internet, one of a single bird in Denmark (July 2009), and my picture of one of the two birds from Sømna, Norway (Figure 1). In addition, I was informed about four additional observations in Norway between 1990 and 2015; one bird in Jæren (July 1990), two birds in Skiptvet (May–June 2013), two birds in Grue (June–July 2015), and one bird in Bærum (June 2015). All six observations in Denmark and Norway (a total of nine birds) were made between May and July. The occurrence of yellow and black Magpies is not restricted to northern Europe, as one or two yellow and black Magpies were observed in Shanghai, China, in January 1989. None of the yellow and black birds differed significantly from normal coloured birds in regards to size and shape, except for the Danish bird which had a shorter bill than normal (visible on the picture and commented on the actual website).

DISCUSSION

Under the light microscope, the yellow colour on the normally white part of the feather, which faded over time, seemed to be deposited from the environment and not during moulting. This conclusion is supported by earlier speculation that fading colours are applied to the feather surface, and not colours from pigments or nanostructures. However, it has been shown that at least one type of carotenoid (astaxanthin) deposited inside the feathers during moulting can cause temporary colouring which can fade (Montgomerie 2006). In addition, feather colours might also change because of UV damage, abrasion to their delicate structure, or because of keratin-degrading enzymes from bacteria on their surfaces (Montgomerie 2006).

The chemical analysis revealed that the source of the yellow colour on the Magpie feather was probably an iron compound found in a pond suited for bathing. The iron compound would adhere to the wet feathers, increasing in colour strength as the water evaporated and the concentration of the iron compound increased. Rusty water can contain iron(III) oxide-hydroxide, FeO(OH), creating a red-brown-yellow colour (Hägg 1969). The iron seems to have been from a human-made source as the manganese that is normally found with iron in natural conditions (Hägg 1969) was not in higher concentrations in the yellow feather than in the normal white feather. The first pictures I received of this black and yellow Magpie from Sømna were a darker yellow-brown than the more clear yellow I observed when I arrived and took my pictures. The change in colouring was likely caused by fading and the washing away of the rusty colour.

There are other examples of stained colours in birds. It has been observed that the orange-red colour caused by iron oxide has stained the feather tips on Bearded Vultures *Gypaetus barbatus* and the white plumage on the head of Snow Geese *Chen caerulescens* and Emperor Geese *Chen canagica* and bellies of Red-throated Divers *Gavia stellata* and Red-necked Phalaropes *Phalaropus lobatus* (Hill & McGraw 2006). It is quite common that birds feeding in water containing iron gradually stain and become rusty-coloured on head, neck and belly, and this is especially visible on white birds like swans (Brazil 2003). However this is, to my knowledge, the first publication on this phenomenon in Magpies.

All yellow and black Magpies were observed during the ice-free season, which supports the idea that bathing might be the source of the colour. This may not be, however, the cause of the yellow colour for all the birds, as only one was analysed chemically.

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