Recognizing individual Bewick's Swans by bill pattern

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One of the problems of biologists is to identify individual animals in the population they are studying. In the case of the Bewick's Swan *Cygnus columbianus bewickii* the first diagrams of the variability of the black and yellow areas of the bill were published by Acland (1923). Geroudet (1962) observed three Bewick's Swans on Lake Geneva, Switzerland, and drew their bill patterns. The following winter he found a pair there, and believed them to be two from the previous year (Geroudet 1963). Interestingly enough, Sermet (1963) drew four Bewick's wintering 50 km away on Lake Neuchâtel, and one could be the third of Geroudet's birds.

Scott (1966) concluded that 13 of the Bewick's Swans that flew daily from the Severn estuary, Gloucestershire, England, into the grounds of the Wildfowl Trust in the winter of 1964–1965 had bill patterns identical to 13 of the 18 he had carefully drawn the previous winter. Moreover the birds were obviously familiar with the rather artificial surroundings, several were in the same pairs as in 1963–1964, and one had been ringed.

The Bewick's Swan numbers at Slimbridge increased annually with the protection and food offered, until by 1969–1970 over 500 Bewick's Swans of second winter or older were recorded during the winter (Evans 1970). As much research has been based on this individual identification, it seemed necessary, scientifically, to assess the method and its reliability.

Development of the bill pattern up to the third winter

When four-month-old Bewick's Swan cygnets arrive at Slimbridge their bills are usually coloured cream next the feathering, then pink, with black appearing around the nail and nostrils. Feathering usually extends partially down the culmen, so that no browline is obvious. By February, when the birds leave, pale yellow and dark grey patterns, often ill-defined, have emerged, especially on the sides. These can be recorded on printed forms used for all the swans, giving outlines of the two profiles and a front view of the head. These patterns may be used the following winter to suggest the identity of a second-winter bird with remnants of juvenile grey feathering on the head and neck) whose confident behaviour indicates some Slimbridge experience. This identity may be confirmed if the parents arrive, and are acknowledged by the second winter bird, but the evidence is somewhat tenuous.

Unless ringed as a cygnet, therefore, the life record of an individual Bewick's Swan cannot generally start until its second winter, when it is given a reference name, and recorded by bill pattern. Some 2,500 swans have now been so recorded and named. The bill is now virtually the adult black and yellow, although there may be pink in a patch in the centre of the culmen, or in two parallel lines extending towards the nostrils from the edge of the black (termed 'post nareal area'—Figure 1). This pink is replaced by black during the winter. A little juvenile feathering may still remain in the centre of the brow line.

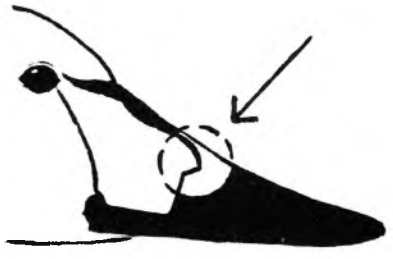


Figure 1. Post nareal area on Bewick's Swans' bill pattern.

To check on any subsequent changes, 23 swans were photographed by Philippa Scott from both sides and head-on in their second winter and again in a later one. Only ringed birds were used so that their identity was confirmed independently. Each photograph measured 8 × 13 cm, and many were very detailed, being taken when the bird was in the hand.

Using the terminology of Scott (1966) there were four 'darkies' (i.e. the black on the bill extending up the centre from the tip to the brow), nine 'pennyfaces' (black extending from the tip to the brow, but not up the centre, where there was a yellow patch), and 10 'yellow nebs' (no continuous black from the

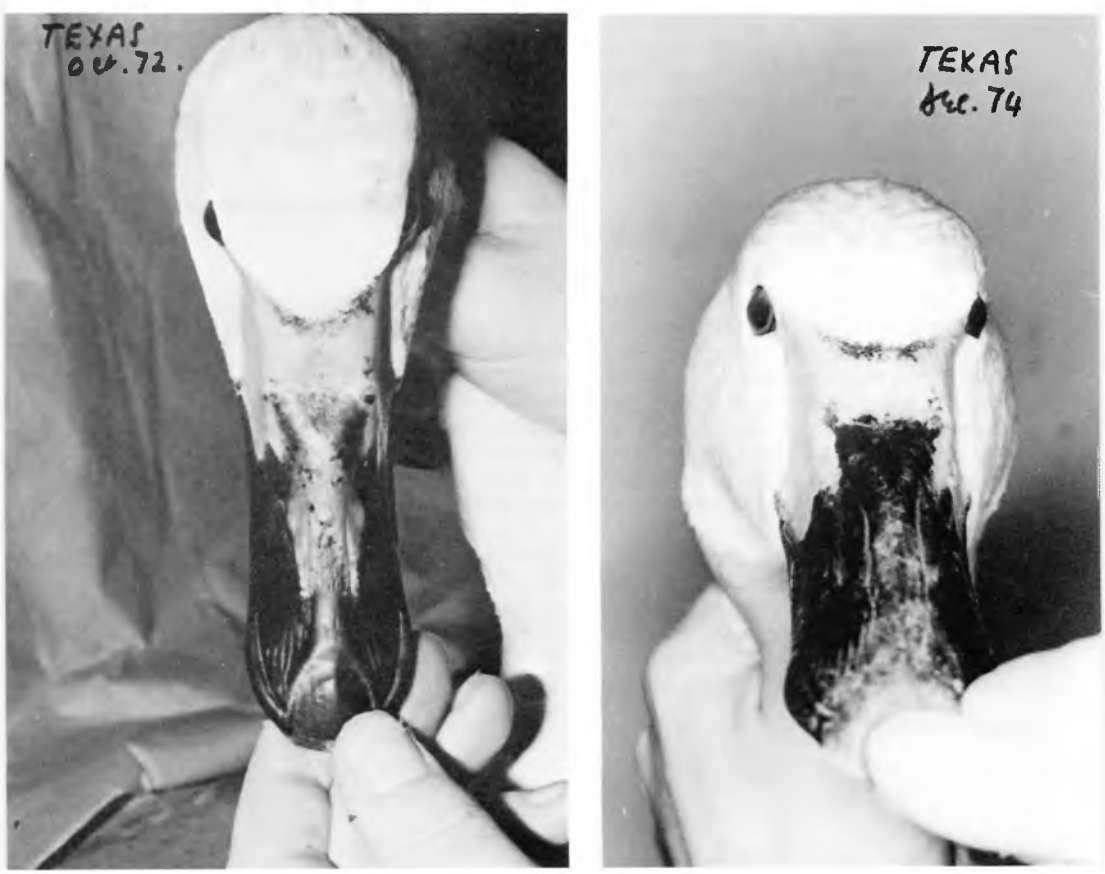
Figure 2. The three main divisions of Bewick's Swans' bill patterns. Variation in the browline and sides is also shown.

tip of the bill to the brow) (Figure 2). In the head-on view only darkies and pennyfaces have black lines up to the brow, and in 4 of the 13 swans their edges had become more solid. Recognition of one bird might have been affected. The browlines of the two pennyfaces had become blacker. Only pennyfaces and yellow nebs can have a haze of black spots on the upper culmen. Of the 19 the spots had lessened or cleared (being replaced by yellow) in 6. One pennyface might have become unrecognizable.

Nearly all changes on the sides of the pattern occurred in the post nareal area, where the edges had become firmer in 8 birds. The only other changes on the sides was that four black spots on one bird faded, although not completely.

Apart from the two birds mentioned, the others were considered quite recognizable again on the basis of their second winter bill patterns. See, for example, Figure 3 where only the pink patch in the centre of the culmen became blacker. The pattern appears

Figure 3. **'Texas'** (a) In his second winter, (b) two years later. (*Philippa Scott*).



to develop firmly first on the sides up to post nareal area. There, and on the upper culmen, a final firming of outlines and clearing of haze may occur during the bird's second year. Figure 4 illustrates all these developments.

The large amount of black appearing on the pattern of one second winter bird, James, turning him from a yellow neb to a darky in three months, with an intermediate white phase (Ogilvie 1968), was very unusual. It may have resulted from scarring of the epidermal tissue due to abrasion. Changes to black are normally confined to spots.

Development of the bill pattern after the third winter

Twenty adult birds (third winter and over) were photographed in the hand when they were ringed, and later in two successive years (usually by Philippa Scott).

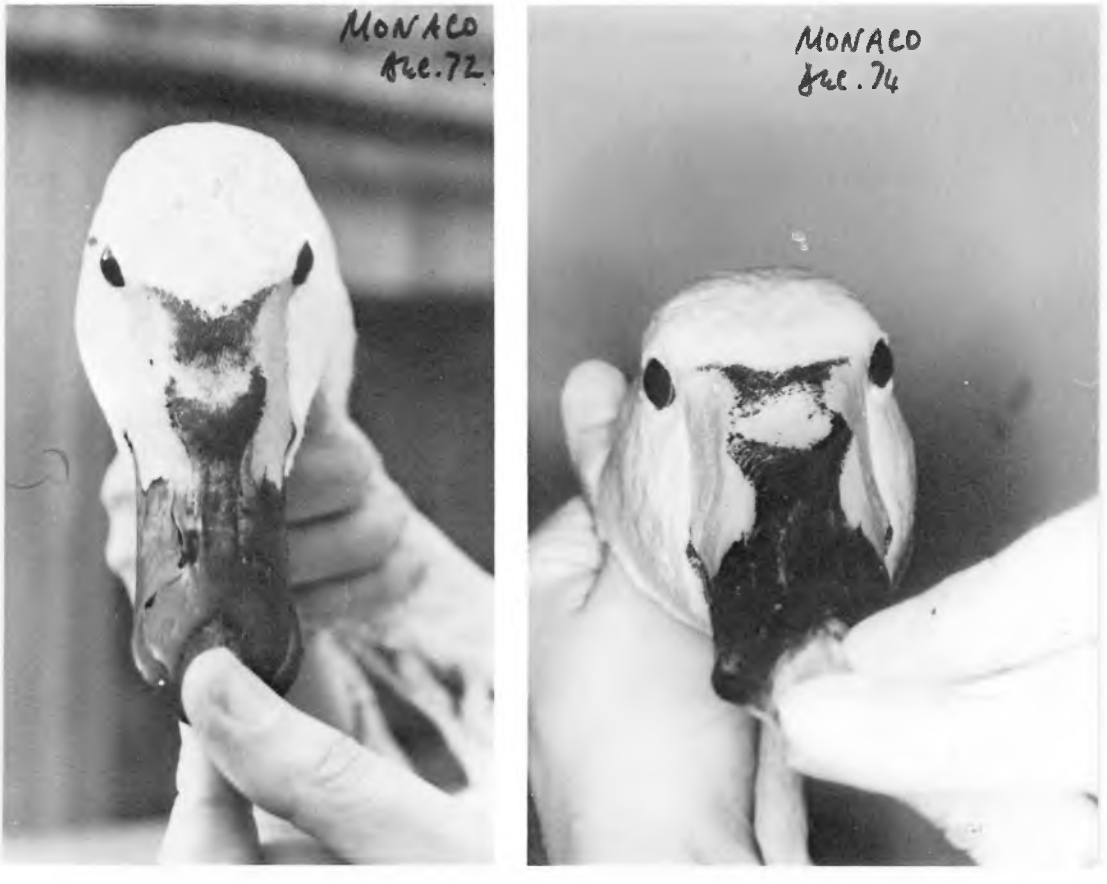
The series of photographs showing both profiles and head-on views was carefully examined by an unprejudiced biologist, Dr Carlo Violani, who had never seen a wild Bewick's Swan. He found no changes in fifteen of the birds. In the other five, four of the changes occurred in the upper part of the culmen. In three, this was from yellow to black, in the fourth from black to yellow. In the fifth bird, the change was only on the right side: light, slightly blurred spots became darker and more definitive.

In all cases the alterations were infinitesimal, and Dr Violani was of the opinion that they did not affect identification.

Bill colour

The bill colour is usually a cadmium yellow but each winter there are a few examples of rather paler shades (Scott 1966). This may indicate that the bird is not in best condition. The yellow on two captive Bewick's Swans became pale several months before they died; indeed, one went quite white in large areas (cf. James). Less common is a really strong orange colour, sometimes on birds that were quite normal in previous winters. This colour variation obviously cannot be used as an identification clue beyond one winter.

Figure 4. **'Monaco'** (a) In his second winter, (b) two years later. (*Philippa Scott*).



A recognition test

In order to assess the reliability of recognition by bill pattern objectively, a test was devised, and 20 people volunteered to help. Their experience with Bewick's Swans' bill patterns fell into two categories: 11 were "experienced", i.e. had looked closely at the swans at Slimbridge (8), or actually become adept at bill pattern recognition (3—termed 'workers'); and 9 were 'inexperienced', i.e. had never seen Bewick's Swan close-to (9). All were asked to familiarize themselves with those areas of the bill where variation occurs through Scott's descriptive and diagrammatic paper (1966).

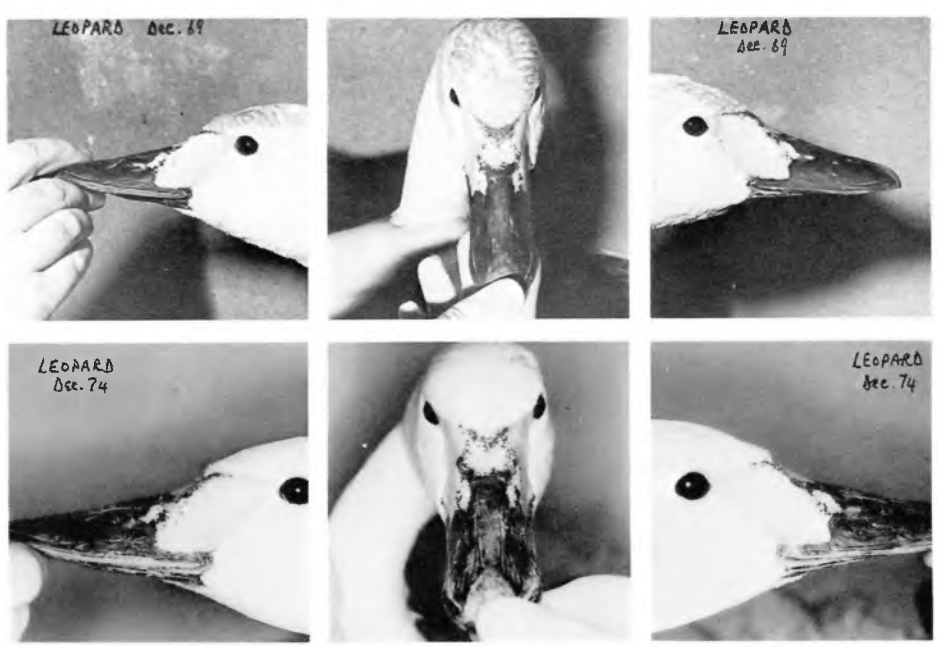
Two sets of photographs of the heads of 52 different Bewick's Swans were assembled. The best photographs were selected quite randomly as to bill type. The first set (A) was taken in the hand when the birds were caught for ringing, and the second set (B) when they were recaptured anytime from one to six winters later. Each set consisted of three photographs of the individual, a left profile, a head-on view and a right profile, fastened side by side (Figure 5). Set A was set out in five randomized rows.

Each subject was tested singly, presented with the pack of set B in a (fixed) randomized order, and asked to work through it, matching the swans with those in set A. The first choice of pair did not have to be final, and if a 'better' match came up, the subject might alter a pairing already made. A time limit of two hours was imposed.

Table 1 shows that subjects, on average, correctly paired 39 photographs, i.e. 75% of the total. However, experienced subjects did significantly better (47 paired) than inexperienced (29 paired), ($p < 0{\cdot}001$). Even when the results of the three swan workers (51 paired) were excluded, the average of the experienced observers (46) was still significantly different from that of the inexperienced ($t = 3{\cdot}73$, $p < 0{\cdot}01$). The range of individual results, and the standard errors, were less in experienced observers, than in inexperienced.

Times taken to complete the test also varied: all the inexperienced subjects took the full two hours, except for one (with 47 correctly paired) who took 35 minutes less. Seven experienced subjects took the two hours, the other four (with 52 correct) taking 110, 90, 55 and 18 minutes. The last two results were those of swan workers, who used a different approach. They were not matching one anonymous bill pattern with another, but, being familiar with the actual swans depicted, identified the swan in set B,

Figure 5. **'Leopard'** (a) In December 1969, (b) five years later. (*Philippa Scott*).



and then looked for that same swan in set A. The third swan worker (49 correct) was not familiar with these particular 52 birds.

The number of subjects correctly matching each swan was also checked, so that assessments could be made of difficulties which might result from (i) the number of years between the photographs, and (ii) distinguishing certain types of bill patterns. Table 2 shows that on average the swans were correctly paired by 15·2 subjects. There was, however, a slight decline in performance as the years between the photographs increased (those with one year interval were correctly paired by 15·8 subjects, with two years by 15·1 and three to six years by 14·2), but these differences were not statistically significant.

Only three swans were not correctly paired by more than half the subjects; all were pennyfaces. Table 2 shows that matching performances on darkies and yellownebs were almost identical, while that on pennyfaces was not as good, although again the differences are not significant.

It may be that yellowneb and darky patterns are more 'straightforward' (i.e. have slightly fewer clues) thus making them easier to match in a test of this sort, or perhaps any small changes in the pattern on the upper culmen were especially obvious in such detailed photographs. It would, however, be misleading to make any statements as to difficulty of bill pattern type, especially as subjects differed as to which they found most difficult. Variation in perception is also indicated in that six subjects saw black patterns on yellow, eight yellow patterns on black, and six 'a black and yellow jigsaw'.

This enters the field of human psychology, which has been pursued by Brown & Lewis (1977). However, the emphasis at Slimbridge was primarily on testing the material, rather than the observers, except as regards the latter's experience. The 'average' observer managed to pair three-quarters of the swans correctly, while experienced observers managed better than 90%. This not only confirms that individual swans can be identified by bill patterns, and that these remain sufficiently stable over a period of years to allow subsequent recognition, but also that experience increases proficiency of the observer.

Discussion

The Slimbridge test was of necessity artificial, and irrelevant factors might have been involved, such as picture contrast and slight differences in the angles at which the head was photographed, which could make matching more difficult. It is, however, very difficult to test numbers of people under field conditions. Bateson (1977) photographed over 100 individual Bewick's Swans at the

Table 1. Number out of 52 swans correctly paired by different subjects.

Subject category	Range	Mean	S.E.	t	Significance level
Experienced subjects (11)	38–52	47	1·650		
Inexperienced subjects (9)	16–47	29	3·751	4·67	0·001
All (20)	16–52	39	2·768		

Table 2. Number of subjects (out of 20) correctly pairing swans according to (a) intervals between first and second photographs and (b) bill pattern type.

		No. of swans in group	No. subjects making correct pairs	S.E.
(a)	No. years interval between 1st and 2nd photographs			
	1	19	15·8	0·424
	2	12	15·1	0·538
	3–6	21	14·2	0·714
	Total	52	15·2	0·334
(b)	Bill pattern type			
	Yellowneb	25	15·4	0·402
	Darky	13	15·5	0·693
	Pennyface	14	14·0	0·895

Wildfowl Trust Refuge at Welney, Norfolk, noting the identity of each as indicated by Dafila K. Scott (DKS), the worker who correctly paired all the swans in the Slimbridge test in 18 minutes. Two weeks later she had to identify 30 swans from slides, and this she was able to do correctly for 29. In another 30 slides which were of inferior quality, she was able to identify 23 correctly. Given identifiable differences in an animal species, however, two weeks is not long to be able to remember them, and the real problem in practical application has been in remembering the individual markings over several years.

To this end a code was devised by Peter Scott: the bill was divided into 13 sections, and for each of these several possible variations (each of which had a reference number) were depicted on a code sheet. Instructions for use were drawn up by Scott and MEE to try to ensure that objective criteria were applied. Every bill pattern drawing could then be coded and filed, subdivided by the code into groups of about ten. The aim of the system was to reduce the potential identities of a swan to a manageable choice, rather than isolate the individual bird entirely. To date it has not been wholly successful, due probably to inability to eliminate subjectivity, or to the effects of different viewing conditions. Unreliable characters may also have been over-weighted. Such a system may be as simple or as complex as desired, and the best balance is difficult to achieve.

Although bill patterning is the major means by which we recognize individual Bewick's Swans, there are other factors: the body size, the shapes of the bill and head, its head carriage, the colours of the side of the lower mandible and underbill. Even the iris can vary in colour, and the amount of yellow around the eye differs considerably, as does the shape of the browline (Scott 1966). Additionally it is often possible to judge by the bird's behaviour whether it is really new, or might be in the files. New birds are nervous of the artificial situation; experienced birds generally swim confidently in to feed close to the buildings on the day they arrive.

The fact that many of the birds stay constant in pairs for many years eases recognition, for there are then twice as many clues. Conversely it must be remembered that a single bird may have been previously recorded as one of a pair.

In the final analysis, trained observers actually identify the swans in the same way as they recognize other humans. The birds are simply 'known' by a subconscious totalling of their individual parts. Therefore small changes that may occur in the pattern of reasonably well known birds do not impair recognition, just as the development of grey hair or wrinkles does not hinder recognition of one's friends. It seems likely that a new bird would rarely be mis-identified as being one that had been recorded before, but some previously recorded swans may not always be recognized on subsequent return. For long-term studies, leg rings readable at a distance are at present undoubtedly the best solution, but in the short term, where close viewing is possible, bill patterns remain invaluable.

Summary

The background to the identification by bill pattern of Bewick's Swans *Cygnus columbianus bewickii* is given, followed by description of bill pattern development up to and following the third winter. A recognition test demonstrated the reliability of identification by bill pattern, even over a period of years, and that experience of the observer increases proficiency. The problems of storing large numbers of bill patterns are discussed, other clues to identification mentioned, and a recommendation is made that at present identification by bill pattern is better for short rather than long-term studies.

References

Acland, C. M. 1923. Notes on Bewick's Swans in Glamorganshire. *Brit. Birds* 17: 63–4.

Bateson, P. P. G. 1977. Testing an observer's ability to identify individual animals. *Anim. Behav.* 25: 247–8.

Brown, J. & Lewis, V. 1977. A laboratory study of individual recognition using Bewick's Swan bill patterns. *Wildfowl* 28: 159–162.

Evans, M. 1970. Wild swans at Slimbridge, 1969–1970. *Wildfowl* 21: 134–6.

Geroudet, P. 1962. L'hivernage des *Cygnus bewickii* sur Le Léman savoyard. Nos Oiseaux 26: 317–19.

Geroudet, P. 1963. Retour des cygnes de Bewick sur Le Léman. Nos Oiseaux 27: 181–2.

Ogilvie, M. A. 1968. The Bewick's Swans, 1967–68. *Wildfowl* 19: 162–4.

Scott, P. 1966. The Bewick's Swans at Slimbridge. *Wildfowl Trust Ann. Rep.* 17: 20–6.

Sermet, E. 1963. Des Cygnes de Bewick à Yverdon. *Nos Oiseaux* 27: 181.

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