

Lead shot in Bewick's Swans

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Introduction

The western population of the Bewick's Swan *Cygnus columbianus bewickii* is supposedly protected by legislation and/or custom (Lampio & Michaelis, 1972) in its breeding area (Arctic U.S.S.R.), in the countries bordering the Baltic which it passes through on migration, and in its wintering area (West Germany, Denmark, the Netherlands, Great Britain and Ireland). The flock of 400-600 Bewick's Swans which winters in the Wildfowl Trust's refuge at Slimbridge, Gloucestershire, has been intensively studied (Scott, 1971) and recently it has been found possible, for the first time, to trap substantial numbers. While the birds were being handled for weighing, measuring, ringing and dye-marking, the opportunity has been taken of X-raying them to detect lead shot in their tissues and so determine whether their protection from shooting has been effective. A preliminary account (Evans *et al.*, 1973) was presented to a symposium on hunting rationalization. The present paper contains the results of three winters of investigation, 1970-71, 1971-72 and 1972-73.

Methods

The swans are restrained in a tailored plastic jacket (Evans & Kear, 1972) and radiographed using a Watson MX1 portable machine, at 65 kilovoltage potential and 15 milliamps, at a focal distance of 52.3 cm, and Kodak R.P./D.X-omat radiographic film 30.5 cm x 38.1 cm. The birds are placed belly-down centrally on the screened film cassette. The head and neck are included in the radiograph by tucking the bill into a flap of the jacket, which is barely visible on the X-ray picture.

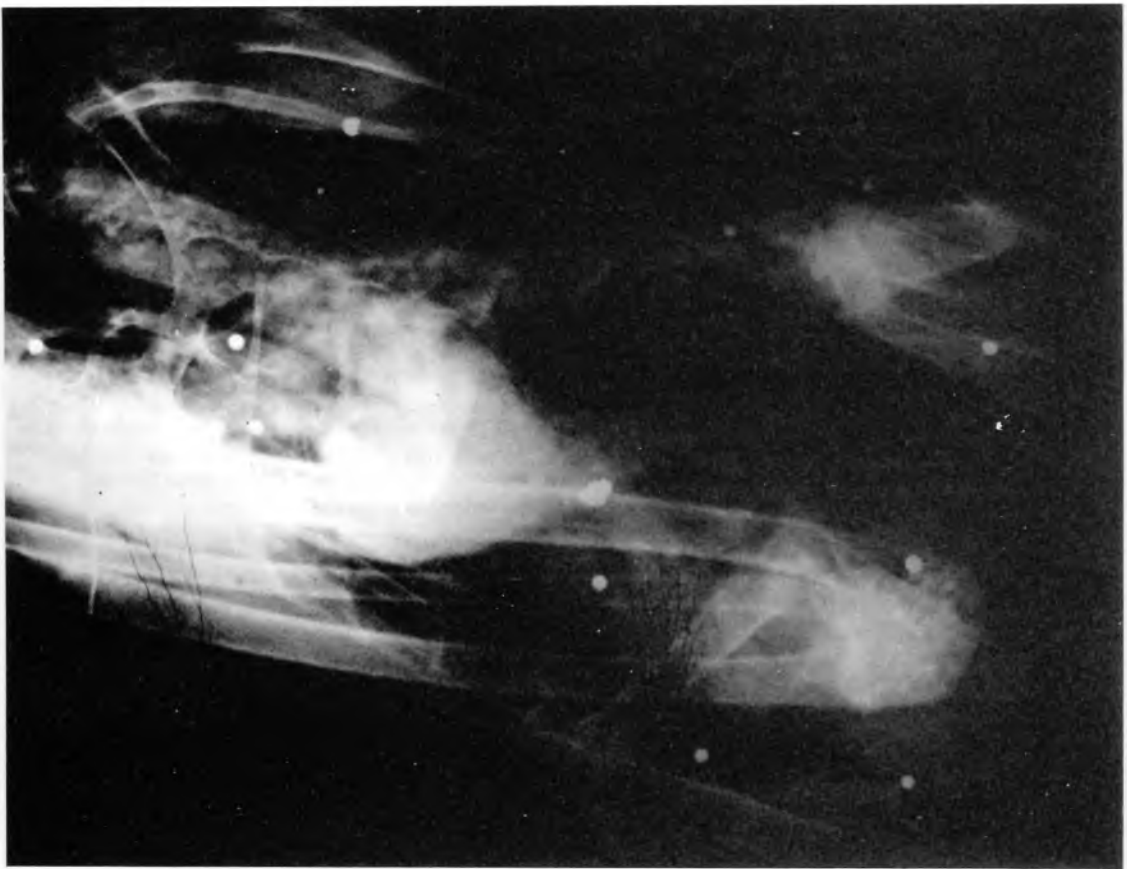
The use of radiographs rather than fluoroscopic examination was decided upon for two reasons. Firstly, any risk of the operators receiving excessive X-ray dosages was removed. Secondly, we were left with a permanent record that could be examined in detail at leisure, or matched with subsequent records if a bird was recaptured. Although the plates are quite expensive, their cost was largely offset by the prolongation of the life of the X-ray tube

because of the short exposure (1.2 sec) needed.

The incidence of lead shot

Of the 272 Bewick's Swans examined after capture at Slimbridge, ninety-two (34%) had lead shot embedded in their body tissues (Figure 1). These shots had been fired at the birds in question without bringing them down (shot too small or fired at too great a range). None of the 272 was found with ingested lead pellets in the gizzard. These would rapidly give rise to lead poisoning. Birds sent in for post-mortem (and not used for the main survey) did indeed include five which had eaten lead shot or fishing weights.

The incidence of shot in the bodies of these protected birds is disconcertingly similar to those reported by the earlier workers in European quarry species, for example, 41% for adult Pink-footed Geese *Anser brachyrhynchus* (Elder, 1955a) and up to 28% for Mallard *Anas platyrhynchos* (Hoffmann, 1965). These studies had demonstrated a relation between body size and pellet incidence, the larger birds presenting more surface area to a burst of pellets and so being more likely to sustain a hit. That this relationship holds good in the present case is indicated by the fact that the adult (3rd winter and older) males were more likely to carry shot than the smaller adult females, i.e. 47% of ninety-seven males, 39% of seventy females. Indeed the difference is greater than would be expected on body size differences (see Scott *et al.*, 1972 and also Table 3 of this paper) and other factors may be involved. However, swans that were freely being treated as hunting quarry would be expected to have a higher proportion carrying pellets than would geese. The really appropriate comparison would be with the western American population of the conspecific Whistling Swan *Cygnus columbianus columbianus* which has recently been put on the shooting list in certain of the United States (Martin, 1970). No X-ray studies are, however, available. It may be noticed in passing that Elder (1955b) advocated such studies to determine the effectiveness of the closed season on this very swan.



N. A. Wood

Figure 1. Radiograph of a Bewick's Swan. This bird (Pie) had no less than twenty-one shot in its body.

The numbers of individual shot found in the birds are shown in Table 1. From this it can be deduced that 37% of the birds carrying shot had only one pellet, and that the average number of pellets per bird was 3.2. This may be compared with the figures Elder (1955b) quotes for the Canada Goose *Branta canadensis*, the nearest quarry species in body size for which we have data, 41% and 2.9.

It is difficult to ascertain the exact size of the shot, since some flatten, distort or shatter on impact. Most of the swans (eighty-five) had the relatively small pellets (No. 4/6) commonly used against duck or pheasants. Goose shot (BB and AAA) were in nine birds, one had an S.S.G. (fox-shot) and one an L.G. (deer). At the other end of the scale six birds (two in the same family) had the small shot (No. 7/9) normally reserved for clay-pigeon targets. Some birds contained more than one size of shot. It is not possible to state that the different shot were received on separate occasions, for shooters sometimes load their own cartridges with different shot sizes. Four birds each con-

tained three different sized shot, and another eleven had two sizes. One bird received for post mortem carried three shot which were probably home-made. They appeared to have been chopped off a length of lead.

Possible causes of variation in the proportion of birds carrying shot

The number of seasons that an individual has been exposed to shooting might be expected to affect its chances of carrying shot. Swans in their first and second winters are easy to age. Thereafter the age classes cannot be distinguished with confidence, even in the hand. Only a small number of adults were of precisely known age, having been ringed in their first two winters. However, the patterns of black and yellow on the bills enable the experts at Slimbridge to recognize individuals as such. Their visits to the pond at Slimbridge having been registered since 1964, it is possible to allocate many of

Table 1. Numbers of pellets carried by ninety-two individual swans

No. of pellets	1	2	3	4	5	6	7	8	9	15	17	...	21
No. of birds	34	22	10	9	5	0	5	2	2	1	1		1

the swans X-rayed to minimal age classes. If they first arrived as adults they were assumed to be then at least in their third winter. How the incidence of pellets varies with age is shown in Table 2.

The young birds travel in the company of their parents to spend their first winter at Slimbridge, and they clearly have not been exposed to much shooting. Some may have been mistaken for geese as Haapanen, Helminen & Suomalainen (1969) suggest in the case of Whooper Swans *Cygnus c. cygnus*. Even the 12% incidence is inflated because three of the seven carrying shot were in one family. Both the parents also had shot in their tissues, so the whole group may have been wounded in the same incident. Further evidence that birds travelling together are likely to be hit at the same time is shown by the X-rays of eighteen pairs known, from their history on the Slimbridge pond, to be well-mated. Both birds in a pair were X-rayed in the same winter. In seven cases both contained shot. In the other pairs, however, only one bird was affected.

The young birds stay with their parents throughout the first winter, barring accidents, and leave with them on the spring migration north-eastwards. At some stage they must separate, for breeding swans do not tolerate last year's offspring in their territory. Probably the young birds amalgamate in flocks of non-breeders in northern U.S.S.R. By the time they arrive back at Slimbridge for their second winter the proportion carrying shot has doubled (to 25%). This is only to be expected in that the relatively inexperienced birds, without parental guidance, are more likely to make the mistake of flying too close to hunters who do not respect the law. There is only a marginal increase in the shot-carrying proportion in their 3rd+ winter, and none in their 4th+ winter.

There is then another over-doubling of the proportion of shot-carrying birds in their 5th+ winter (to 67%). Thereafter there is no indication of further increase with age, so we do not have a steady increment in lead-carrying in relation to the number of migratory journeys completed. Instead there is this great increase at an age when the birds would be expected to have become experienced and wary. Several sojourns in the safety of the Slimbridge refuge might have allayed their suspicion of Man. However, the pond on which they spend much of their time, and are fed, is screened and only one man enters the paddock to scatter grain. If a stranger intrudes they leave in a panic. The swans to be caught are drawn in behind screens by feeding and then driven into a corral. This procedure tends to recapture the most confident swans. Yet of swans which arrived at Slimbridge before 1970-71 (when X-raying commenced), fifteen of thirty-two (47%) were carrying shot when later recaptured, as compared with twenty-three of forty-one (57%) caught for the first time. This at least suggests that Slimbridge-experience was not affecting vulnerability to shooting.

When colour-marking was started in 1970-71 it was also feared that this might selectively expose the birds to the attentions of inquisitive hunters. Yet 79% of the 114 birds which had been dyed returned to Slimbridge the following winter as against 81% of a matched sample of undyed birds of similar age and Slimbridge-experience. Further, of twenty-eight birds X-rayed and dyed and then again X-rayed the following winter, only three had gained shot.

As far as it goes, therefore, the evidence suggests that treatment at Slimbridge does not increase the vulnerability of Bewick's Swans to gunfire. Even on the pond there they become extremely alert if the sounds of shooting are carried into the sanctuary;

Table 2. Variation in lead pellet incidence with age of swan (includes thirty-one birds X-rayed again in subsequent winters)

Winter:	1st	2nd	3rd+	4th+	5th+	6th+	7th+	8th+/ 12th+	All
No. X-rayed	60	55	86	27	21	19	13	22	303
No. with pellets	7	14	27	8	14	11	8	14	103
% with pellets	12	25	31	30	67	58	62	64	34

repeated bangs (even those produced by a carpenter in the buildings) cause them to fly out.

It is permissible therefore to contemplate whether there has been a recent change in the shooting pressure to which the swans are exposed, such that the younger swans are less at risk than had been the older birds in our series. In particular, a ban on spring shooting had been imposed in most of the provinces of the Soviet Union by 1968 (Bogdanov, 1970). The dramatically higher proportion of birds carrying shot in their 5th and later winters may just be coincidental, but it would certainly be interesting to ascertain whether the proportion of swans of that age carrying shot is permanently lowered.

Least it be thought that the English hosts of the Bewick's Swans are only seeking law-breakers in other countries, it must be admitted that hooligans with guns exist not far from Slimbridge. One swan, X-rayed on 8 December 1971, carried six pellets; on 2 February 1972 it had eight. Yet its attendance record showed that it had only been away from the pond at Slimbridge for 7 of the intervening 65 days. The same winter a bird picked up close to the refuge had definitely died of gunshot wounds. A pellet had penetrated the optic nerve; yet only 2 days previously it had been seen on the Slimbridge pond in normal condition.

There have been suggestions that the country of origin of the lead shot could be determined by size, weight or chemical analysis. However, there is not only the difficulty of locating and extracting the shot from the living bird, but it is also a fact that there is a good deal of trade in cartridges between countries even as far apart as the Soviet Union and Britain. Identification of origin would therefore be of little use.

Effect of the shooting on the population and individual

A hunter killing a protected bird is unlikely to report its ring number. We are not, therefore, in a position to gauge the effect of unlawful shooting on the small population of Bewick's Swans which winter in N.W. Europe, estimated to be only about 6,000 birds (Atkinson-Willes, 1972). Yet we know that swans are killed by shooting. A case was mentioned above. Another Slimbridge swan was reported shot in Latvia. Mostly, however, the reports are only of 'found dead' or 'injured'. Again we have a case of a blood-stained swan arriving at Slimbridge without its mate (which had presumably fallen to the same burst of shot). Superficially wounded swans have come in to the Wildfowl Trust's other Bewick's Swan refuge at Welney, Norfolk.

Goose shot and ball could be quite lethal to these small swans and we should not assume that shots from careless or indifferent duck- or pheasant-hunters can be discounted as a cause of death. The smallest shot recorded would have been ineffective, but what a sad commentary on the clay-pigeon shooter(s) who could not resist firing at something live chancing to fly overhead.

Those survivors which were examined by X-ray were not apparently much incommoded by the pellets they carried. One bird, containing two pellets, had a healed fracture of the leg and walked with a limp. Another, also with two pellets, had an atrophied and sightless eye.

An ailing swan loses weight, so the weights of shot and pellet-free birds were compared (Table 3). The differences are small, without statistical significance, and, if anything, the birds with pellets are slightly heavier.

Table 3. Weights of swans carrying pellets compared with pellet-free birds in same catches (includes twenty-nine birds weighed again in subsequent winters)

	Without pellets		With pellets	
	No.	Av. weight (g)	No.	Av. weight (g)
Males				
1st winter	30	5,097	2	6,105
2nd winter	23	5,701	8	5,680
Adults	56	5,960	52	6,249
Females				
1st winter	23	4,913	5	4,746
2nd winter	18	5,177	6	5,220
Adults	49	5,306	29	5,525

Conclusions

It is a distressing reflection on the effectiveness of hunting legislation when a totally protected bird is shown to be exposed to a similar level of shooting pressure as are the quarry species. European hunters do not even have the excuse available to their American counterparts who encounter huntable white geese. The adult Bewick's Swan cannot, even in a poor light, be confused with anything other than another swan; and all the species are protected in any case.

The responsible wildfowlers are as horrified as we are by the unhappy situation revealed by the X-ray camera. But it is clear that there are a lot of irresponsible shooters around, even in what we like to think of as the conservationally advanced countries. Hunter education and stringent tests before the issue of a shotgun licence may be a long-term solution. For the moment, legislation based on the selected protection of scarce species of wildfowl does not seem to be as securely based as had been thought.

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Summary

The totally protected Bewick's Swan *Cygnus columbianus bewickii* population was found by X-ray to have 34% of its individuals carrying shot in their tissues, a proportion not dissimilar to that in quarry species. A good deal of the shot appeared to have been received between the first and second winters. A higher level still was found in adults at least 5 years old. This may reflect changes in shooting regulations in part of the range. The effect of this illegal shooting is ex-

amined. The effectiveness of species by species legislation is questioned.

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