Mortality of Mute Swan progeny in an area of south Staffordshire

A. E. COLEMAN and C. D. T. MINTON

Introduction

Since 1961 various aspects of Mute Swan *Cygnus olor* biology have been studied in a 550 square mile (1,440 sq km) area of south Staffordshire. The area extends 40 kilometres north and 36 kilometres east of National Grid co-ordinates SO 900900. This paper deals with the progeny of breeding pairs within the study area, analyses the causes of mortality and attempts to interpret their effects on survival. Mortality is considered (a) before hatching, (b) before fledging, (c) after fledging. Observations were made between 1961 and 1978 inclusive during which there were 349 records of death of birds ringed as pulli within the study area.

Teams of volunteers cover the entire study area at least four times during the spring to determine the number of breeding and non-breeding pairs. Nesting sites and territories are located and plotted (Coleman & Minton 1979). The hatching success of each breeding pair is determined and family parties are again located in August and September to determine the number of young reared to fledging.

Pulli are ringed on the left leg with a numbered metal BTO ring and on the right leg with a large numbered or lettered yellow Darvic plastic ring. The Darvic ring is large enough to be read at a distance with binoculars, thus enabling resightings of individual birds to be made without having to catch them (Ogilvie 1972).

Initially low numbers of pulli were ringed but techniques improved and greater success is now achieved. Since 1972, with the exception of 1977, over 90% of the cygnets hatched each year in the study area are caught and ringed (Coleman & Minton 1979). Flocks are visited regularly throughout the year and all Darvic sightings are recorded. The number of positive identifications of individual birds has built up to an average of 3,000 per year.

Mortality before hatching

During 1961–1978 inclusive a total of 1,151 first clutches and 92 repeat clutches were recorded. Of the first clutches, 588 (51%) were incubated to full term, hatching at least one cygnet per clutch, 548 failed and the fate of the remaining 15 clutches was unknown. Table 1 analyses the causes of failure of the 548 clutches. Minton (1968) analysed failure in the area from 1961–1967 and during that period nearly 80% of nesting failures were due to predation by humans—mainly boys stealing or breaking eggs. This continues to be the major cause of failure within the study area. One clutch was taken by a badger *Meles meles* and three disappeared without trace, no indication being given of the agent responsible.

Table 1. Causes of failure of 548 Mute Swan first clutches from 1961–1978.

Cause of failure	Agent responsible for failure: Humans	Others	Unknown	Total	%
Stolen or destroyed	373	1	3	377	68·7
Desertions	3	2	5	10	1·8
Killed	9	2	8	19	3·5
Flooded				54	9·9
Infertility				28	5·1
Unknown				60	11·0
Total				548	

Desertions account for few failures and of the five known examples: one was due to interference by a fox *Vulpes vulpes*; two to persistent interference by boys; one to workmen commencing to fill in the gravel pit in which the nest was built; and one to an intruding pair of swans (failed breeders), who drove the pair from their nest and territory.

Of the 19 swans killed during incubation eleven causes are known. One was killed by a car; two as a result of oiling; two flew into wires; three were shot; one was killed by a fox; one was stoned on the nest; and one choked itself on a potato.

Flooding was the second highest cause of failure, particularly for those pairs nesting by rivers and streams, and affected the earliest breeders most frequently. These observations agree with those of Perrins & Reynolds (1967), in the Oxford area. They

found a higher percentage of losses due to flooding and this probably reflects a higher proportion of nest sites along the rivers in the Oxford area. Infertility was also a rare cause of failure, 28 complete clutches failing to hatch.

Second clutches were often laid in the same nest but sometimes a new nest was built on the territory, often in the near vicinity. Forty-two pairs (47·2%), were successful in their second attempt.

Table 2 analyses the causes of failure of the 47 clutches. It is not surprising that 72% of all second clutch failures were due to humans taking eggs since 56 (63%) of the first clutches were stolen—clearly the sites were already very vulnerable to human interference. Three pairs laid a third clutch after their second had also been stolen. Of these, two were successful but the other was again robbed. Repeat clutches were recorded in all years but were not typical.

Table 2. Causes of failure of 47 Mute Swan second clutches from 1961–1978.

Cause of failure	Agent responsible for failure			
	Humans	Others	Unknown	Total
Stolen or destroyed	34	0	0	34
Desertions	0	0	0	0
Killed	0	0	1	1
Flooded				2
Infertility				1
Unknown				9
Total				47

The information above clearly shows that human interference accounts for the vast majority of losses prior to hatching—70·5% of all failures, and in future years it will undoubtedly continue to be the major cause of mortality before hatching. Only 15·1% of losses were positively attributed to sources other than man and one can only speculate on how many of the 11·5% of failures of unknown cause were also due to man's interference.

Minton (1968), noted that when the incubation period of pairs was timed between the Easter and Whitsun bank holidays a higher than average percentage of nesting pairs hatched young—the holiday periods being peak periods of human predatory activity. This continues to be the case within the study area. It is also clear that pairs nesting near to protective humans, or on reserves and parks that are wardened have a far greater chance of survival.

Mortality of pulli before fledging

Table 3 summarizes the pullus mortality data. In the earlier years of the study the number of young hatched was not recorded. An average mortality of 24% is calculated for the period 1966–1978. This

Table 3. Annual hatching and fledging success.

Year	No. pairs hatching young	No. pairs rearing young	Total pulli hatched	Av. brood size at hatching	Total pulli fledged	Av. brood size at fledging	% mortality before fledging	% fledging success
1961	30	23*			75	3·3		
1962	39	39			154	3·9		
1963	33	32			119	3·7		
1964	42	42			125	3·0		
1965	52	49			170	3·5		
1966	37	34	166	4·5	123	3·6	25·9	74·1
1967	32	29	146	4·6	116	4·0	20·5	79·5
1968	34	30	163	4·8	117	3·9	28·2	71·8
1969	24	20	105	4·4	72	3·6	31·4	68·6
1970	33	30	162	4·9	120	4·0	25·9	74·1
1971	32	28	138	4·3	108	3·9	21·7	78·3
1972	37	33	150	4·1	120	3·6	20·0	80·0
1973	34	32	145	4·3	115	3·6	20·6	79·4
1974	43	37*	205	4·8	160	4·3	21·9	78·1
1975	39	34	166	4·3	125	3·7	24·6	75·4
1976	31	25*	123	4·0	96	3·8	22·0	78·0
1977	26	22*	123	4·7	91	4·1	26·0	74·0
1978	32	29	158	4·9	124	4·3	21·5	78·5

* = 1961—4 unknown; 1974—3 unknown; 1976—3 unknown; 1977—1 unknown.

Table 4. Overall brood sizes at hatching of Mute Swans from 1966–1978.

	Brood size at hatching									
	1	2	3	4	5	6	7	8	9	10
Totals	41	42	75	61	72	54	51	28	9	1
	83			208		105			38	
%	19·1%			48·0%		24·2%			8·7%	

figure is far lower than that given by Reynolds (1965), where a mortality of 49·5% was calculated for one season in cygnets up to the age of three months. It is unfortunate that no records are available of the total pulli hatched in this area during 1964 so a direct comparison cannot be made.

From 1966–1978, of the 434 broods hatched 215 (49·5%) were reared without loss, 168 (38·7%) lost part of the brood prior to fledging, and only 44 broods (10·0%) were completely lost. The fate of the remaining 7 broods (1·6%) remains unknown. Brood sizes at hatching ranged from one to ten, with three, four and five being the commonest (Table 4). The brood size varied markedly from year to year (Table 5).

The rearing success (Table 6) tended to decrease with brood size—large broods presenting greater problems of food supply in the initial stages and individual care in the latter stages of rearing. The proportion of broods that lose at least one cygnet is undoubtedly too high since no accurate figures are available for mortality of cygnets that may become separated from their family parties. The average brood size at fledging was 3·7 with a maximum of 4·3 in 1974 and 1978. Minton (1968) calculated that the average brood size at fledging during the period 1961–1967 was 3·5 and this increased to a mean of 3·8 for 1968–1974 and 4·0 for 1975–1978. These figures are also higher than the 3·1 found by Perrins & Reynolds (1967) in the Oxford area. The increase in the average brood size at fledging is accompanied by a reduction in the average number of breeding pairs during the three periods, which were 67·4, 65 and 50 respectively.

It is possible that as the breeding population reduced, pairs were able to avoid poor habitats. Consequently more young fledged per brood. Causes of death of pulli were determined for only a small percentage of the total. Information was obtained not only from the experienced volunteer observers but also from people living or working in the vicinity, though only the most reliable of these sources were utilized. Causes of death, generally in the first few days of life, fell into seven main categories.

Table 5. Annual means and standard deviations of brood sizes at hatching of Mute Swans from 1966–1978.

Year	Annual mean	S.D.
1966	4·5	1·894
1967	4·6	2·154
1968	4·8	2·483
1969	4·4	2·618
1970	4·9	1·665
1971	4·3	2·131
1972	4·1	2·210
1973	4·3	2·050
1974	4·8	2·213
1975	4·3	2·010
1976	4·0	2·149
1977	4·7	2·108
1978	4·9	1·933

Table 6. Analysis of rearing success within brood sizes of Mute Swans from 1966–1978.

Brood size	% rearing complete broods	% losing at least 1 cygnet	% losing complete broods
1	66	0	33
2	71	13	16
3	52	40	8
4	43	46	11
5	51	45	4
6	44	53	3
7	39	53	8
8	39	54	7
9	44	56	0
10	0	100	0

(a) Exposure/starvation:
accounted for the majority.
(b) Pike *Esox lucius*:
in 1961 on a gravel pit near Burton-on-Trent, Staffs, five of a brood of six cygnets were taken within a week of hatching.
(c) Fish hooks:
most cygnets were observed to be very retarded physically prior to death and abscesses were often present where the hook had penetrated.
(d) Weirs:
there were many cases of cygnets being swept over weirs and drowned.
(e) Vandals:
cygnets were shot or stoned to death.
(f) Foxes:
three cases of foxes taking complete broods of cygnets.
(g) Movements:
many deaths occurred as a result of parents moving their broods from their hatching site, often to a considerable distance.

Minton (1968) recorded one extreme example in 1966 when a pair which had hatched young on a remote and rather unsuitable pond, flew off after about a week and left their young to die, probably because they were unable to lead their young to more suitable waters.

More recently in 1974, a brood of five cygnets was hatched on a secluded pool. Within a week of hatching, the parents attempted to move them to the river over a kilometre away. The journey involved crossing very rough ground with deep ditches and not one cygnet survived. In 1975 the same pair again nested here but prior to their arrival the pool had been completely fenced in. Within a week of hatching their seven young, the parents flew to the river leaving their cygnets. Over the next week the parents returned frequently but never stayed long. The female and the entire brood were caught and transported to the river, five of the brood being subsequently reared successfully. It is difficult to see why these parents should need to move their young from a large pool, rich in food and with the initial security for incubation.

Another pair for the past five years have taken their cygnets to another pool about a kilometre away within a week of hatching. The journey involves climbing a very steep bank, crossing a major road and has always resulted in the loss of part of the brood.

The 76% survival of cygnets to fledging is a marked improvement on the 51·0% hatching success and this is undoubtedly due to diminished interference by man.

Mortality of fledged cygnets hatched within the study area

This analysis is based on re-traps, controls and Darvic sightings together with 349 records of death over the period of the study. Table 7 shows the numbers of live birds recorded and the reported deaths for each year from 1961–1977. A swan is regarded as being in its first year up to August of the year after hatching, the data being complete up to August 1978. A large number of birds disappear each year and are not recorded alive or dead in subsequent years. This may be due to birds having died and their bodies remaining

Table 7. Numbers of live birds recorded and reported deaths of Mute Swans fledged and ringed from 1961–1977.

	Total	First year			Second year			Third year			Fourth year			Fifth year		
	pulli		Not			Not			Not			Not			Not	
Year	ringed	Dead	known	Alive	Dead	known	Alive	Dead	known	Alive	Dead	known	Alive	Dead	known	Alive
1961	24	2	19	3	0	2	1	0	0	1	0	0	1	0	0	1
1962	97	11	53	33	4	3	26	5	3	18	3	2	13	0	0	13
1963	48	4	30	14	4	2	8	3	0	5	1	0	4	0	0	4
1964	79	5	43	31	10	8	13	3	2	8	1	0	7	1	0	6
1965	27	5	10	12	3	2	7	1	2	4	1	0	3	1	0	2
1966	47	7	17	23	1	6	16	4	5	7	2	1	4	0	0	4
1967	87	5	47	35	8	4	23	2	3	18	2	0	16	1	1	14
1968	61	5	32	24	0	2	22	1	2	19	2	1	16	0	3	13
1969	56	7	28	21	4	0	17	0	0	17	1	1	15	1	2	12
1970	99	5	47	47	7	1	39	3	6	30	0	8	22	6	1	15
1971	97	11	46	40	4	7	29	2	5	22	6	0	16	5	1	10
1972	109	12	47	50	10	12	28	12	2	14	1	2	11	3	1	7
1973	109	13	50	46	11	7	28	3	9	16	1	6	9	1	0	8
1974	153	15	69	69	6	15	48	7	12	29	4	1	24			
1975	124	13	41	70	3	20	47	5	6	36						
1976	90	12	42	36	3	10	23									
1977	68	6	47	15												

undetected or they may have moved outside the area. The percentage arrived at here is therefore for maximum mortality and minimum survival, derived from positive records only.

From 1961–1977 the average survival of birds in their first year of life was 41·4%. Of the birds that survived the first year 67·7% survived the second year and similarly 69·3%, 77·4% and 79·5% survived the third, fourth and fifth years respectively. It is quite clear that if a bird survives its first year of life the chances of further survival become very much greater.

Analysis of the 349 records of death of birds ringed as pulli in the area (Figure 1), excluding deaths due to oiling, also shows that the highest number of deaths occurred during the first year of life.

Analysis of the causes of death of the 138 birds who died in their first year shows that 60 (43·5%) were due to flying into overhead wires, 7 were due to collisions with vehicles, 3 were killed by foxes, 2 were due to vandals, 1 was killed by other swans, 10 were oiled, 1 swallowed a plastic bag and starved to death and 54 were due to unknown causes. Of the known causes of death a total of 95·2% was therefore positively attributed to the agency of man and only 4·8% was definitely due to agencies other than man.

Figure 2 shows the months in which swans who died during their first year of life were reported dead. Again deaths due to oiling are excluded. The mortality peaks shown for October and March mirror those found by Perrins & Reynolds (1967) in their analysis of mortality at all ages in the Oxford area from 1960–1966. They suggested that the mortality peaks were reflections of the greater amounts of movement at these times.

By October most pulli are fledged and first appear in the wintering flocks chiefly in October and November. The influx continues throughout December and in January peak numbers of cygnets are recorded in the wintering flocks.

Mortality figures for September–December inclusive (peak periods of cygnet movements into the flocks), show that 56 (43·7%) of the total recorded deaths occurred during this period, and of these 33 (58·9%) were due to collisions with overhead wires. Doubtless some of the 16 deaths (28·6%) of unknown cause are also due to overhead wires. Of the remainder 2 were killed by foxes, 2 by vandals and 3 by vehicles.

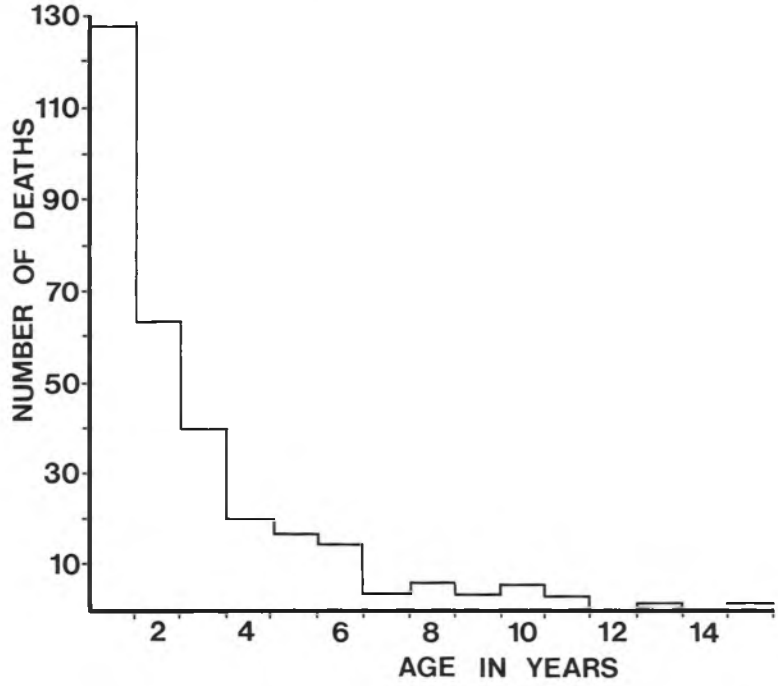

Figure 1. Total recorded deaths of birds (excluding those due to oiling) ringed as pulli within the study area.

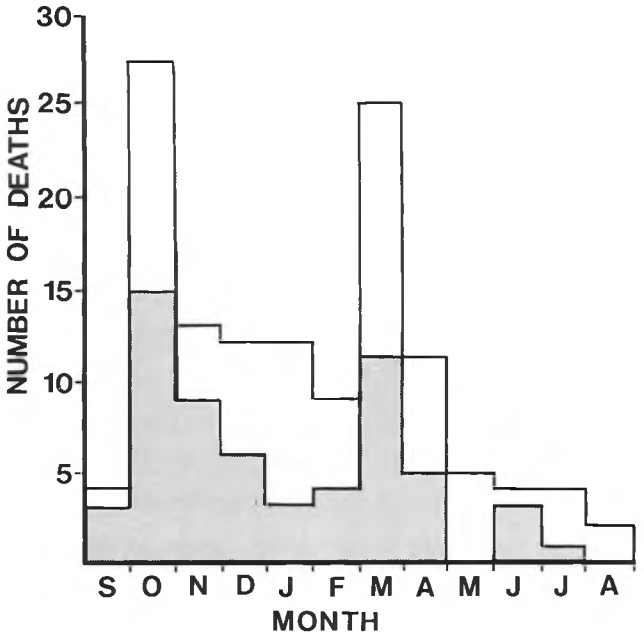

Figure 2. Deaths per month of birds ringed as pulli and dying during their first year (excluding deaths due to olling). Deaths due to overhead wires are shown shaded.

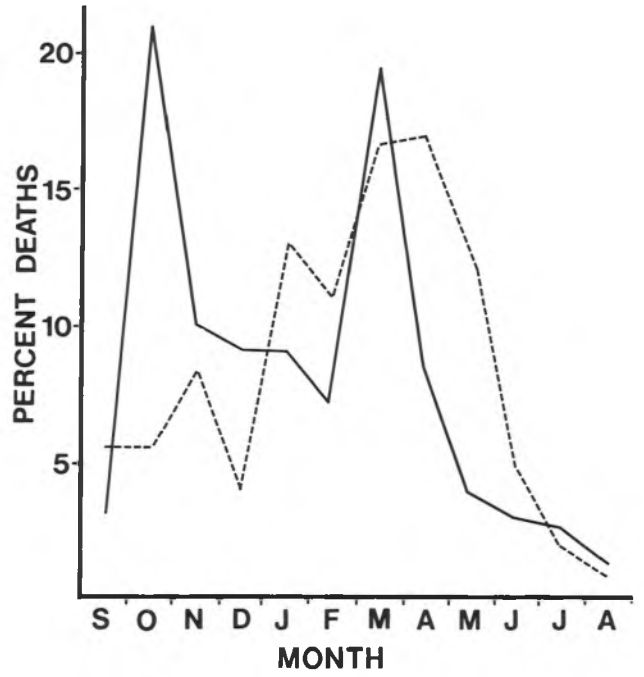

Figure 3. Deaths per month of first year birds (solid line) and birds aged two years and over (dotted line) expressed as a percentage of the total deaths for each age group (excluding deaths due to oiling).

Of the deaths recorded for September–December, 71·4% occurred within 3 kilometres of the natal site, suggesting that these casualities occurred during the first few flights made by cygnets.

March reflects another peak period of movement with 19·5% of the total deaths; of these 44·0% were due to collisions with overhead wires. The March peak is difficult to interpret. Minton (1971) noted that by April most of the older birds and a proportion of the three and even of the two-year old birds had paired and moved out of the flocks to take up territories. It is possible that the onset of breeding activity coupled with the increased hours of daylight stimulate activity in first-year birds also, resulting in movement and hence the March mortality peak.

The comparatively few records of death for January–February suggest a period of restricted activity when the birds are in the wintering flocks. The April–August records show a gradual decline in mortality as the birds enter and remain within the pre-moulting flocks. Figure 3 compares the mortality figures for 174 birds in their second and later years with that of 128 first-year birds. No October peak occurs in the older birds but there is a late March–April peak, believed to be associated with breeding activity.

Mortality figures for March–April inclusive show that 59 (33·9%) of the total recorded deaths for birds aged two and over occurred during this two month period. Of these 22 (37·3%) were due to collisions with overhead wires and 29 were of unknown cause. Of the remainder three were shot, two died of lead poisoning, one was killed by a dog and two by foxes.

The lack of an October mortality peak for older birds may suggest that during this period they move along established routes, which are safe, to known flocks with little risk of accident, whereas in the spring they are searching for breeding sites and this involves flying over unfamiliar ground and the risk of death due to collisions with obstacles increases.

Oiling

There were two major oiling incidents at Burton-on-Trent in 1966 when 85 birds died and at Tamworth in 1974 when 75 birds were killed. In both cases non-breeding flocks were involved. Clearly if spillages on this scale were to become more frequent the effect on the population of swans in the area would be disastrous since the young flock birds represent the nucleus of the breeding population for the future.

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Summary

Mortality of Mute Swan *Cygnus olor* progeny has been studied since 1961 in a 550 square mile (1,440 sq km) area of south Staffordshire. Nearly half of all clutches were stolen by humans—man's interference being the major cause of mortality before hatching. Rearing success was high, approximately 50% of the broods fledged without loss. The highest mortality after fledging occurred during the first year of life with peak periods in both October and March. Overhead wires were the commonest cause of known death. Birds in their second and later years show mortality peaks between January and April.

References

Coleman, A. E. & Minton, C. D. T. 1979. Pairing and breeding of Mute Swans in relation to natal area. *Wildfowl* 30: 27–30.

Minton, C. D. T. 1968. Pairing and breeding of Mute Swans. *Wildfowl* 19: 41–60.

Minton, C. D. T. 1971. Mute Swan flocks. *Wildfowl* 22: 71–88.

Ogilvie, M. A. 1972. Large numbered leg bands for individual identification of Swans. *J. Wildl. Mgmt.* 36: 1261–5.

Perrins, C. M. & Reynolds, C. M. 1967. *Wildfowl Trust Ann. Rep.* 18: 74–84.

Reynolds, C. M. 1965. The survival of Mute Swan cygnets. *Bird Study* 12: 128–9.

A. E. Coleman, 67 Park Lane, Bonehill, Tamworth, Staffs.

Dr C. D. T. Minton, c/o I.M.I. Australia, P.O. Box 4572, 148, Lonsdale St., Melbourne, Victoria 3001, Australia.