Population changes and mortality of the Mute Swan in Britain

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Summary

An index based on winter counts shows that the population of the Mute Swan in Britain underwent a 25% decline between the years 1960-61 and 1964-65, following a peak in 1959-60. In the last three years the numbers have remained constant in the country as a whole, though an increase has taken place in the north and a decrease in the midlands and west. There is no migration and little movement of swans other than following watercourses. The average annual mortality for swans ringed when under one year old, excluding recoveries in year of ringing, is 40.5%, and for birds ringed when over one year 38.5%. The cold weather in the winters of 1962 and 1963 increased both mortality and recovery rates, but mortality was lower than average in 1963-64. There is possibly greater survival in the third and fourth years of life than in the first two. Overhead wires are responsible for over 44% of Mute Swan recoveries where the cause of death is known: young birds are no more vulnerable to this hazard than older ones. Other causes of death include oiling, disease, cold weather, shooting and fighting.

Introduction

It is only in the last ten years that the Mute Swan *Cygnus olor* has been subjected to extensive scientific study in Britain. With its history obscured by centuries of semi-domesticity and with the belief that all swans belonged to the Crown or to the Livery Companies still widespread, most ornithologists tended, like the general public, to regard the Mute Swan as a tame bird of park lakes and urban rivers whose only claims to fame were fidelity and long life.

The first complete census of the Mute Swan in Britain, organised by the British Trust for Ornithology, was made in the summer of 1955, with a partial repeat the following year. Campbell (1960) gave the results of this census and estimated the total population of England, Wales and Scotland to be between 18,000 and 19,000 birds, with evidence that it was increasing. Further reports of increases led to a second census in 1961. The Wildfowl Trust, co-operating with the British Trust for Ornithology, conducted a ground and aerial survey in eighteen counties that the earlier study had shown to be the most populous. This partial census revealed (Eltringham 1963) that the population had reached a peak in 1959 and had begun to decline. As well as the summer counts, Eltringham used the winter counts of swans, available in the files of the National Wildfowl Count Scheme, to produce a winter index of population which could readily be continued in succeeding years. The first section of the present paper brings that winter index up-to-date and examines the recent trends.

In 1960, as part of the renewed investigation, ringing was begun on a large scale. The ringing of Mute Swans had previously been handicapped by the lack of a really suitable ring. A new, stronger and longer-lasting ring was introduced that year but its price discouraged many ringers. The Wildfowl Trust, therefore, undertook to supply rings free and provided a massive boost. Up to the end of 1959 less than 1,000 Mute Swans had been marked, by the end of 1965 over 14,000. In 1963 it was estimated that in the south of England about one in four birds were ringed and in some areas the proportion has approached 100% The recovery data from this mass of ringing is of a very recent character, but thanks to a recovery rate higher than expected there is a very considerable volume of recoveries already available. These provide the material for the other three sections of this paper, on movements, mortality and causes of death.

Population changes as shown by winter counts

Eltringham (1963) used indices to compare the winter counts of Mute Swans from year to year. Under the National Wildfowl Count scheme, bird-watchers make a count on their local water in the middle of each month from September to March. By pairing the monthly counts in one winter with the monthly counts on the same water in any other winter, it is possible to calculate a ratio between the two years. Eltringham designated a "Master" season with which all other seasons were compared. The level of population in the Master season was equated to an arbitrary 100. The annual indices were then built up from counts on about 300 waters throughout Britain.

One modification of the above method has been introduced which enables a rather larger sample to be incorporated.

Although the Master season was selected so that it included the maximum number of places counted, inevitably there are a number which were for some reason missed out. Although counts may be available for these places in other years, they could not be compared with the Master season and therefore were excluded from the indices. To overcome this restriction a single Master season has not been used in the present analysis, but each winter is compared directly with the one preceding it. The resultant ratios are then adjusted to a suitable base line. Similarly, counts which have only started in the last few years can be included. Using this process the sample size available for the indices has been increased to over 600 waters carrying up to 10,000 birds. It also avoids the fall-off in the number of pairings, and thus the total number of swans available, the further the season is away from a fixed Master season. The indices arrived at by the two methods differ only slightly, but the new method has the advantage of representing a larger proportion of the total population.

The indices probably reflect changes in the non-breeding section of the population more accurately than in the breeding part. Almost all the large wintering flocks in the country are covered by the National Wildfowl Count Scheme, together with a great many regular small flocks. Although many resident pairs are counted, large parts of the normal Mute Swan breeding habitat, namely stretches of river and canal, are not included because they do not hold the ducks at which the count scheme is aimed. However, breeding success in the previous summer is probably reflected in each winter's index because most cygnets leave their parents during the winter and join a non-breeding flock.

The annual indices for Britain from 1954-55 to 1965-66 are shown in Table I and Figure 1. The population increase and subsequent levelling out noted by Eltringham has been followed by a sharp decrease of about 25% and then a second levelling out for the past three seasons. The decrease is largely attributable to the cold winters of 1962 and 1963. The effects were very marked and further evidence will be given in the section on mortality. Another probable cause is the high proportion of birds dying from hitting overhead wires and other obstructions, both of which have been increasing in number and extent in recent years. This too will be dealt with in a later section.

Figure 2 shows the regional variations within the national picture over the last six seasons. Variations before this were only slight and no trends were apparent. Scotland and northern England south to Yorkshire and Lancashire comprise the

Table I. Annual indices for Mute Swans in winter in Britain, based on the National Wildfowl Counts.

Winter	*No. of comparisons made*	*No. of swans counted* *Slave (= Col. 1)*	*Master (= Col. 1 less one year)*	*Ratio*	*Index related to 1957-58 = 100*
1954-55	—	—	—	—	76
1955-56	1450	19,386	15,358	126	96
1956-57	1810	24,096	22,314	108	103
1957-58	1853	23,565	24,347	97	100
1958-59	1912	26,392	25,562	103	103
1959-60	1797	23,642	23,182	102	105
1960-61	1871	23,892	25,813	93	98
1961-62	1846	22,409	22,635	99	96
1962-63	1811	19,239	22,451	86	83
1963-64	1761	18,984	20,296	94	77
1964-65	1600	20,159	19,753	102	79
1965-66	1556	20,743	21,089	98	78

Note: The reduced sample for 1955-56 is because the previous season, here being used as the "Master", was the first one in which Mute Swans were included in the National Wildfowl Count Scheme and the recording of them was not made universal until the next year. The gradual reduction apparent over the last four seasons of the run is partly a reflection of the reduced population because waters from which swans have entirely disappeared are not included after two blank seasons, and partly due to the dropping from the count scheme, which is primarily for recording the numbers of ducks, of those waters which carry only a very few of the latter plus small numbers of swans.

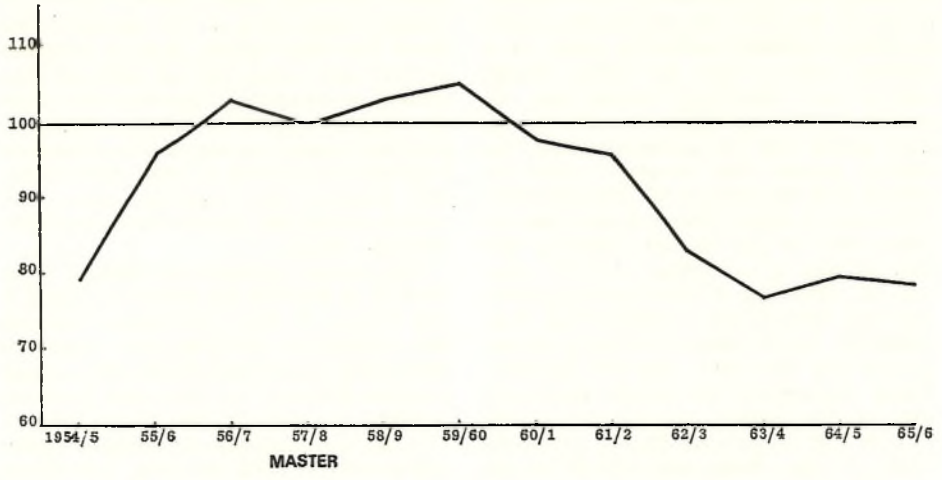

Figure 1. National indices for the Mute Swan in Britain, 1954-55 to 1965-66.

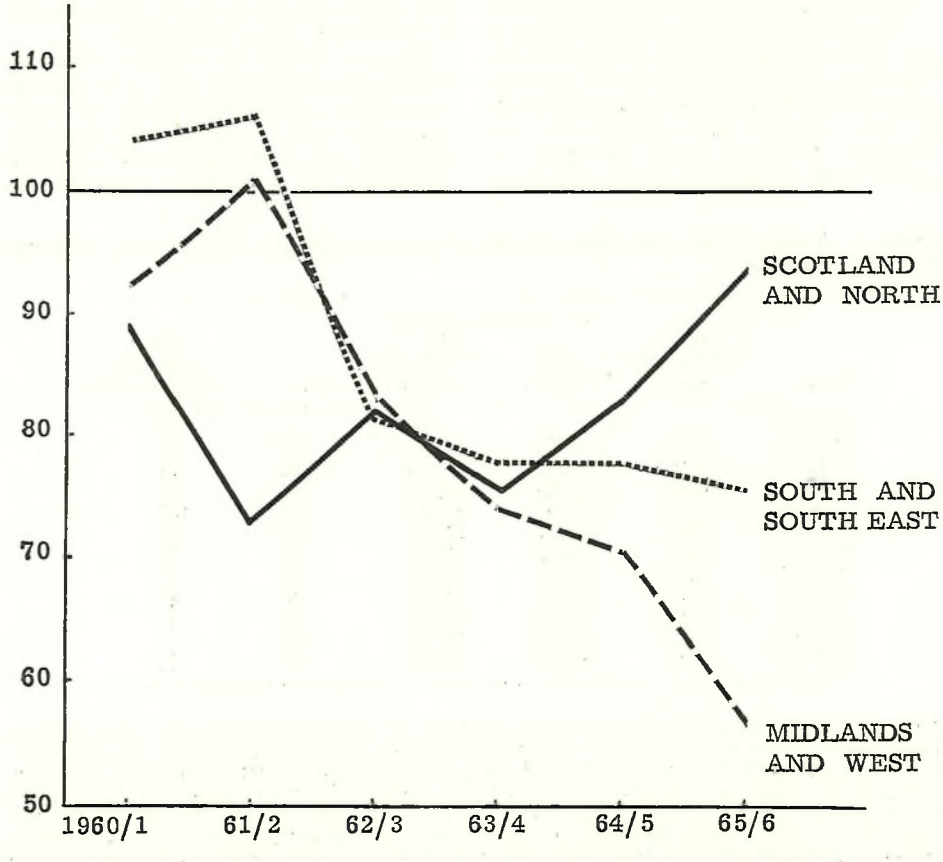

Figure 2. Regional indices for the Mute Swan in Britain, 1960-61 to 1961-62.

first region, which contains about 35% of the birds covered by the winter counts; the Midlands, Wales and the south-west counties form the second, holding about 20%; the south coastal counties from Dorset eastwards, the Home counties and East Anglia north to Lincolnshire are the third with 45%. The ringing evidence considered later indicates that less than 2.5% of birds had crossed a boundary between any two of these regions during the six years.

The regional variations shown in Figure 2 are most marked in 1961-62 and in 1964-65 and 1965-66. The index for Scotland and the north of England shows a sharp drop in 1961-62 but a slight rise in 1962-63 when the other regions had great reductions. In 1961-62 Scotland suffered from severe weather for most of January and February while the rest of Britain had just a short, though very cold, spell at the beginning of January. In 1962-63, while the south suffered its worst winter of the century, Scotland, at any rate, had no worse weather than the previous year, and with much less snow in some areas. Although this is less true of Yorkshire and Lancashire, these counties only contributed about 10% to the regional index. Thus for the two winters the regional indices appear to reflect the relative severity of the weather.

The recent increase in the index for the north and the sharp drop in that for the Midlands and west are rather baffling. Just as the reasons for the country-wide trends between 1955 and 1961 remain obscure, so do these differences in regional levels, with the national index stationary. Scotland and the north may have recouped the losses sustained in the hard winters. The birds in the south and east have not managed such a recovery, perhaps because of poor breeding success, but are maintaining a steady lower level. The drop in the Midlands and west, which is nearly comparable to that sustained in the hard winters may be partly explained by a series of poor breeding years.

Movements of ringed Mute Swans

Ringing of Mute Swans in the last six years had produced 2,156 recoveries by 1966. Of these 1,513 (70.2%) had travelled less than ten miles from the place of ringing. The other 643 birds had moved as follows:

10 - 20 miles	385	(17.9%)
21 - 30 miles	125	(5.8%)
31 - 50 miles	87	(4.0%)
over 50 miles	46	(2.1%)

In 423 of the 643 recoveries the place of ringing and that of recovery were situated on the same river or canal. A further 101 birds moved between two places on the coast, and only 119 (18.5%) had crossed a watershed between two river systems. The suggestion is that nearly all journeys made by Mute Swans in Britain are confined to routes following watercourses.

The recaptures of ringed birds give a very similar pattern of rapidly decreasing numbers with increasing distance. However, because the reporting of local recaptures by ringers is known to be far from complete, it has not been possible to treat them in a systematic way in this investigation.

Since so little movement within the country is shown it is not surprising that there are no regular migrations overseas of British birds. Small influxes of foreign birds into south-east England have occurred during periods of very severe weather (Harrison and Ogilvie 1967).

Mortality of Mute Swans estimated from ringing results

Ringing of Mute Swans reached worthwhile annual totals during a period of population decline and much of the data is of such a recent nature that its use for mortality calculations is subject to severe limitations. There is the added complication that two spells of hard weather, in early 1962 and 1963 undoubtedly resulted in markedly different mortality in those years. However, it is worth applying Haldane's (1955) formula to discover the average mortality that has occurred over the six year period both for the birds ringed as juveniles and for those ringed at one year old or older. It is unfortunate that ageing Mute Swans after the second autumn of their life is an uncertain business. For the purposes of the analysis the juvenile class has been restricted to those ringed as juveniles or as first year birds before the 30th June in the summer following their rearing. This naturally means that the "adult" class must include a proportion of birds in their second and third years which may have differing mortalities from older birds.

Tables II and III set out the recovery data for birds ringed, respectively, under and over one year of age. The ringing periods run from 1st July to 30th June. The surprising result is obtained that the mortality of the first year birds is only slightly higher than that for older birds, and the difference is not significant. In other ringing studies birds in their first year have invariably been shown to be

more vulnerable than older ones. Indeed on all counts this is to be expected. In the present study a bias is introduced in that swans cannot be ringed (because the leg is too small) until about three months old. The known high mortality of young cygnets (Reynolds 1965, Eltringham 1966) is therefore not reflected in the present results. Furthermore it is probable that the proportion of non-breeders in the present sample is high, since they form the large flocks on which ringers concentrate to get the best return for their expenditure of effort. The more detailed study of Perrins and Reynolds (1967) has shown that mortality for breeding birds was about 20% whereas for non-breeding immatures the figure was about 40%, similar to the present results.

As pointed out at the beginning of this section, there are a number of reasons which prohibit a detailed statistical treatment of the recovery data at present. However, although this will not be possible for another five or ten years, there are already some points of interest concerning differences of time-specific and age-specific mortality which can be extracted from the recovery series given in Tables II and III.

Are there any significant variations between the mortality in different seasons? Any recovery series may be considered as the resultant of three factors—a constant mortality-rate, a reporting factor and an "annual factor" which may modify one or both of the others. In most calculations of mortality based on recoveries it has been usual to make the assumption that the likelihood of a ring being reported when found does not vary importantly from year to year or from place to place. The validity of this assumption in the case of the Mute Swan has yet to be verified. Supposing it to be justified, a model for the recovery series can be constructed in which successive terms in the series for birds ringed just prior to year 0 are proportional to k_0d, k_1ds, k_2ds^2, k_3ds^3 . . . , where k represents an annual factor, d the (constant) death rate and s ($= 1-d$) the constant survival rate. Proceeding in this way for the six year-class samples a table of the expected numbers of recoveries in the years $n = 0, 1, 2, \ldots$ can be compiled, and compared with the numbers actually obtained.

Table II. Mortality of Mute Swans ringed when under one year old. The ringing and recovery periods run from 1st July to 30th June, and recoveries in the same period as that of ringing are omitted.

Ringing periods	*Survival after first 1st July after ringing, in periods*						
	1	2	3	4	5	6	total
7/1959 - 6/1960	7	4	7	1	1	2	22
7/1960 - 6/1961	55	34	17	11	11		128
7/1961 - 6/1962	65	27	18	11			121
7/1962 - 6/1963	57	40	13				110
7/1963 - 6/1964	44	30					74
7/1964 - 6/1965	59						59
totals	287	135	55	23	12	2	514

Average annual mortality = 40.5± 2.86%

Table III. Mortality of Mute Swans ringed when over one year old.

Ringing periods	*Survival after first 1st July after ringing, in periods*						
	1	2	3	4	5	6	total
7/1959 - 6/1960	39	23	32	4	0	6	104
7/1960 - 6/1961	122	92	32	30	20		296
7/1961 - 6/1962	152	69	42	42			305
7/1962 - 6/1963	103	60	45				208
7/1962 - 6/1964	45	34					79
7/1964 - 6/1965	41						41
totals	502	278	151	76	20	6	1033

Average annual mortality = 38.5± 1.84%

Since the calculations of $\hat{s}$ for the data of Tables II and III separately lead to very similar values, it seems best to increase the sample size by combining the two tables yielding $\hat{s} = 61.8 \pm 2.2\%$. Table IV sets out the expected seasonal recovery totals using the procedure outlined above. Only two of the calculated seasonal survival rates depart importantly from the mean value for all years. In 1962-63 survival was lower (54.4%) and in 1963-64 it was higher (66.8%).

Variations in survival with age can be investigated by an analogous procedure. They used the number of recoveries in the hard winter period of birds ringed the previous year, as a proportion of the total number ringed that year. Extending this method the recovery rates have been calculated for three-monthly periods for swans ringed in each year from 1960-61 to 1964-65. These rates range from 5.0% in periods immediately after ringing down to 0.2% in the periods four or more years after ringing. Table VI sets out the sums of the first and second year recovery rates in each quarter for all age-classes.

When considering the effect of the 1962-63 hard winter on the Mute Swans of England, Boyd and Ogilvie (1964) showed that some differential mortalities could be demonstrated, when the data are limited, by the use of recovery rates.

Table IV. Seasonal survival of Mute Swans, 1960-61 to 1965-66.

seasons	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	*total*
recoveries reported	46	204	382	310	291	314	1547
recoveries expected	50.9	209.5	320.3	357.1	314.5	294.5	1547
reported/expected (= annual factor)	0.91	0.97	1.19	0.87	0.92	1.07	
seasonal survival %	65.4	62.8	54.4	66.8	64.7	58.3	$\hat{s} = 61.8\%$

Table V. Age-specific survival of Mute Swans ringed when under one year old.

	age (years after first 1st July) 1	2	3	4	5	6	*total*
recoveries reported	287	135	55	23	12	2	514
recoveries expected	273.4	137.9	65.0	26.7	9.9	0.8	514
age-factor	1.05	0.98	0.85	0.86	1.21	(2.5)	
age-specific survival %	59.9	62.5	67.5	67.2	53.8	47	

The recoveries of birds of known age (given in Table II) can be compared with those expected from a model incorporating the seasonal survival rates and age-specific survival rates a_n ($n = 1, 2, 3, \ldots$). This gives the results shown in Table V.

The most striking result is the apparent falling-off in survival in the fifth and sixth years. This is probably nonsense due to the relatively small numbers of marked birds that have so far been at risk for more than five years or, perhaps, to ring loss, and a correct assessment cannot be obtained for several years yet. Of much greater importance at present is the indication, from the estimated rates in the first four years, that survival in the third and fourth years of life may be somewhat greater than in the first and second, though the differences are small enough to be negligible for many purposes.

Table VI. Sums of first and second year recovery rates in three-monthly periods for Mute Swans ringed in Britain between 1960 and 1965.

	Recovery periods			
Recovery year	*Jul - Sep*	*Oct - Dec*	*Jan - Mar*	*Apr - Jun*
1960-61	1.1	2.1	2.4	1.4
1961-62	1.6	3.2	6.1	3.6
1962-63	2.3	4.0	7.6	3.0
1963-64	1.4	2.7	4.5	3.2
1964-65	1.7	2.0	4.7	2.8
means	1.6	2.8	5.1	2.8

The effect of the severe weather at the beginning of 1963 is clear. The previous winter's cold spell is also reflected, though less markedly, in higher than average rates both in the last quarter of 1961 and the first of 1962. Boyd and Ogilvie *(loc. cit.)* found that losses in England in the first quarter of 1961 were two-thirds and one-half those in the same periods of 1962 and 1963 respectively. The proportionately higher losses in 1962 shown in the table are probably because of the inclusion of Scottish-ringed birds. It is considered that the rates in the winters of 1963-64 and 1964-65 are more normal than those for 1960-61, which may be depressed because a number of birds ringed in 1960 carried the old-style ring which had a slightly shorter life than the later model.

The table also gives some indication of the incidence of mortality through the year, with the concentration in the winter quarter.

Four age-groups are investigated: birds ringed and recovered in their first year of life; birds recovered in their second year; birds in their third year; and all others. This last grouping includes birds dying when aged over three years, and all those whose age at ringing was not known.

Overhead wires

This is the predominant reported cause of death. The mileage of overhead wires and cables increases every year and the growing tendency, welcome in other ways, to run major power lines along valley bottoms rather than on the hills brings them more into the habitat and flight-lines of swans. Harrison (1963) reported 21 swans killed in two months by a quarter-mile stretch of power line in Kent, an estimated 30% of the local flocks.

Table VII shows, perhaps surprisingly, that the proportion of birds in their first year dying by hitting overhead wires (44.1%) is not appreciably higher than

Table VII. Causes of death in the Mute Swan, and age-distribution at death.

		Age at death			*Full-grown and*
Cause	*Total*	*1st year*	*2nd year*	*3rd year*	*over 3 years*
Wires	464	74	66	22	302
Obstacles	28	10	3	1	14
Railway	44	8	3	2	30
Road	37	8	4	2	26
Injury	102	16	7	7	72
Oil	100	26	7	6	61
Disease	92	5	8	6	73
Cold weather	36	6	6	4	20
Shot	85	7	10	3	65
Fighting	28	5	2	1	20
Fishing	8			2	6
Miscellaneous	27	3	3	3	18
totals	1051	168	117	59	707

Causes of death in the Mute Swan

A cause of death was specified for 1,051 (48.8%) of the 2,156 recoveries of the Mute Swans ringed in Britain reported between 1960 and 1965. Apart from quarry species this is probably a higher proportion than for any other bird. Table VII sets out the reported causes of death in 12 different categories, and according to the age of the bird when killed. Since post-mortem examinations by skilled persons are rarely made, the reported causes are presumably heavily biassed in favour of those producing superficial injuries or marks. Table VIII sets out all the recoveries received by month of recovery and the distribution for the recoveries of birds reported as flying into overhead wires.

it is for older birds (42.2%), but that there is an appreciably higher level (56.4%) in the birds' second year. In the third year of life the proportion is close to that for all older birds. Table VIII shows the monthly distribution of recoveries for first and second year birds hitting wires. In the first year over 40% are in the months of October and November, which are effectively the first months in which a young bird is flying. In the second year there is a distinct peak in March, corresponding to the time of most movements, when young birds are leaving their adolescent quarters and seeking territories, even though they may not actually be going to breed at two years old. The spring peak is also present, though less marked,

Table VIII. Monthly distribution of recoveries of the Mute Swan.

Month	*Total*	*Juveniles in 1st year*	*All others*	*Death caused by wires*		*Over 2 years*
				1st year	*2nd year*	
July	64	1	63	0	0	5
August	89	1	88	0	2	3
September	155	5	150	0	7	20
October	195	33	162	15	7	35
November	183	31	152	16	7	31
December	180	29	151	8	6	23
January	223	39	184	8	6	29
February	271	39	232	7	4	36
March	314	43	271	8	15	48
April	238	27	211	3	7	52
May	134	18	116	5	3	35
June	110	17	83	4	2	7
totals	2156	283	1873	74	66	324

in the distribution of recoveries of older birds hitting wires. This is again a reflection of movement by the birds, taking up and defending territories. The number of breeding adults in the older age-sample is not known, but is certainly much less than half.

The evidence suggests that there is no learning by Mute Swans to avoid wires as they get older, and that possibly there is no selecting out taking place. The deaths from hitting overhead wires, and also other obstacles, show no decline with increasing age. There are a very few records of swans hitting wires and not being killed but if this were a regular happening one would expect the figures to offer some evidence of learning.

Obstacles

The numbers of swans dying from hitting miscellaneous objects, anything from cliffs to statuary, are fairly small, but presumably the birds have been seen hitting such objects in order that this cause of death is certain enough to have been mentioned.

Railway

Although a few birds have actually been seen to be killed by trains, most of the casualties found on the railway have probably flown into the wires which are a concomitant of every line.

Road

Incidents of swans being killed on the road are fortunately few in number, though there is one recorded death of a motor-cyclist who was in collision with a swan. Occasionally birds stray on to roads or fly into vehicles and from personal observation a swan that does find itself beside a busy road is bemused by the sight and noise of the traffic. However, road traffic cannot be rated as a major hazard to Mute Swans, nor *vice versa.*

Injury

This category is the second largest and probably includes a considerable number of birds that have had flying accidents. The finder has noted that the bird has been injured but it may be that it has survived long enough to move away from the object it hit.

Oil

Deaths from oiling tend to involve large numbers when they occur. Most recent examples involved the spillage of oil into a river or harbour. Disturbingly, such accidents show no signs of decreasing. That the number of birds killed is as low as it is must be attributed to the valiant efforts of local inspectors of the R.S.P.C.A. and their voluntary helpers, who, though having to put many birds out of their misery, manage to save and clean a considerable number after every disaster. The River Thames through London and out into the estuary has a bad record, and even upstream at Oxford 22 ringed birds were among many that perished after an oil spillage in June 1965. Flocks on the south coast have suffered in recent years, at Worthing, Southampton Water and Weymouth. The Midlands have recurring trouble, with oil deaths at Leicester in January 1964, and other cases in Derbyshire, Staffordshire and Warwickshire. What was probably the worst case of all as far as numbers of birds killed was concerned took place at Burton-on-Trent in June 1966, when 75 out of a flock of 90 birds succumbed after an oil leakage into the river.

Oiling tends to affect non-breeding flocks of swans rather than pairs and their

families. This is reflected in Table VII which shows a high proportion of deaths for birds in their first year of life. These are all after 1st January when most cygnets will have left their birth-place and joined flocks for the first time.

Illness and disease

Apart from one or two well-documented epidemics among flocks of swans, very little is known about the incidence of disease. Understandably very few birds noted to be in poor condition or emaciated when found dead have been post-mortemed. It requires more than average interest on the part of the finder to carry out or arrange for a detailed examination. A number of birds have been brought to the Wildfowl Trust at Slimbridge for post-mortem and Dr. J. V. Beer provided the following information. Eleven birds were examined which had apparently succumbed to disease or poisoning. Avian tuberculosis, nephritis, enteritis and pericarditis were each held responsible for one or more deaths. Two birds were believed to have died from metal-poisoning after fragments of copper and zinc were found in their alimentary tracts. MacDonald (1962) recorded the death of a Mute Swan from an infestation of cestodes.

Epidemics among flocks of swans have been noted occasionally in this country, the best studied being at Abberton Reservoir, Essex, in late 1958 (Jennings, Soulsby and Wainwright 1961), where 50 birds died, heavily infested with parasites. This was coupled with a serious shortage of their normal aquatic food plants. Further deaths, though fewer in number, have taken place in most years since, notably 1963. The birds affected moult their flight feathers in late summer and having done so are unable to leave the reservoir if the food becomes inadequate.

Cold weather

Deaths directly due to cold weather conditions are not often reported though the number of birds dying during these periods is much increased (Boyd and Ogilvie, 1964). From Table VII it will be seen that younger birds are probably more susceptible to death in hard weather.

Shot

For a protected bird the number reported as shot must be rated as substantial. Vandals take a considerable toll in some parts of the country, both of grown birds and of eggs. Vandalism is becoming more frequent, mostly in urban areas. A number of reports of shot birds come from trout farms or noted fishing rivers and these birds were undoubtedly thought to have come into conflict with the interests of fishermen.

Fighting

Small numbers of birds are killed or severely injured in fighting other swans, usually during territorial disputes. An aggressive male Mute Swan is capable, physically, of killing another swan, but it is unlikely that this would normally occur except when the attacked bird is unable to escape.

Fishing

Fishing tackle is responsible for a few unpleasant deaths of swans, but records of people removing hooks and lines and releasing live birds are more common.

Miscellaneous

Apart from the many causes listed above, a few others occur and make a macabre catalogue. They include death caused by horses, cattle and dogs, death from impalement on barbed wire, death in locks and from boats, and, not least, the bird that got in the flight-path of a landing aircraft at London Airport.

Conclusions

Life for a Mute Swan in Britain is an increasingly hazardous business, for man continues to adorn the countryside with obstructions for flying birds. If the first five categories in Table VII are summed, it will be seen that nearly 65% of all reported causes of death are probably due to accidents in flight. There is no sign that these deaths will be reduced in future because of learning by the birds and every sign that they will increase as the obstructions increase. The British population of the Mute Swan remains in a state of flux. Although the national numbers have been stationary for the last three years, there are marked regional variations that may prevent this stability continuing for much longer. The winter index will perform a useful service in depicting the general trends in future years. The mortality figures will gain in validity and reliability as the years pass, and will require review in the future. The really large scale ringing of the period 1961 to 1965 has been reduced by ending the supply of free rings to all ringers. Only those engaged on special projects will continue to be supported in this way. However, the reduction should not be so

great as to render further analysis of recoveries more difficult. With a cumulative recovery rate of about 20% and a recapture rate as high again, the data will continue to flow in. This paper is in the nature of an interim report which serves as a background to the more detailed study presented elsewhere in this Annual Report.

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