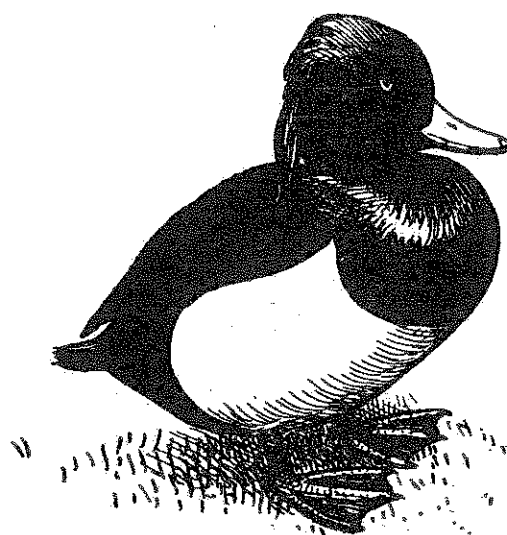


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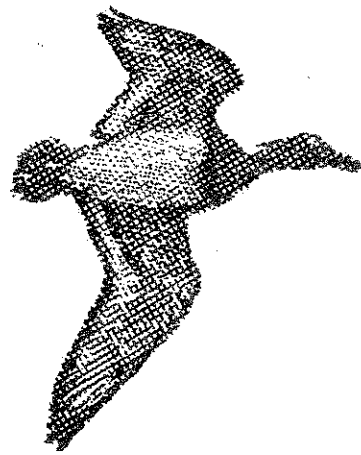
SLIMBRIDGE - - GLOUCESTERSHIRE



NATIONAL WILDFOWL COUNTS

FOURTH REPORT

TWO SHILLINGS AND SIXPENCE

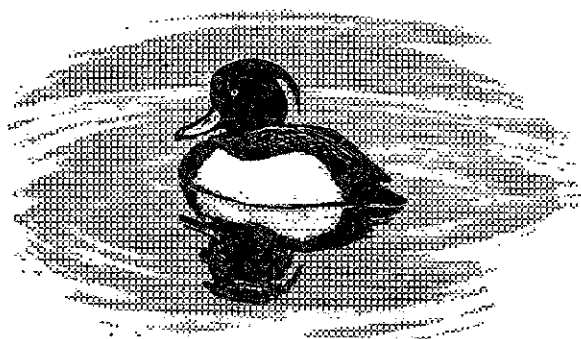


National Wildfowl Counts

FOURTH REPORT

FLUCTUATIONS IN THE WINTER POPULATION OF TUFTED DUCKS IN GREAT BRITAIN

By G. L. ATKINSON-WILLES



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FOREWORD

THE most recent event recorded in this report occurred eighteen months ago, and may no longer be topical, but I do not think that the time which has elapsed has been wasted. With the National Wildfowl Counts in the British Isles now entering their tenth season, the tide of information which flows in each year is still rising steadily and its volume has now reached proportions which allow of a more detailed analysis. Much of the past year has been spent in devising, and for the most part rejecting, new methods which have in turn entailed a much closer inspection of the data.

When the counts were first started by the Wildfowl Inquiry Committee in 1948, it was perhaps an act of faith on the part of everyone concerned to hope that anything worthwhile would emerge. They knew that they were embarking on a long term project and that much time and effort must be expended before anyone could say whether it was wasted or not. The wildfowl counts were already firmly established when the Wildfowl Trust took them over three years ago, but even now we are only just able to say that we have enough information to appreciate their true value.

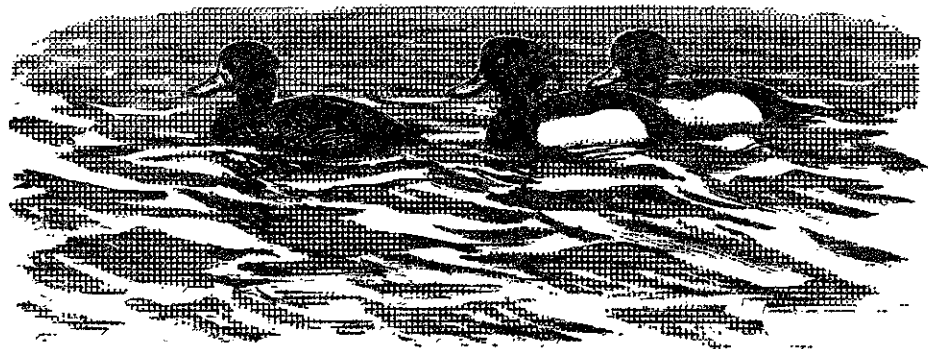
This report on the Tufted Duck is an example of the efforts we are making to extract the utmost from your records, but this alone is not enough. We are working concurrently on various tests which we hope will show the reliability of the data which you send us, and the extent of the errors which are likely to creep in. In this we have been helped by the extraordinary enthusiasm of Miss Eileen Palmer who has visited one of the Somerset Reservoirs almost daily for the past year. From her records we are learning to what extent the monthly counts are representative of the numbers present at other times, and how the moon and tides, and even the time of day affect the populations of ducks there.

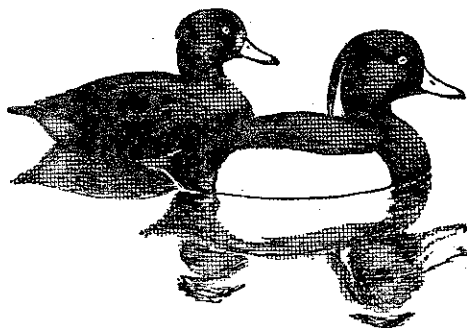
Her zeal brings home to us here at Slimbridge how much we owe to all counters. We are very conscious that any credit which may redound from the Wildfowl Counts belongs not to us but to you who provide us with the raw material. Your continued efforts and good will are enormously encouraging to us and we are most grateful for them.

Our thanks are also due to the Nature Conservancy, who from the earliest days of the Wildfowl Counts have shown their confidence in them by providing the means to keep the organisation in being.

PETER SCOTT,
The Wildfowl Trust,
Slimbridge,
Gloucestershire.

October, 1957.





SUMMARY

THIS report is devoted entirely to a study of the populations of Tufted Ducks, *Aythya fuligula*, wintering in Great Britain. This predominantly fresh water species has proved a most satisfactory subject, and new methods of analysing Wildfowl Count data have been devised, which, it is hoped, will be equally applicable to other species.

One of the main difficulties in assessing trends in the populations of any species by means of wildfowl counts is that continuous records over periods of sufficient length are available from only a small proportion of the waters now counted. In the case of the Tufted Duck, however, it can be shown that the small samples of records available for long periods give much the same picture, in the years to which they are common, as the much larger samples available in more recent years.

Five samples of comparative counts have been assembled varying in size and length from one of 165 waters for the six years 1950/51 to 1955/56, to one of 601 waters for the single season 1955/56. The patterns of the seasonal fluctuations in the numbers of Tufted Ducks presented by these five samples are first compared and shown to be similar in the years for which they are all available. From this it is inferred that the smaller samples are as reliable as the larger ones.

The trends in population are also examined by this method with the larger samples being used to confirm the results of the longer but smaller ones. During the period 1950/51—1955/56 wide variations in the numbers present in October, November, February and March may be detected, with increases in the level of population in these months in 1955/56 and to a lesser extent in 1954/55. In January, however, which is the month in which the population of Tufted is most likely to be stable, no variation between the levels in the six years is detectable. From this it is inferred that although early and late in the season the British wintering population of Tufted may be augmented by varying numbers of immigrants, the basic population in January, after the arrival of the autumn immigrants and prior to the hard weather influxes, has been constant throughout the six years under review.

Examination of the relative number of Tufted Duck counted in different areas and on different habitats reveals a variety of population patterns. In particular reservoirs appear to be of great importance, as although they comprise only 20% of the waters counted, they carry up to 60% of the birds recorded throughout most of the winter. As a great deal of information on the size and depth of reservoirs is already available it is intended that the behaviour of the populations of Tufted on them shall be the subject of a further more detailed paper.

FLUCTUATIONS IN THE WINTER POPULATION OF TUFTED DUCKS IN GREAT BRITAIN

IN June 1956 the International Wildfowl Research Bureau, whose task it is to co-ordinate the activities of research workers throughout Europe, requested all Wildfowl Count Organisers to direct their efforts towards a study of the Tufted Duck during the period 1953/54 to 1955/56 so that the several findings, when dovetailed together, might reveal a much broader picture than has hitherto been available. This species has proved a most suitable choice as its habits make it one of the easiest ducks to count, and one for which the results of wildfowl counts are likely to be most accurate. It is predominantly a bird of the larger inland waters, seldom going to the sea except in hard weather, and although its distribution is wide, its flocks are often small and therefore easily counted. Unlike the dabbling ducks it usually finds its food on the water where it roosts, and so the errors inherent in a daily movement between roosting and feeding grounds do not arise. This report considers only the wintering populations of Tufted, but it is also present in some numbers in the early autumn and nests freely in many parts of the British Isles. It seems probable, however, from ringing returns, that the majority of wintering birds come from Finland and Russia, with a much smaller group from Iceland, whose main winter quarters are in Ireland and to a lesser extent in Scotland.

THE PROGRESS OF THE COUNTS

BEFORE considering the Tufted Duck, however, the sources from which the data have been drawn must be examined. Hitherto the annual progress of the counts has been shown by listing the numbers of waters on which "regular counts" were made on most of the set dates throughout the season, and by adding to them the number of waters on which "occasional counts" were made from time to time. This ignored the possibility that quite a large proportion of even the "regular counts" might have been missed once or twice in a year and the certainty that only a small proportion of the "occasional counts" would be done on the set dates. In Figure 1 is shown the actual number of "Regular" and "Occasional" counts made on each count date since October 1948, and, by the uppermost lines, the possible maximum totals of "regular" counts in each year. Included in these figures are counts made within seven days of the set date, but those which were made earlier or later than this have been omitted.

THE QUALITY OF THE DATA

It will be seen that on no occasion so far have all the waters covered in any one year been visited simultaneously, and that during the holiday time of the summer months the number of counts made is little over half the winter totals, which themselves are liable to fluctuate under stress of weather conditions. In attempting a more accurate assessment of trends in the status of wildfowl, it has therefore been necessary to select only those dates on which a reasonably complete cover was achieved. In general the cover for July, August, September and, to a lesser degree, April has proved so erratic in recent years that, in the analyses which follow, these months have been omitted. This has been done with regret, but it has made it possible to include many waters, which, although lacking these early counts, were covered regularly through the winter. Even after thus pruning the data to the bare winter counts, a certain number of records are still found to be missing for some waters. If there are not too many gaps, estimates of the population based on the numbers present in other years and in adjacent months can sometimes be interpolated, but they are a serious potential source

of error. A statistical method of analysing incomplete material has in fact been evolved by Elfving in Von Haartman's paper "Population Changes in the Tufted Duck" (*Societas Scientiarum Fennica, Commentationes Biologicae* XVI. 5. 1957) but its application is to a fairly limited study of nesting colonies, and its complexity makes its wider use so laborious that it is impracticable.

A further problem is whether to accept or reject counts made on dates other than those prescribed as wildfowl count days. The use of ones made even within a couple of days of the correct dates is open to criticism, but in practice it has been found necessary to accept as valid any counts made within 7 days of them. It is considered permissible to do this, and also to include a certain number of estimates, provided that they do not exceed fixed limits. The rather arbitrary criteria which have been adopted are that in no month shall the results be acceptable if estimates have to be made for more than a tenth of the waters or amount to more than one tenth of the total recorded population. This does not mean that those who made counts when many others were prevented, were wasting their time; on the contrary their returns attain a scarcity value as a source of data in allied studies.

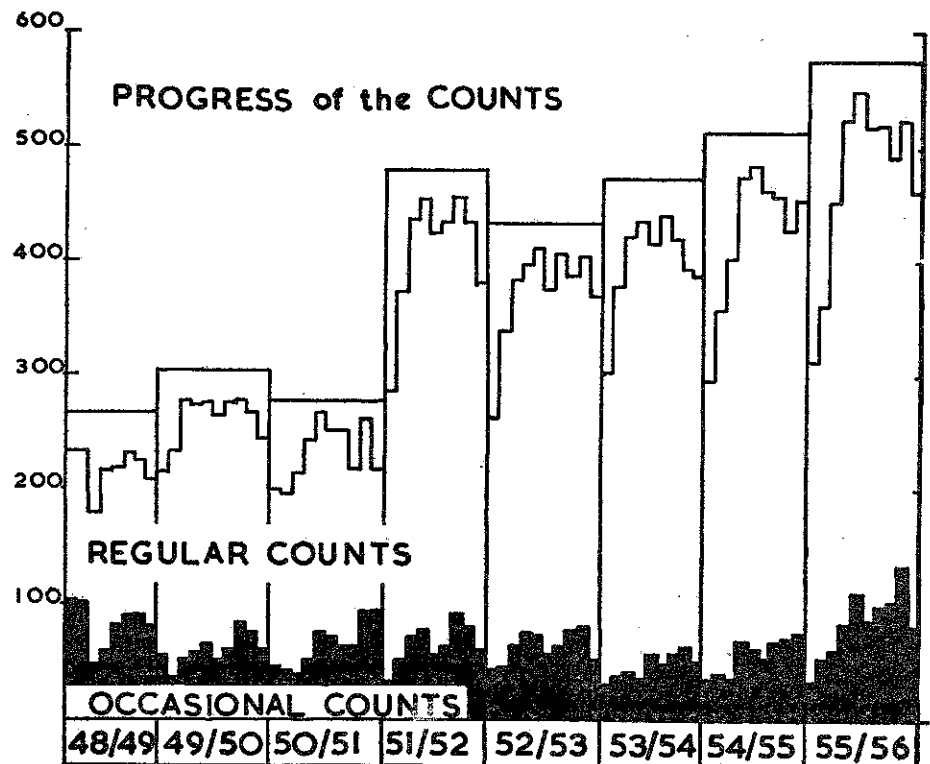


FIGURE 1. The number of waters visited on each count date since 1948.

In attempting to compare the results of wildfowl counts in one year with those in others, only those waters which were counted regularly in all the seasons under review can be used. It is natural enough that the longer the period under consideration, the smaller will be the number of waters covered throughout it. For some purposes a sample with a large number of waters is needed, for others one covering a longer period of time is more use, and so

in the discussion which follows samples of varying size and length have been used. All of them include the most recent season under review, that of 1955/56, and a comparison of the number of waters contained in each is given in Table 1 below. For convenience the samples are numbered serially according to the period which they cover. Since the season of 1948/49 was the first during which counts were made in Britain, 1950/51 the third and 1955/56 the eighth, the period 1950/51-1955/56 becomes Series 3/8 and similarly the shorter period 1953/54-1955/56 becomes Series 6/8. The final season of 1955/56, which presents by far the largest sample, is, when considered alone, known as Series 8.

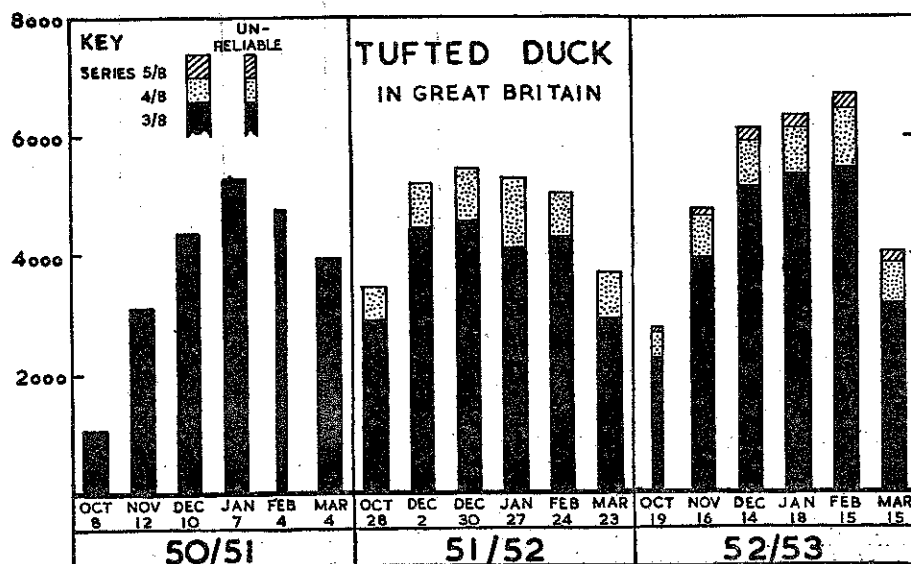
TABLE I. Numbers of waters contained in samples of varying length.

Series No.	3/8	4/8	5/8	6/8	8
Period Covered	1950/51— 1955/56	1951/52— 1955/56	1952/53— 1955/56	1953/54— 1955/56	1955/56
No. of waters in sample	165	270	295	356	601

SEASONAL FLUCTUATIONS IN THE NUMBERS OF TUFTED

REFERENCE to Figure 2, which shows the monthly numbers of Tufted counted in each of the series, suggests from inspection, that although the total numbers of duck in the various samples in any one month are different, the patterns of the seasonal fluctuations presented by them in each year are very much the same. This similarity is of the greatest importance as it implies that although series 3/8 with 165 waters is less than half the size of series 6/8 with 356 waters and considerably less than one third of the size of series 8 with its 601 waters, the results shown by all three are substantially the same.

FIGURE 2. The numbers of Tufted Ducks recorded in Great Britain in five samples of varying length and size.



Series 3/8 however covers double the length of time spanned by series 6/8 and if the extent of their similarity can be demonstrated numerically in the years to which they are common, 3/8 can be used to detect any trends in population which may have occurred during the six seasons of its span with the confidence that its results are as valid as those of the best data available.

COMPARISON OF SEASONAL PATTERNS

To compare the patterns presented by the various samples in Figure 2 more accurately than by casual inspection it is necessary to provide a common index: This is done by taking in turn for each of the five series the average number of Tufted Ducks present over the whole period between October and March in the season 1955/56. These five averages are then each reduced to 100, and the individual monthly totals in this and preceding years are, in turn, reduced in proportion. The resultant figures, set out in Table II, while still reflecting exactly the pattern of the original samples, are directly comparable since the variation in actual numbers has been eliminated. The figures in brackets are based on totals which contain a higher proportion of interpolation than would seem to be admissible, and comparisons should be made with caution, but the remainder provide a measure of the similarity of the patterns shown diagrammatically in Figure 2.

FIGURE 2. Continued from opposite

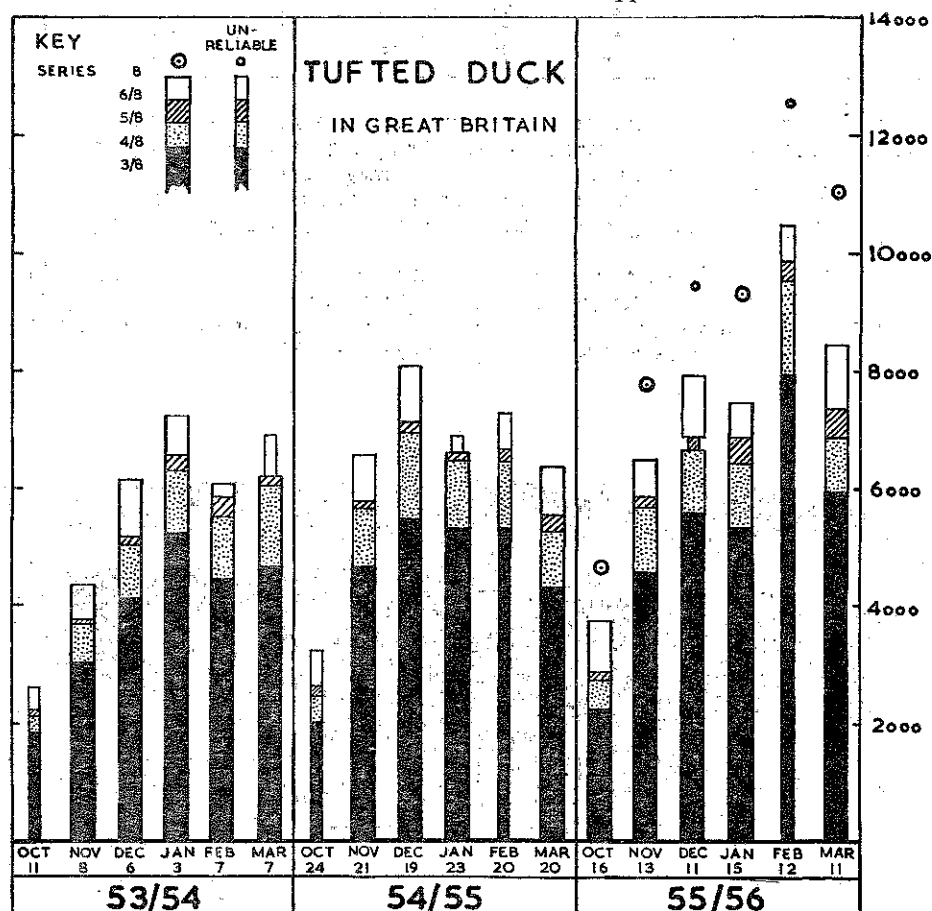
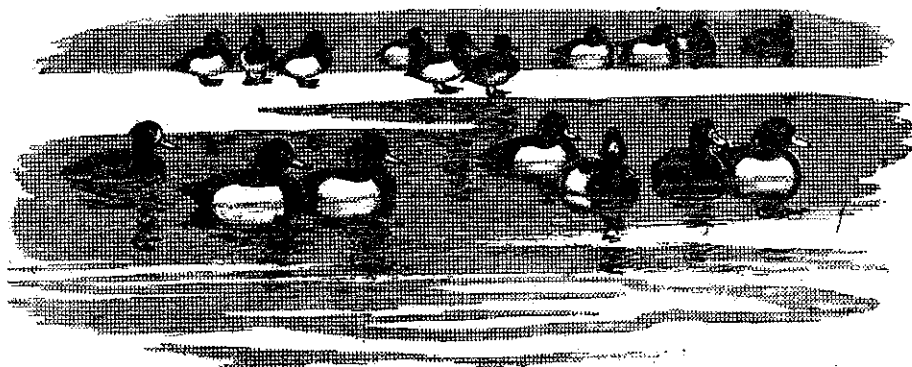


TABLE II. Showing the similarity between the patterns of seasonal fluctuation in the numbers of Tufted Ducks as revealed by five samples of varying size and length.

1955/56				Oct. 16	Nov. 13	Dec. 11	Jan. 15	Feb. 12	Mar. 11
Series	8	..	..	51	85	104	102	(138)	121
"	6/8	..	..	51	88	107	101	(139)	114
"	5/8	..	..	44	89	104	103	(149)	111
"	4/8	..	..	44	90	105	101	(151)	109
"	3/8	..	..	43	87	106	102	(151)	113
1954/55				Oct. 24	Nov. 21	Dec. 19	Jan. 23	Feb. 20	Mar. 20
Series	6/8	..	..	44	89	110	94	(98)	86
"	5/8	..	..	40	88	108	100	(101)	83
"	4/8	..	..	40	90	110	102	102	84
"	3/8	..	..	38	89	104	101	101	82
1953/54				Oct. 11	Nov. 8	Dec. 6	Jan. 3	Feb. 7	Mar. 7
Series	6/8	..	..	(35)	59	83	98	82	94
"	5/8	..	..	34	56	78	99	88	94
"	4/8	..	..	(34)	58	80	100	87	95
"	3/8	..	..	35	58	78	99	85	89
1952/53				Oct. 19	Nov. 16	Dec. 14	Jan. 18	Feb. 15	Mar. 15
Series	5/8	..	..	42	72	93	96	(101)	61
"	4/8	..	..	43	73	94	98	(102)	61
"	3/8	..	..	43	75	98	102	(103)	61

It will be seen that despite some minor discrepancies, the picture of the autumn increase, the midwinter peak, and the spring decrease in any particular year appears in much the same form and magnitude whichever series is considered. In no month for which reliable figures are available is the divergence greater than $\pm 8\%$ from the mean, and its average value is $\pm 3\%$.

It may perhaps be accepted therefore that series 3/8, the smallest sample in size, but covering the longest period of time, bears a sufficiently close resemblance to the larger and more recent series to be used as an extension of them prior to the date at which they became available.





EXAMINATION OF TRENDS

In the past attempts have been made to demonstrate trends, or the lack of them, by superimposing the graphs of the total numbers of birds counted in each month for consecutive years and comparing the results directly. This method has two great disadvantages, both problems of presentation. Firstly, the confusion of lines entailed in comparing a long series of years obscures any trend unless it is very marked. Secondly, early and late in the season when the numbers are changing rapidly, the graph lines appear to lie much more closely together than they do in the more stable period of mid-winter, thus giving a false impression of a greater trend in the latter period. The reason for this is that the eye is drawn to the connecting lines and ignores the points which they join and which are the only part of the graph based on the data. Furthermore the graphs confuse the problem of assessing trends by emphasizing the seasonal fluctuations, which for this purpose are best eliminated.

For these reasons it has been decided to adopt a method which is in effect a means of comparing the percentage of birds present in each month of one year with the percentage present in each month of another year. It entails taking the averages of the totals in each month over one period of years and reducing each of these averages to an index of 100. The monthly totals in other periods are reduced in proportion and then compared. In choosing the period from which the figures are to be drawn to provide the index it is more satisfactory to take the averages of the monthly totals of a number of years than to use the monthly totals in any single year.

The period chosen in this case is that covered by the three most recent years under review, 1953/54, 1954/55 and 1955/56. Thus in the case of series 6/8, which spans this exact period, the trend shown will be a comparison of the variations of the results of each month about their own mean. In the case of series 3/8, which extends back to 1950/51, the first three years will be compared with the average of the last three, and these in turn will be compared with their own average.

An example of the quite simple mathematics involved is given below. The figures have been drawn from series 5/8 which cover the period 1952/53-1955/56. In it, (1) shows the actual number of birds counted in each November of the 4 years, and (2) gives the average of the 3 most recent years which at (3) is reduced to the index of 100 by dividing in this case by 51.29. To reduce the totals of each year proportionately they must in turn be divided by 51.29 to give the comparative results shown at (4).

(1) Nov. 52 4740			(4) Nov. 52 92
Nov. 53 3717			Nov. 53 72
Nov. 54 5798	(2) 5129	(3) $\frac{5129}{51.29} = 100$	Nov. 54 113
Nov. 55 5872			Nov. 55 114

This same method is applied to each month in turn, and since the index in each case is 100 the seasonal fluctuations in the actual numbers of birds counted is eliminated. Similarly although the total number of birds counted in any one month varies according to which sample is used, the trends demonstrated by all the series are directly comparable as all are based on the same index of 100. In years when the count dates fall either on the last or first days of each month the totals of Tufted, especially in autumn, are likely to be high for one month, being late, or low for the next, being early. The dates in each month for the three years from which the index has been drawn have therefore been averaged and, in cases where a count date lies more than 10 days away from this mean, the average of the total numbers of Tufted in the two months on either side has been taken as a more reasonable figure to use in determining trends. In Table III are shown the count dates for each year since 1950/51 and the mean dates for the three most recent seasons. Count dates which lie more than 10 days away from these mean dates are shown in brackets, and their results have been treated as described.

TABLE III. Showing the dates in each month on which count days fell during the period 1950/1956.

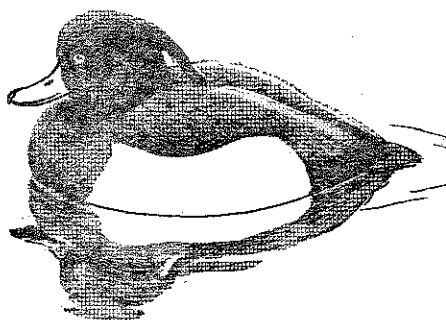
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1950/51	8	42	10	7	4	4
1951/52	(28)	—	(2), (30)	(27)	(24)	23
1952/53	19	16	14	18	15	15
1953/54	11	8	6	3	7	7
1954/55	24	21	19	23	20	20
1955/56	46	13	11	15	12	11
Average of last three seasons	17	14	12	14	13	13

The 1951/52 season is the only one which is affected by this disparity and it may be as well to treat any conclusions drawn from it with caution.

The results of these calculations are set out in Table IV, and, more simply, in graphical form in Figure 3. It shows, as has already been explained, the number of Tufted Ducks in each month in relation to a common index of 100, derived from the monthly averages of the last three years.

1955/56				Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Series 6/8	..	..		117	112	107	103	131	116
" 5/8	..	..		112	114	107	103	132	116
" 4/8	..	..		112	113	107	100	133	114
" 3/8	..	..		111	111	110	101	134	120
1954/55									
Series 6/8	..	..		101	113	110	96	92	88
" 5/8	..	..		102	113	112	99	89	87
" 4/8	..	..		101	113	112	101	90	87
" 3/8	..	..		101	114	108	101	90	87
1953/54									
Series 6/8	..	..		82	75	83	100	77	95
" 5/8	..	..		86	72	81	98	78	97
" 4/8	..	..		87	73	81	99	77	99
" 3/8	..	..		90	75	81	98	76	94
1952/53									
Series 5/8	..	..		107	92	96	95	89	64
" 4/8	..	..		110	93	96	97	90	63
" 3/8	..	..		113	96	102	101	92	65
1951/52									
Series 4/8	..	..		91	93	86	78	70	61
" 3/8	..	..		95	97	88	73	72	60
1950/51									
Series 3/8	..	..		51	76	86	100	81	80

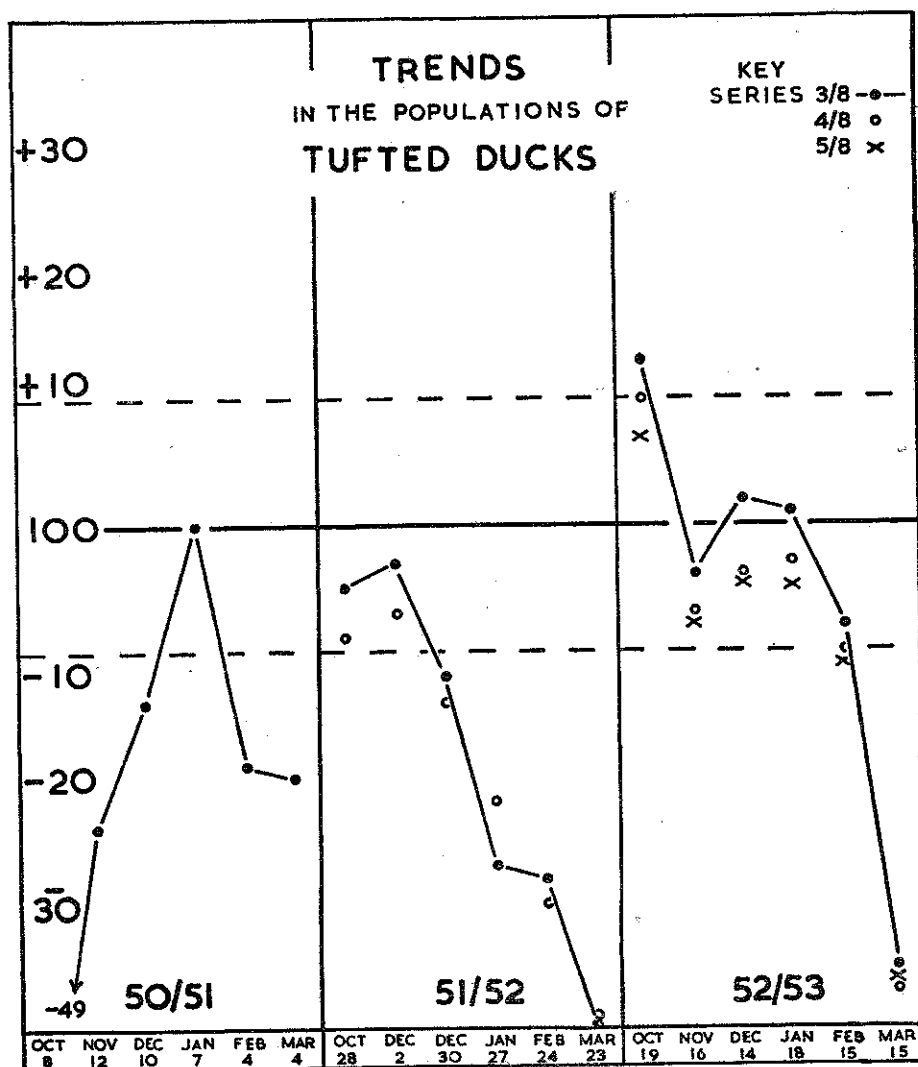
TABLE IV. To show, by the use of four separate samples, the numbers of Tufted Ducks counted in Great Britain in various years in relation to an index of 100.



The data for Figure 3 are drawn from Table IV. In it the index line of 100 is drawn horizontally across the centre of the diagram and the values of each month of each year are plotted in relation to it. To indicate the weight which may be attached to the variation of individual points about this base line of 100, dotted lines have been drawn above and below at ± 10 , denoting that it has always been accepted that there are likely to be errors of counting of at least this magnitude.

The results of four different samples, 3/8, 4/8, 5/8 and 6/8 have been superimposed, and demonstrate by their similarity in the years to which they are common the validity of the earliest and smallest sample, 3/8. The points for this sample, which is the only one available for the season of 1950/51, are joined by line.

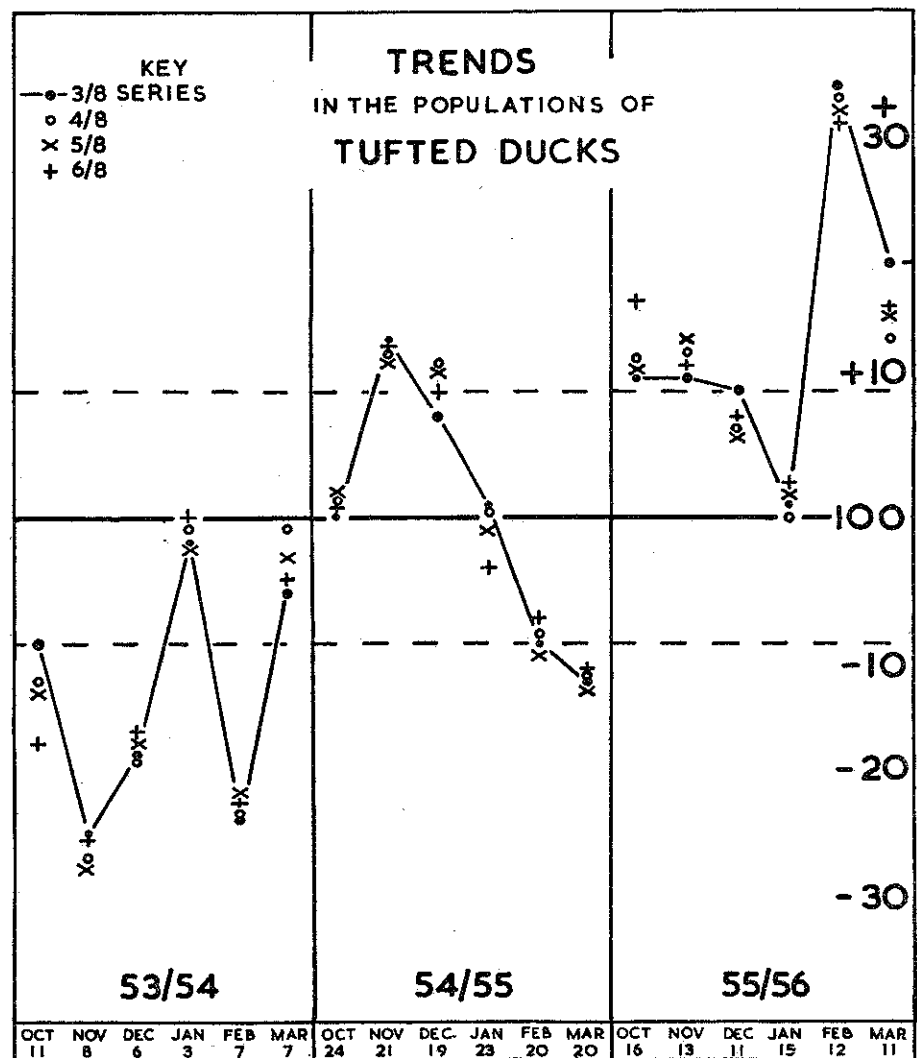
FIGURE 3. The trends in the British populations of wintering Tufted revealed by various samples.



This figure gives a general impression of an upward trend over the six years under review. Figure 4 overleaf considers this pattern in more detail by examining the results for each of the six years month by month. In it the results for each month have been extracted from Figure 3 and laid together.

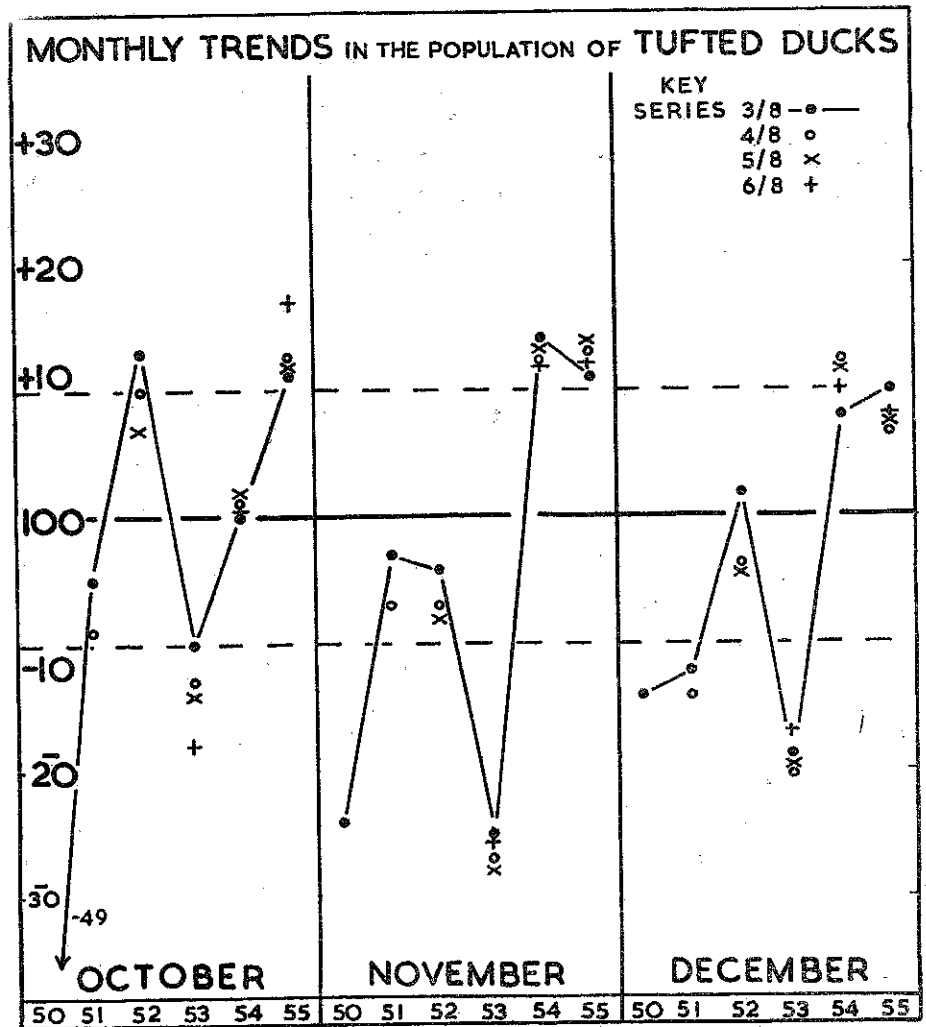
The more dramatic fluctuations between years in the early and late part of the season are at once apparent but are not so important in assessing trends as the constancy of the results for January and to a lesser extent December. In January it will be seen that with the exception of the 1952 results, which have already been shown as suspect, the points for all years lie within $\pm 5\%$ of the base line and well within the range of the probable margin of error.

FIGURE 3. Continued from opposite.



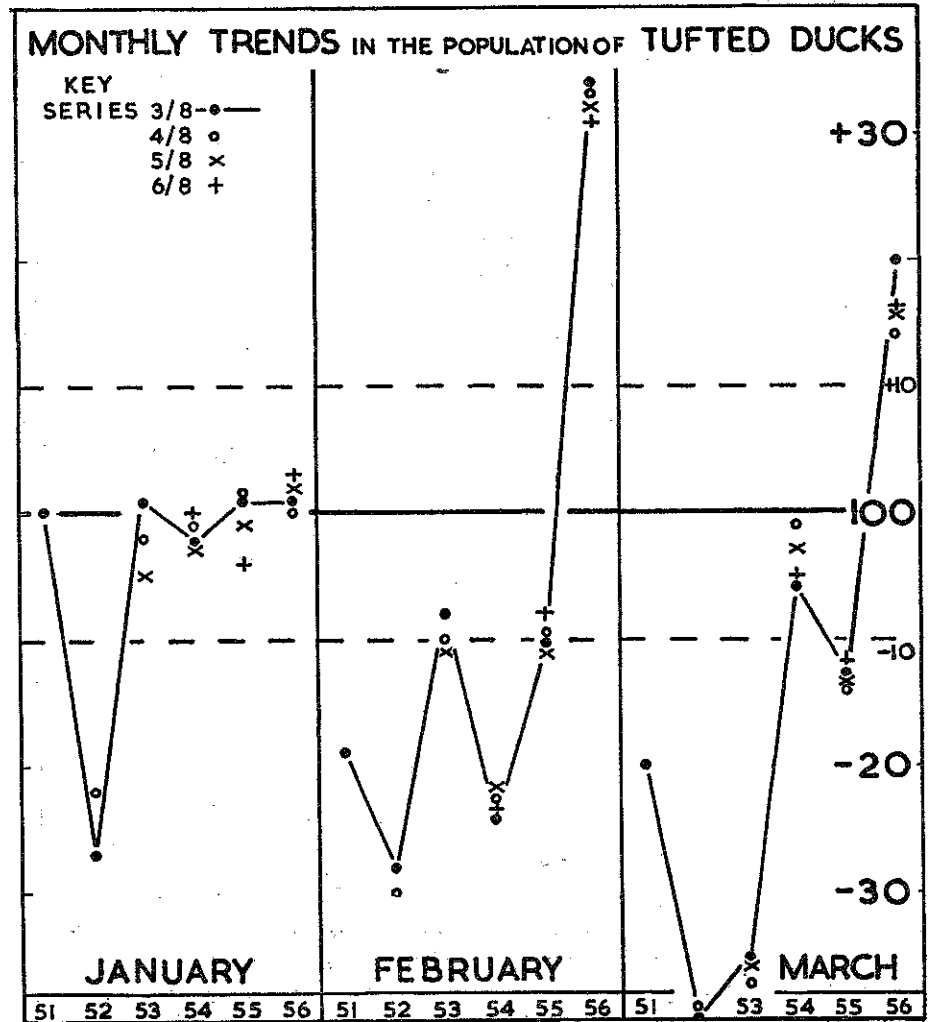
It is in January that one might expect to find the Tufted Duck population at its most stable, with the autumn migrants in full possession, with any emigrants already departed, and with the hard weather influx from N.W. Europe still awaiting impetus to move it. If this hypothesis is correct, and if January is in fact the one month in which an accurate assessment of trend can be made, free from the obscuring influences of widespread movements, then it can be said that the level of the Tufted population in Great Britain over the six years under review has been maintained with great steadiness.

FIGURE 4. The relative abundance, month by month, of Tufted Ducks recorded in each of the six years, 1950/51—1955/56.



Nevertheless the marked fluctuations between years at the early and late parts of the season are of great interest, and in particular the tremendous influx of February 1956 which was still apparent in March of that year. The earlier arrival of immigrant birds which might explain the relatively larger numbers in the Novembers of 1954 and 1955, and which is still apparent in the Decembers of those two years is also notable. But these results which are, unlike the January ones, dependent on conditions in N.W. Europe and even further east, must await the correlation of the results from abroad before they attain their full significance.

FIGURE 4. Continued from opposite.



VARIATIONS OF THE TUFTED POPULATION IN DIFFERENT AREAS

HAVING considered the population of wintering Tufted in Britain as a whole it may prove of interest to examine individual populations in various parts of the country. This has been done in the past for Mallard, when the country was divided into some fifteen geographical areas, but in the case of Tufted, whose peak counted numbers are about a sixth of those for Mallard, much larger regions have to be used. Three areas have been selected, Southern England and South Wales, which includes all to the south of the line Gibraltar Point, on the north shore of the Wash, Newark on Trent, Matlock, Stafford, Wenlock Edge and Aberystwyth; Northern England and North Wales, which extends from this line to that of the Lammermuir Hills and the Southern Uplands between St. Abb's Head and just north of Stranraer; and Scotland to the north of this. Comparative counts from Ireland are so scarce that it is not possible to consider them separately, although they have been included in the preceding analyses for the British Isles as a whole.

In Figure 5 are shown the proportions of the total recorded population which were found in each of the three areas mentioned above. The figures are based on the averages of the monthly counts in the three years covered by series 6/8. They are not intended as a comparison of the actual numbers of Tufted present in each area, but provide a measure of the relative speed of the autumn increases and spring decreases. The extreme steadiness of the figures for Northern England imply that at any rate in this series the seasonal fluctuations there reflect exactly the pattern in the British Isles as a whole, whilst as the season advances Southern England carries an increasingly larger proportion of the total counted population. It is not until March that this trend is checked, probably on account of a more rapid dispersal or emigration in the south.

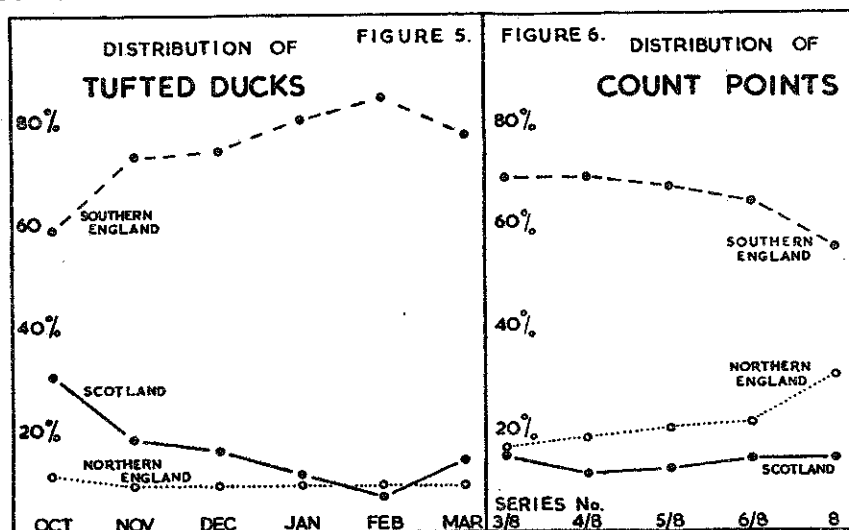


FIGURE 5. The average proportions, in various areas, of the total Tufted population recorded in Series 6/8.

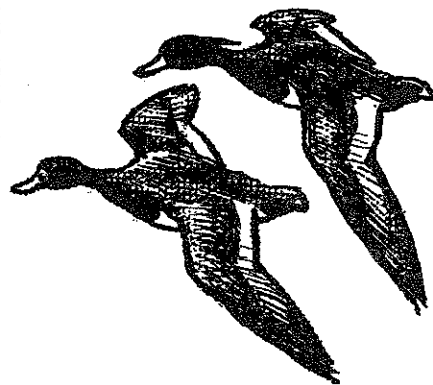
FIGURE 6. The proportion of waters, in each of five samples, which were counted in various areas.

Against Figure 5 has been set for comparison Figure 6, which shows the percentage of the sample that was drawn from each of these three areas in assembling the five series in Table I. In all the earlier

samples up to and including series 6/8 the relative proportions are much the same, but in series 8 the proportion of waters counted in Northern England increases sharply. This added emphasis of the North of England pattern in that of the country as a whole is likely to be responsible for some of the deviations in Table II between the pattern of seasonal fluctuation reflected in series 8 and in those derived from the other samples. In general it may be expected to raise the October and March values and to lower the midwinter peak.

VARIATIONS IN THE TUFTED POPULATION ON DIFFERENT HABITATS

In the past attention has been drawn to the variations between the patterns of populations of Mallard on coastal and inland waters, and this line of investigation is now carried to finer divisions made possible by increased cover. There are listed below ten types of habitat which have been considered separately in studying this aspect of the winter distribution of Tufted in Great Britain. The first five are man made or are due to man's activities, the remainder are natural habitats and, since each have characteristic features, brief definitions and comments on each are included. It is certain that many



of them may be sub-divided again and again, but there is a danger in attempting too detailed a classification to embrace individual cases.

RESERVOIRS. It is probable that a higher proportion of these than of any other habitat are covered by Wildfowl Counts. They range from natural and impounded upland lakes to entirely artificial constructions surrounded by concrete embankments, and are for the most part rather deep with steeply shelving banks. On account of their size and limited public access disturbance is often negligible and they afford a firm bulwark for wildfowl against encroaching human development. A number of Canal reservoirs have also been included in this group, but these in general are smaller and more overgrown than drinking water reservoirs, and often more disturbed.

URBAN PARK LAKES are usually artificial or assume the appearance of artificiality from their perimeter of footpaths and tidy banks. The natural food supply is likely to be limited but a generous increment of bun-crumbs often attracts quite large numbers of wildfowl, which rapidly become confiding but very seldom lose their wild status.

GRAVEL PITS. In this category are included clay pits and brick pits which may be much deeper than the average gravel pit. Their ecology improves with maturity from a rather austere barrenness during the time that they are being worked to densely reeded pools often overhung with alder. The method of extracting gravel frequently leaves ridges of earth which form islands, on which a natural succession of plants establishes itself. They present a most difficult habitat to assess as not only is their character constantly changing but new ones are continually being opened and old ones filled in.

SEWAGE FARMS. The number of old fashioned farms on which sewage is pumped into lagoons to settle grows smaller each year. They form ideal feeding grounds for dabbling ducks, but are mostly too shallow for diving ducks.

INGS. This Yorkshire term for land liable to flooding is used here in a specialised sense for flashes of permanent floodwater formed in the subsidences of mine workings. These pools, which may be extensive, are quite common in the coal areas of the Midlands and North of England. They afford a favourite feeding ground for dabbling ducks but are mostly too shallow to carry large numbers of diving ducks.

RURAL LAKES. This group encompasses the whole range of natural standing water from lowland ornamental lakes to hill tarns, and includes all natural habitats not defined elsewhere. Although the emphasis in this section is on the natural state of the water, it may be that some artificial lakes have been included, but their character so closely equals that of natural lakes that it is likely that the only error will be in assessing to what extent man's activities have assisted wildlife. Clearly division of this wide range of habitat is possible, for instance by region or by height above sea level.

RIVERS. The apparent importance of rivers to wildfowl should not be overestimated. In hard weather it is true that they may afford the only open water, but their narrowness renders them liable to disturbance, and the actual area of water is smaller than might be supposed. A river of 20 yards in width in its middle reaches and a hundred miles in length might cover only 700-800 acres, the same as a large reservoir, although the length of shore line available for feeding is potentially very many times greater.

FLOODWATER includes all temporary inland floodwater, but is distinguished from floods on coastal fresh marshes. It provides a valuable feeding ground for dabbling ducks and if extensive enough is often used as a roost as well.

LAGOONS, BROADS and COASTAL FRESH MARSHES. Proximity to the sea of stretches of fresh or brackish water is likely to impart to them special characteristics and affect the behaviour of wildfowl populations using them. The Norfolk Broads may well lie in a subdivision of their own, as may floodwater and dykes on coastal fresh marshes, but both are included in this group.

COAST. This section also may include a variety of habitat ranging from the broad and sluggish estuaries of East Anglia to the sea lochs of Western Scotland, but subdivision is not practicable at this stage except possibly by regions. Therefore all coastal and estuarine habitat has been included as well as any adjoining salt marsh.

These ten types of habitat are represented in varying proportions in the five samples whose relative sizes were considered in Table I and whose relative compositions are now shown in Table V. It sets out the numbers and proportion of each habitat in each sample and it will be seen that in the more recent series relatively more of the natural habitats have been covered.



TABLE V. To show the numbers and percentage of each type of habitat included in five samples of varying length.

PERIOD	1950-1956	1951-1956	1952-1956	1953-1956	1955/56
SERIES	3/8	4/8	5/8	6/8	8
Reservoirs ..	39 (24%)	56 (21%)	62 (21%)	71 (20%)	113 (19%)
Urban Parks ..	19 (11%)	22 (8%)	22 (8%)	22 (6%)	30 (5%)
Gravel Pits ..	13 (8%)	14 (5%)	19 (6%)	20 (6%)	39 (7%)
Sewage Farms ..	1 (1%)	3 (1%)	3 (1%)	3 (1%)	7 (1%)
Ings ..	— (—%)	2 (1%)	3 (1%)	4 (1%)	9 (1%)
Man Made Habitat	72 (44%)	97 (36%)	109 (37%)	120 (34%)	190 (33%)
Rural Lakes ..	44 (27%)	78 (29%)	80 (27%)	114 (32%)	212 (35%)
Rivers ..	4 (2%)	6 (2%)	6 (2%)	6 (2%)	14 (2%)
Floodwater ..	— (—%)	6 (2%)	6 (2%)	7 (2%)	14 (2%)
Lagoons, Broads & Fresh Marsh	12 (7%)	12 (5%)	14 (5%)	16 (4%)	22 (4%)
Coast ..	33 (20%)	71 (26%)	80 (27%)	93 (26%)	141 (24%)
Natural Habitat ..	93 (56%)	173 (64%)	186 (63%)	236 (66%)	403 (67%)
Total ..	165	270	295	356	601

Series 6/8 has been used in Figure 7 to show the proportions of the wintering Tufted population which, from month to month, use any one of these types of habitat in preference to the others. The figures used in it are the averages of the numbers of Tufted recorded in each month in the three years covered by series 6/8 and are expressed as percentages of the total counted population. The results for man made and for natural habitats are plotted separately for clarity, and four habitats, Ings, Sewage Farms, Rivers and Floodwater, which carry negligible numbers of Tufted, have been omitted.

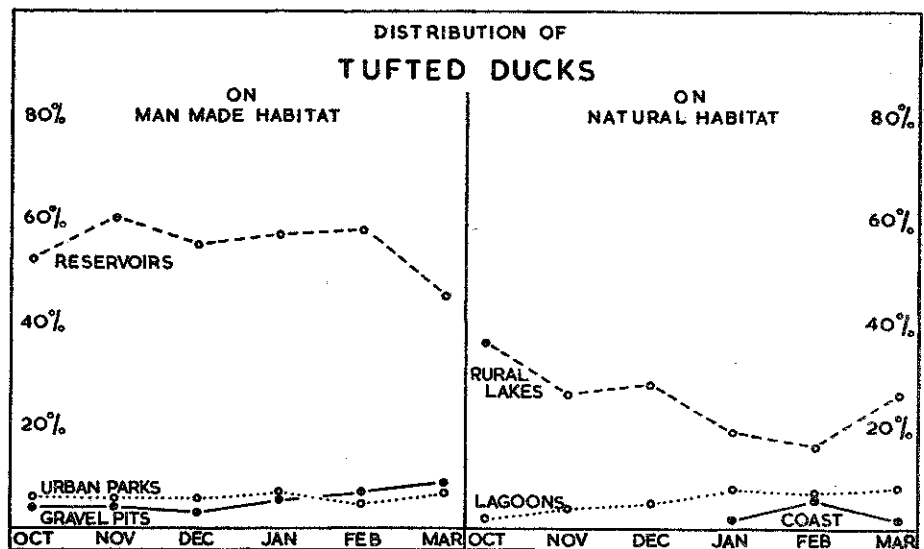


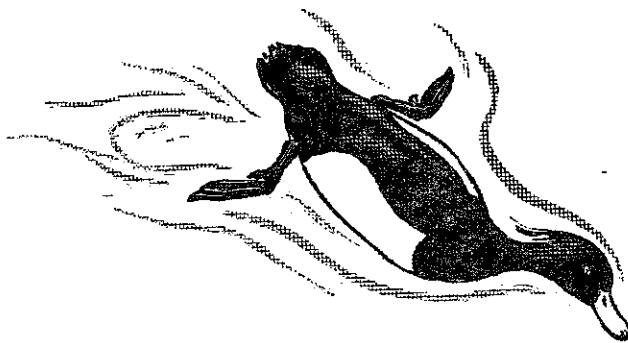
FIGURE 7. The average proportion, on various habitats, of the total Tufted Duck population recorded in Series 6/8.

The most striking feature of this figure is the preference of Tufted for man made habitats, which although comprising only 35% of the waters counted in Series 6/8, carry up to 70% of the total counted population. Reservoirs in particular are the most important single habitat, the 71 of them included in the sample carrying between two and three times as many birds as the 114 rural lakes throughout most of the winter and almost 60% of the birds counted. Their relative importance in the country as a whole should however be put into truer perspective. This sample of reservoirs represents about 10% of the total number of impounding reservoirs in the country, whereas it is extremely unlikely that the 114 rural lakes represent anything like such a high proportion of their category. The sample is thus an unbalanced one in favour of man made habitats, and in this respect does not give a true picture of the situation in the country as a whole. For instance, the relative importance of the midwinter plateau in the numbers of Tufted on the reservoirs is probably overstressed and their autumn and spring preference for rural lakes underemphasized. In view however of the Tufted Ducks demonstrated preference for man made habitats, the present samples of counts must include a considerably higher proportion of the total population than a balanced sample of similar size. It is in fact probable that quite a substantial proportion of the Tufted Ducks wintering in Britain are being recorded.

Nevertheless it is clear that Operation Waterlog, the proposed survey of habitats, has a direct application to this problem of the balanced sample. This project has not been forgotten and a considerable amount of information has already been assembled from central sources. Reservoirs in particular are well documented and details of their size, depth, and height above sea level are readily available. The effect of these factors on what has now been shown to be an important section of the Tufted population can therefore be studied with confidence and in some detail. This will be done in a subsequent paper.

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FUTURE WILDFOWL COUNT DATES

1957/58

July 28
August 25
September 22
October 20
November 24
December 22
January 19
February 16
March 16
April 13

1958/59

August 17
September 14
October 12
November 16
December 14
January 11
February 8
March 8
April 5



