

Duck shooting in the United Kingdom

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Introduction

Coastal wildfowling and inland duck shooting are traditional forms of sporting shooting in the United Kingdom, currently practised by about 160,000 participants (Harradine 1983). In recent years it has become increasingly important to quantify the levels of such shooting as a contribution to its management and the conservation of the quarry species. In 1979 the British Association for Shooting and Conservation (B.A.S.C.) established its National Shooting Survey (N.S.S.) programme to obtain reliable statistics on shooting. Its main objectives are to estimate the numbers of the different species shot each year in the U.K., including the timing and geographical distribution of the kill, and thereby contribute to our ability to assess and monitor the impact of shooting on the populations.

This paper summarises results on the shooting of ducks by members of the B.A.S.C. drawn from the Membership Survey of the N.S.S. programme, from 1979–80 to 1983–84. These results are then discussed in light of information from other surveys which provide the basis for estimating the total numbers of ducks shot in the United Kingdom each year.

Methods

It is not easy to set up a representative sample of shooters in the United Kingdom in order to collect statistics on shooting when there is no national register of all who shoot. The N.S.S. programme, therefore, is based on detailed annual surveys of the B.A.S.C.'s own members who cover the whole spectrum of sporting shooting. In addition surveys were undertaken to estimate total numbers of people who shoot and to identify any differences between shooting people who are members of the B.A.S.C. and those who are not.

Membership Survey

A form was mailed before each shooting season to an effectively random sample of B.A.S.C. members (25% for each of

1979–80 to 1981–82 and 12% for each of 1982–83 and 1983–84), drawn from every 'nth' position throughout the membership file, which itself is subject to continuous random movement. Each member was asked to record the details of each shooting day throughout the season and return the completed form the following February.

The 1979–80 return sought information on the respondent's home county, age, years of shooting experience, main county of shooting activity, frequency of shooting, number of birds killed and retrieved, daily coastal shooting record, night shooting and sale of dead birds. The 1980–81 form further distinguished between coastal (that is, below highest spring tide mark – foreshore and saltings) and inland (above highest spring tide mark) duck shooting. In 1981–82 the form was simplified to monitor the kill thereafter on an annual basis (by numbers shot and the month and county of shooting). A personal shooting record card was included with the form to encourage participating members to keep an accurate record. In 1982–83 and 1983–84 reminders were sent to members not completing their bag returns. This procedure markedly increased the percentage of returns.

Returned forms were checked for correct completion before computer analysis. Data entry errors were minimised by validation and error checking routines and manual checks were made on data file accuracy and completeness.

Estimates of total B.A.S.C. membership kill are a necessary step towards estimating national totals. Simple extrapolation of results from the N.S.S. samples to the whole membership would likely over-estimate the membership kill, however, since hunters are known to exaggerate and introduce other biases (see Discussion).

The geographical distribution of duck shooting is based on the kill reported by each respondent being wholly allocated to the county or region where he did "most" of his shooting. Whilst some ducks undoubtedly were shot in a county/region outside the one to which his kill was allocated, the application of this procedure to all respondents should produce a realistic picture of shooting distribution. An

adjustment for the differing sizes of the counties/regions is also made by dividing the total kill for each county/region by the latter's area.

National Opinion Poll Survey

An N.O.P. Market Research Ltd survey was commissioned to obtain information on how many of the 866,000 shotgun certificate holders known from government records shot different types of quarry, including wildfowl. N.O.P. interviewed a nationally representative quota sample of 3,840 men (15 years and older) between 22 April and 7 June 1982, drawn from 165 locations within Great Britain. Sampling was based on a two-stage stratified design with parliamentary constituencies being selected in a stratified random way at the first stage and men selected by quota sampling methods at the second stage.

Shows Survey

It is likely that shooting men belonging to the B.A.S.C. differ in some ways in their shooting from those who are not members. In order to test this some 1,650 randomly selected people were interviewed about their shooting at a number of agricultural, country and field sports shows throughout the U.K., according to whether or not they were members of the B.A.S.C.

Results

Number of returns

The numbers of returns analysed for each of the years was 1746, 1680, 1745, 2258 and 2146. The corresponding percentages of those circulated were 16.0, 14.4, 14.0, 36.2 and 34.4%, the last two higher figures resulting from the second circulation in those years. Response rates varied within and between county/regions and years, the only clear pattern being a lower-than-average response from Northern Ireland.

Characteristics of duck shooting

The estimated total numbers of ducks shot by the B.A.S.C. membership are influenced not only by sampling variation and seasonal differences in numbers shot but also by the

progressive increase in total membership. The estimated membership kill for each species for 1983–84 is given in Table 1 to indicate the scale of the membership's shooting. These figures somewhat over-estimate the number killed, particularly for the coastal duck species, since they are based on successful respondents only: some respondents will have gone out without shooting any birds. Estimates for the sparsely or patchily distributed species should be viewed with some caution.

Table 1. Estimated total B.A.S.C. membership kill of each duck species in 1983–84 and mean percentage species composition of ducks, 1980–81 to 1983–84 (total number of ducks = 84,577)

	Estimated membership kill	Percentage of each species
Mallard	300,900	59.5
Teal	103,200	21.8
Wigeon	42,000	11.8
Tufted Duck	12,000	2.7
Pintail	5,300	1.5
Pochard	6,200	1.3
Shoveler	2,700	0.7
Goldeneye	2,800	0.5
Gadwall	1,300	0.3
Garganey ¹	—	<0.1
Scaup	—	<0.1
Common Scoter	—	<0.1
Velvet Scoter	—	0
Long-tailed Duck	—	<0.1

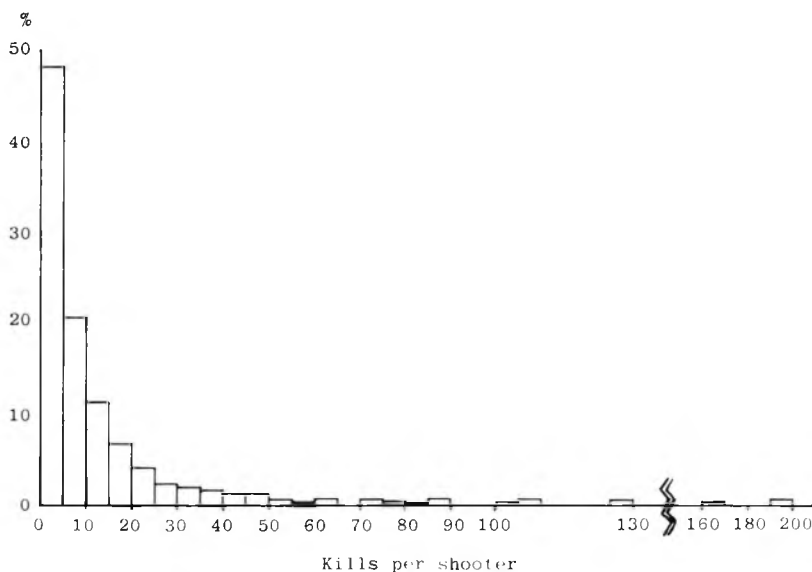
Note:

1. Garganey – Long-tailed Duck: based on 1980–81 and 1981–82 only.

The proportion of each species in the annual total is given also in Table 1. There was little inter-seasonal variation for any species, except perhaps Wigeon *Anas penelope* (12.7, 16.1, 10.9 and 8.2% over four seasons). Average numbers shot per season, based on the numbers of respondents successfully shooting each species, are indicated in Table 2. The standard error estimators, however, on account of the skewed frequency distributions (presented for season 1980–1 only in Figure 1), are likely to be somewhat inefficient (Couling *et al* 1982). The medians (Table 2), calculated for 1983–84, better suggest the seasonal kills by the average B.A.S.C. member.

Table 2. Mean and median numbers of ducks shot per season per respondent who reported kills of each species, 1983–84 (with range of means for seasons 1980–81 to 1982–83).

	Mean kill per member	Standard error	Median kill
Mallard	13.6 (11.1–13.3)	0.62	7
Teal	8.3 (7.6– 9.5)	0.65	4
Wigeon	6.6 (6.7– 9.6)	0.71	3
Tufted Duck	4.1 (3.2– 6.3)	0.56	2
Pintail	3.5 (3.8– 4.5)	0.54	2
Pochard	4.6 (2.6– 5.8)	1.22	2
Shoveler	2.1 (2.2– 2.8)	0.20	2
Goldeneye	3.5 (2.0– 3.9)	0.89	2
Gadwall	1.8 (1.9– 2.8)	0.25	1

**Figure 1.** Frequency distribution of Mallard kills per hunter, 1980–81.

The mean total number of ducks shot per successful respondent was 17.6 (s.e. 0.91) in 1980–81 and 19.0 (s.e. 1.01) in 1981–82. For coastal ducks in 1980–81 the mean was 13.7 (s.e. 1.38) and for inland ducks 15.6 (s.e. 0.91). The discrepancy between these figures and that given for all ducks is caused by separating the two types of duck shooter, whereas most coastal wildfowlers shoot inland ducks as well and vice versa to a lesser extent. All these figures were derived from respondents actually shooting ducks. For the same year mean kill for all respondents who went shooting ducks,

whether successful or not, was: coastal ducks 9.7 and inland ducks 14.6.

Most respondents shot 1–5 birds although some (up to 4%) shot more than 50 birds of each of the main duck species. Half the respondents shooting Mallard *Anas platyrhynchos* shot more than five birds in a season; for Teal *Anas crecca* and Wigeon the proportion was a third. Of the remaining species, less than 20% of respondents shot more than five birds. Overall, relatively more respondents shot larger numbers of Mallard than any other species.

Distribution of duck shooting

Most ducks were shot in the north-west of England (particularly Lancashire), in

eastern and south-eastern counties and in some midland counties of England (Figure 2). Most coastal shooting took place in Lancashire and in eastern sea-board

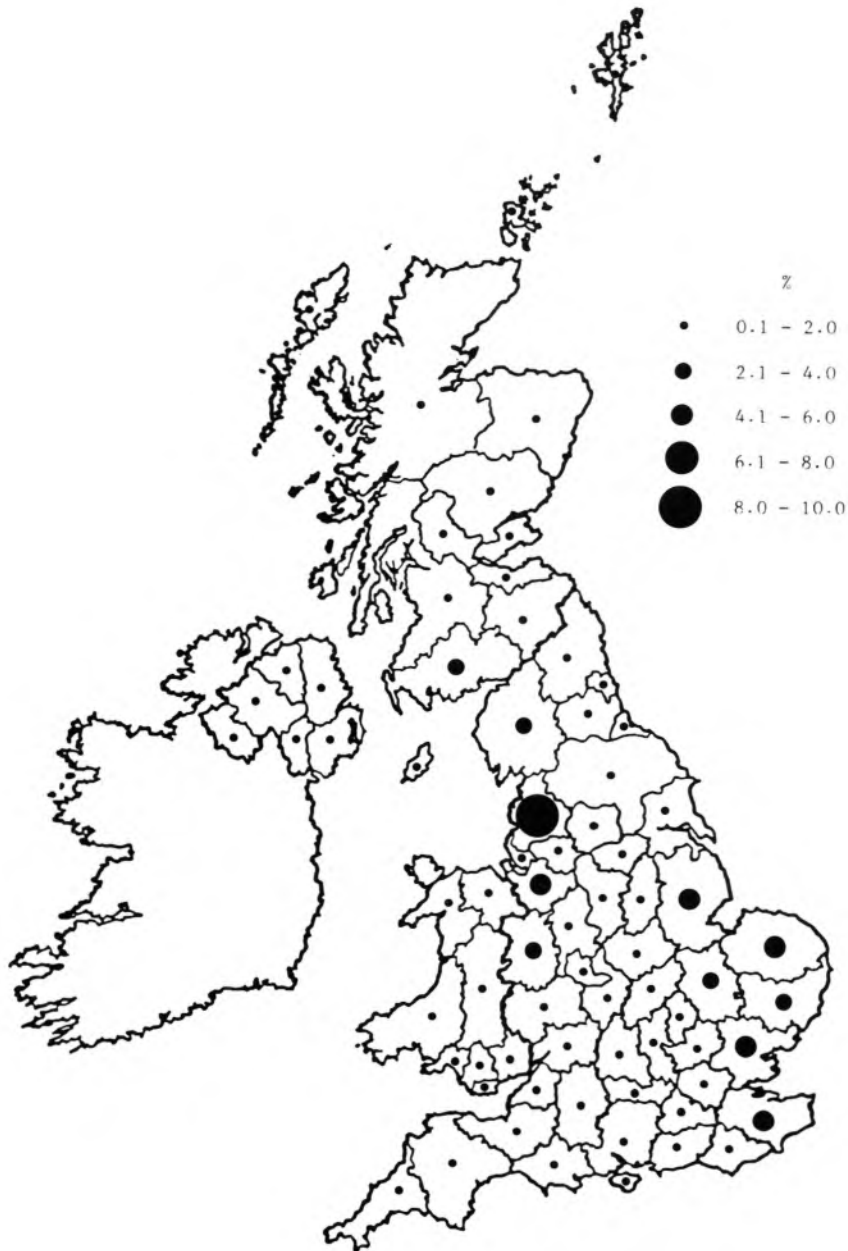


Figure 2. Relative importance of each county/region for duck shooting (all species), 1980-81 to 1983-84, expressed as the mean number of ducks shot in each county/region as a percentage of the total kill.

counties, including Northumberland.

This overall picture was influenced mainly by Mallard, this being the most widespread and commonly-shot species. It dominated inland shooting. Teal and Wigeon were also most commonly shot in the north-western and eastern/south-eastern counties. When the data were corrected for county size Lancashire, Cheshire and Essex emerged overall as the counties with the largest kills of ducks per km².

From amongst the other species with sufficient records, Tufted Duck *Aythya fuligula* were mainly shot in southern counties, the south-east especially, but also in Fife and Northern Ireland; Pintail *Anas acuta* were shot in Cheshire and Lancashire and in counties around the Wash and Thames Estuary.

Some three-quarters (75.5% for 1980–81) of the total numbers of ducks shot were taken from inland sites. Shooting frequency on the coast appeared to be slightly higher than inland (10.6 and 8.6 days per respondent, respectively, for 1980–81),

whereas, as seen above, duck kills appeared to be larger inland than on the coast. A further indication of difference between coastal and inland duck shooting is given by a "probability of success" derived from the numbers of respondents successfully shooting and the numbers attempting to shoot ducks (1980–81). For coastal shooters the ratio was 0.71, inland 0.92. That is, those who went shooting inland were more likely to be successful than the coastal wildfowlers.

Most ducks were shot between October and December (Table 3), the monthly proportions being consistent over the five years. The 1980–81 data indicated that coastal duck shooting peaked markedly in mid-season, whereas inland shooting varied less from month to month. Two-thirds of the Mallard were taken in the first three months of the season (Table 4). Teal was largely a mid-season species while the Wigeon kill was proportionately greater later in the season. The relative importance of these major species in the total kill through the season is illustrated in Figure 3.

Table 3. Mean percentage of all ducks shot each month of the season, 1979–80 to 1983–84.

	Sept	Oct	Nov	Dec	Jan	Feb	Sample of ducks shot
All ducks %	17.1	19.9	22.2	20.7	17.3	2.7	92,976
Range	15.9–18.1	18.4–22.4	20.6–24.5	19.1–21.9	15.2–19.3	1.2–4.1	
Coastal ducks % (1980–81)	13.3	17.2	27.8	23.7	13.0	5.0	3,496
Inland ducks % (1980–81)	18.9	18.8	23.4	21.3	17.6	–	10,718

Table 4. Mean percentage of each duck species shot each month of the season, 1981–82 to 1983–84.

	Sept	Oct	Nov	Dec	Jan	Feb ¹	Sample of ducks shot
Mallard	21.7	23.1	20.7	17.9	14.5	2.1	38,496
Teal	12.8	18.5	21.7	23.3	19.2	4.2	14,318
Wigeon	3.5	13.8	25.0	25.8	24.5	7.5	7,474
Tufted duck	13.6	15.8	27.7	22.5	19.0	1.3	1,819
Pintail	4.8	16.1	22.7	22.5	23.4	10.4	981
Pochard	6.1	11.9	29.6	28.3	22.3	1.7	879
Shoveler	23.7	16.7	17.9	19.4	20.1	2.2	448
Goldeneye	1.4	14.4	29.3	28.2	20.4	6.3	348
Gadwall	19.0	9.5	26.8	15.6	27.4	1.7	179

Note:

1. Inland duck shooting season ends on 31st January in England, Wales, Scotland and N. Ireland, whereas foreshore shooting continues in Britain to 20th February.

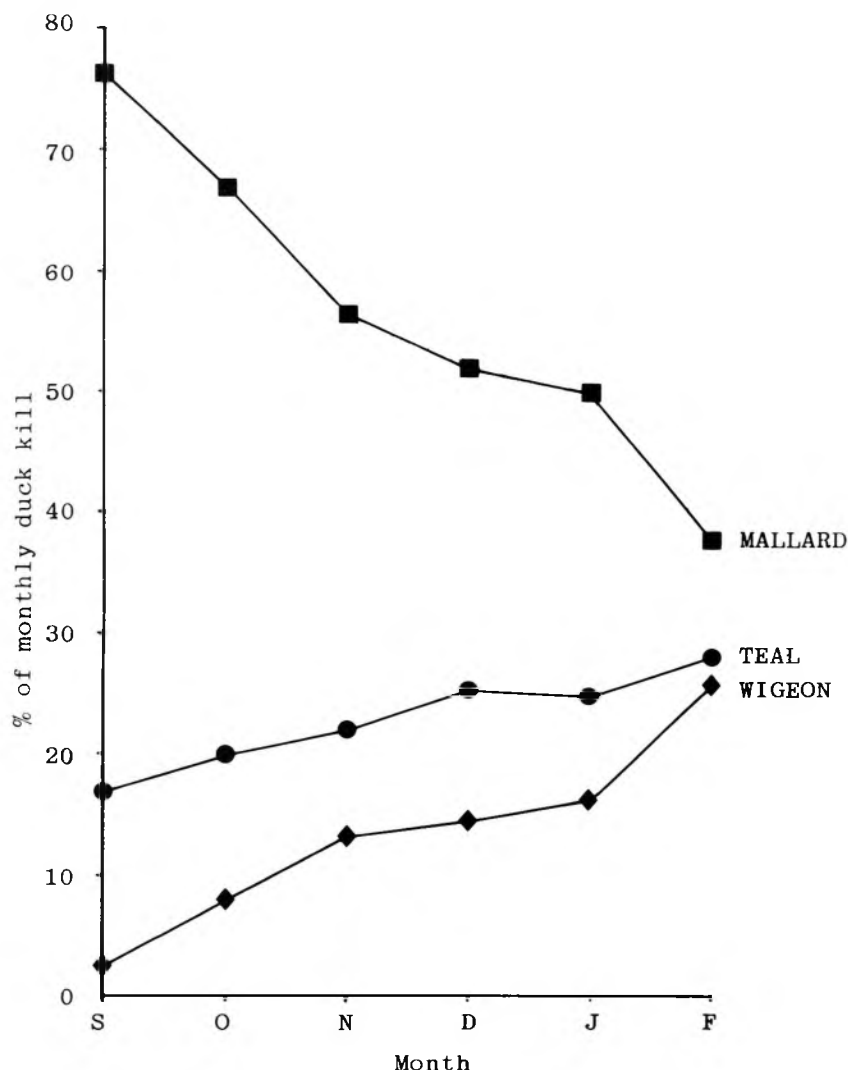


Figure 3. Relative importance of the main duck species through the season as a percentage of the total monthly kill, 1981-82 to 1983-84.

The remaining species are much less widely distributed. Their monthly kill distributions were more variable but, apart from Shoveler *Anas clypeata* (mainly shot in September), they also peaked around mid-season.

A third or more of the duck were taken on Saturdays with only slight variation during the other days of the week (Table 5). In many English counties, however, Sunday

shooting is probably relatively more common than indicated since such shooting is prohibited in Scotland, Northern Ireland and several English and Welsh counties.

Duck shooting typically takes place around dawn and dusk and during the day according to tides, weather and other conditions. Night shooting between one hour after sunset and one hour before sunrise is also a traditional form of shooting for

Table 5. Mean percentage of ducks shot each day of the week, 1979–80 and 1980–81.

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sample of ducks shot
All ducks % (1979–80)	9.5	7.8	8.4	12.1	10.2	9.3	42.7	13,763
Coastal ducks % (1980–81)	12.7	11.2	9.3	10.5	8.4	15.2	32.8	3,496

ducks and geese in Britain. Moonlit nights were the most favoured, as specified by three-quarters of night-shooting respondents. During 1980–81, 27.4% of those respondents shooting wildfowl did part of their shooting at night and accounted for 5.8% of the season's total of duck shot during that time. Mallard, Teal and Wigeon were the main species reported, in the approximate ratio of 5:3:1, and the monthly pattern of night shooting closely followed the overall pattern.

Numbers of members shooting ducks

Some 55% of the B.A.S.C.'s membership shot ducks each season, equivalent to about 35,000 in 1983–84. Coastal wildfowling was practised by about 42% of these (12,000) and inland duck shooting by 85% (25,000) of the duck shooting members in 1980–81 (the former figure may not have increased since then, despite the subsequent growth in B.A.S.C. membership). It is believed that most coastal wildfowlers in Britain are members of the B.A.S.C. but that their numbers are unlikely to increase substantially. More than half (32,000) of the B.A.S.C.'s members shot Mallard (91% of duck-shooting members), 29% shot Teal (51%) and 16% shot Wigeon (28% of duck shooters). The other species were shot much less: only around 5% of members shot Tufted Duck and Pintail and fewer still shot Pochard, Shoveler, Goldeneye *Bucephala clangula* and Gadwall *Anas strepera*.

Frequency of shooting

The mean frequency of outings (1979–80 and 1980–81) was about 12 days each season, or approximately once every fortnight. The skewness of the frequency distribution of days shooting, however, suggests that most members shot less frequently.

Number of wildfowl shooters in Great Britain

Of the 866,000 shotgun certificate holders in Great Britain (i.e. not including Northern Ireland), some will be held by persons no longer possessing a shotgun. The number of shotgun owners is taken to be 850,000. The N.O.P. survey showed that 70% of the 94 shotgun owners identified used their gun in that year, that is, some 600,000 shotgun users nationally (N.O.P. 1982). The survey showed that 28% of those shotgun users shot ducks and geese. This implies some 160,000 wildfowl shooters, most of whom shoot ducks, in Great Britain (Harradine 1983).

B.A.S.C. and non-B.A.S.C. wildfowl shooters

The Shows Survey revealed that each B.A.S.C. member ($n = 83$) shot on average 2.7 times the number of duck obtained by non-B.A.S.C. shooters ($n = 280$), a highly significant difference (d, the statistic comparing the means of two large samples, = 3.33, $p < 0.001$).

Discussion

Sources of error

Biases can be introduced through, for example, inaccurate recall of shooting days, exaggeration of numbers shot, inclusion of other people's kill, putting correct information in the wrong place, deliberately falsifying the return.

Some attempts have been made to assess the effects of such "response bias" (collectively the various factors which cause a given kill return not to be an accurate account of that respondent's shooting) on estimates of hunting activity and success

(for example, Atwood 1956; MacDonald & Dillman 1968; Cooch *et al* 1978; Wright 1978; Strandgaard & Asferg 1980). These studies, mostly North American, have indicated that estimated total kills may be up to double the true totals measured by other means (Wright 1978). The effect of "non-response" bias (the errors caused when respondents are not representative of all hunters) is thought to inflate "true" totals by less than 10% (Cooch *et al* 1978; Wright 1978). As a result correction factors are applied to kill estimates to compensate for these errors, from 0.74 to 0.37 for wildfowl depending on type and area. In the absence of quantitative data from the U.K., membership estimates of ducks shot have been reduced by 25% in anticipation of such biases in this country. Another bias can arise, when less successful hunters tend not to respond to surveys. This also has the effect of over-estimating total kill (Cooch *et al* 1978; Wright 1978). B.A.S.C. membership kill has been further reduced by 5% to allow for this, making a total correction factor of 0.70. No allowance has been made for the proportion of the birds killed but not retrieved, around 20% in the U.S.A. (Martin & Carney 1977).

It may be incorrect to assume that British sportsmen behave as do American hunters under their very different conditions of shooting. In particular, the influence of the American system of bag limits in encouraging exaggeration has been shown by Atwood (1956). However, completion of forms by non-selected members, total shoot or syndicate kills, the predominance of kill sizes and number of days shooting with multiples of "5" and "10" in them (indicating memory biases) and lower proportions of active duck shooters amongst second circulation respondents have all been observed in the N.S.S., showing some similarities in behaviour between British and American shooters.

The results for each of the five years, where comparable, are generally similar. This suggests that the N.S.S. does reflect current shooting practice in the U.K. or that constant biases are operating from year to year. Either way the survey provides the only means of monitoring the total numbers of duck (and other migratory quarry) shot annually and the characteristics of the kill in this country. There may be some difficulties in obtaining statistically meaningful differences, in view of the large variances. In

general, however, the estimates for those widespread and abundant species shot by relatively large numbers of members can be viewed with more confidence than those for species only locally abundant or shot in small numbers

The N.O.P. survey was the first attempt to quantify the different sections of the British shooting community. Despite the small sample and potential extrapolation errors it has provided a basis for estimating the total kill of ducks in this country.

Estimated national duck bag

A provisional figure can be derived from the results of the three surveys under the N.S.S. programme. In 1983–84 a total of 23,549 ducks was shot by 1,149 respondents. These latter, however, excluded those who went shooting unsuccessfully. From 1980–81 data, when the number of coastal duck shooters pursuing ducks was 40% greater than the number being successful and the corresponding figure for inland duck shooters was 8%, it can be estimated that some 1,340 respondents pursued ducks, successfully or not. The mean seasonal kill per shooting member, therefore, after correcting by 0.70 for response and non-response bias, was 12.3 ducks. Since 35,000 B.A.S.C. members went shooting ducks in 1983–84 the total membership kill was some 430,000 birds for that year.

The seasonal kill of the non-B.A.S.C. shooter, obtained from the Shows Survey, is 0.36 of the B.A.S.C. figure, or 4.4 ducks. Since there are some 125,000 non-B.A.S.C. wildfowl shooters in Great Britain (N.O.P. Survey), their total kill was about 550,000. The total kill of ducks in Britain, therefore, was 980,000. Including a possible 43,000 ducks in Northern Ireland, the U.K. kill was 1,023,000 ducks.

This method is crude but it is likely to be more realistic than previous estimates for the United Kingdom, the most recent being 153,000, based necessarily on little more than educated guesswork (Scott 1982). It does compare realistically, however, with the accurate estimate of ducks shot in Denmark – some 850,000 (Scott 1982; I. Clausager, pers. com.) and with the most recent estimate in France of just over two million (O.N.C. 1985).

It is less easy to estimate the numbers shot of each duck species. The B.A.S.C. membership may not fully represent all the

country's duck shooters. It is believed to include most of the coastal wildfowlers. Not only is most wildfowling, at least in England and Wales, regulated by B.A.S.C.-affiliated clubs, but most other wildfowling opportunity is available to members of the Association through permit-controlled shooting. Many inland duck shooters, however, are not B.A.S.C. members. Wigeon, being essentially a coastal bird (notwithstanding the Ouse Washes' population) are likely to be shot largely by B.A.S.C. members, whereas Mallard, being more inland than coastal in distribution (Salmon 1981) probably figure to a lesser extent, relatively, in ducks shot by the B.A.S.C.'s membership. Teal lie somewhere inbetween.

It is likely that the number of Mallard shot each year lies between 600,000 and 700,000. The Game Conservancy had provisionally estimated this figure at over 800,000. This is probably an over-estimate because of the many large inland estates contributing to the Game Conservancy's National Game Census (S.C. Tapper, pers. com.). In Denmark, where diving ducks are relatively more important, the Mallard kill is some 380,000 (Scott 1982) whilst in France 1,376,000 were shot (O.N.C. 1985).

Relationship between bags and duck populations

The only information with which to put the U.K. figures into perspective is obtained from the Wildfowl Trust's estimates of wintering duck populations derived from its National Wildfowl Counts. Owen (1983), for example, estimates the wintering Mallard population at 500,000. The possible number of Mallard being shot, as derived from the N.S.S. figures, may be in error. However, the monthly winter wildfowl counts do not allow for passage movements through sites between counts. Many Mallard (currently believed to approach 500,000) are reared on estates and inland waters and are mostly shot early in the season. Also many smaller waters where Mallard are present are not counted (Tuite *et al.* 1984).

Shooting mortality may be offset by reduced natural mortality or increased production of young. Such compensatory mechanisms are gaining acceptance in studies of hunted wildfowl populations. Insufficient is known, however, about the

threshold levels of shooting mortality above which it ceases to be fully offset or whether such compensation operates in all species. In Canada Patterson (1979) has suggested that Mallard and other dabbling ducks might tolerate hunting mortality up to about 40% of the autumn population, whereas diving ducks may have lower thresholds, perhaps nearer 10% of the autumn population. In Britain Hill (1983, 1984) suggests that over-wintering loss (through mortality or dispersal) is the main regulatory factor in Mallard populations and that current shooting losses (30% being the estimated maximum level) should be compensated by this over-winter density-dependence.

In Britain, whatever the actual harvesting rate, the Mallard wintering population has recovered from its decline in the 1970's and has maintained itself, if not increased (Salmon 1981, 1982, 1983; Salmon and Moser 1984). Possibly continental immigrants are supporting the British population (Salmon 1981) to a greater extent than previously but, equally, evidence is not known for any consequential decline in the continental population.

It is even more difficult to estimate the proportions of the populations wintering in Britain of the other duck species. The B.A.S.C. membership kill of Teal is in itself similar to Owen's (1983) estimated population of 100,000. The U.K. wintering population of Teal has increased since the mid-1970's. The north-west European winter population increased from 1967 to 1976 (Atkinson-Willes 1982). Unless there has been a change since, the British figures suggest the species is doing well.

The number of Wigeon shot by the B.A.S.C. membership probably comprises a large proportion of the total U.K. kill. The national total of, say, 60,000 birds shot would constitute nearly a third of the estimated wintering population of 200,000 birds (Owen 1983).

Although Wigeon sites are well counted (Tuite *et al.* 1984) the problem remains of passage migration through the sites between the monthly counts. The wintering population in the U.K., however, has remained stable since the mid-1970's. The British/Icelandic population is doing well but severe weather movements complicate assessment of the continental population for a decline in 1984 followed two mild European winters. The north-west European population declined somewhat from 1967 to 1976

(Atkinson-Willes 1982). In the Golfe du Morbihan, a major Wigeon wintering area in France, numbers generally declined from 1962–63 to 1978–79, at least partially as a result of changes in the feeding area (Mahéo 1982). Such changes in numbers and distribution in Europe, together with the creation of large refuges in Britain (such as the Ouse Washes), make it difficult to evaluate the possible impact of British shooting on this species at the European level. Similar assessments for the other duck species are necessarily even more speculative.

The national counts of wildfowl show that the main British populations are not declining. Britain does not appear to be drawing in more birds than in the past from elsewhere in their north-west European range. It remains unclear, however, how well the information now available on the total population size of each species enables the level of shooting and its impact on each population to be accurately assessed. Further work is needed to understand and quantify the biases in methodologies, analyses and interpretation of results, so that the biological impact of shooting can be better understood.

Species' composition

Currently three surveys provide data on the relative importance of Mallard, Teal and Wigeon in the U.K. wintering populations (Table 6). The National Wildfowl Counts probably cover less than 50% of the Mallard component (Salmon 1980), whilst most Wigeon haunts are well counted. The Mallard proportion, therefore, "should" be substantially higher and the Wigeon proportion consequently lower. The B.A.S.C.'s Duck Wing Survey (Harradine 1981 and unpub.) under-estimates Mallard and over-estimates Wigeon because many contributors are coastal wildfowlers and reared Mallard are excluded. In the

National Shooting Survey, although both reared and migratory Mallard and all habitats are included, this species may still be under-represented, as we have already seen. Whilst the representativeness of the B.A.S.C.'s kill composition has yet to be quantified, the N.S.S. does give a good indication of the relative importance of these three major species.

Geographical distribution of shooting

The areas where most ducks were shot not unexpectedly coincide broadly with those of importance to wintering duck populations. These are shown by the National Wildfowl Counts, Birds of Estuaries Enquiry and other surveys (Atkinson-Willes 1963; Owen and Williams 1976; Prater 1981; Salmon 1980, 1981, 1982, 1983; Salmon and Moser 1984). The Mallard, alone influenced by widespread and large-scale rearing and releasing schemes, is ubiquitous; Teal and Pintail figure particularly around the Dee/Mersey/Ribble estuaries' complex; Wigeon in eastern England coastal and inland (Ouse Washes) sites; and diving ducks are associated with the reservoirs, lakes and gravel pits particularly in southern England.

The relationship between B.A.S.C. membership kill and the quarry populations is further influenced by the distribution of nature reserves, other no-shooting areas, the sites actually shot by the members and sampling variations, especially in the more localised populations.

Data in Owen (1983) and Salmon (1981, 1982), based on the wildfowl counts, indicate that about one-third of wintering ducks are usually found on the coast. The kill distribution results suggest a quarter on the coast and the rest inland. The difference between these estimated populations may be due to the known under-counting of Mallard on inland sites.

Table 6. Mean percentage of Mallard, Teal, and Wigeon in the total U.K. wintering quarry duck population as estimated by different surveys.

	Mallard %	Teal %	Wigeon %
Wildfowl Trust National Wildfowl Counts (1976–77 to 1983–84)	29	16	34
B.A.S.C. National Shooting Survey (1980–81 to 1983–84)	60	22	12
B.A.S.C. Duck Wing Survey (1978–79 to 1983–84)	40	26	26

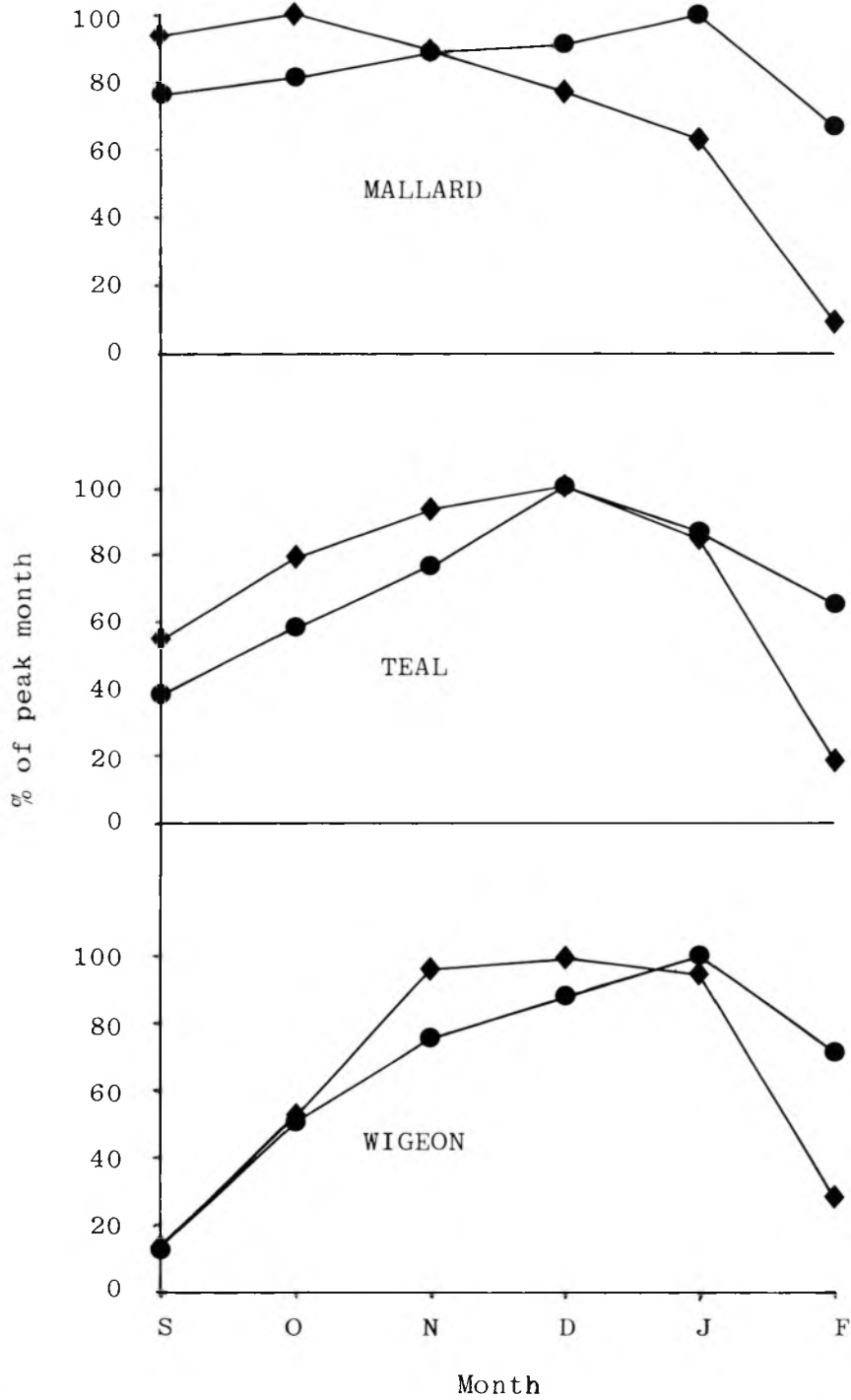


Figure 4. Distribution of mean monthly kill and total monthly counts for Mallard, Teal and Wigeon from the National Shooting Survey, 1981-82 to 1983-84 (◆-◆), and National Wildfowl Counts, 1976-77 to 1983-84 (●-●), each expressed as a percentage of its peak month value.

Temporal distribution of shooting

The distribution of shooting in time also broadly conforms with expectation. It reflects early-season shooting mainly of Mallard, coastal and inland shooting of migratory species in mid-season and the increasing importance of coastal wildfowling towards the season's end, although shooting frequency declines then as well. This pattern is also revealed by the B.A.S.C.'s Duck Wing Survey (Harradine 1981 and unpub.).

The mean monthly kill distributions for Mallard, Teal and Wigeon (1981–82 to 1983–84) are compared with the total monthly counts of these species from the National Wildfowl Counts, the peak monthly counts being averaged over 1976–77 to 1983–84 (Marchant 1981; Salmon 1980, 1981, 1982, 1983; Salmon and Moser 1984) in Figure 4. For each data set the monthly figures are expressed as percentages of the peak figure. This indicates that these three species are not shot in direct relationship to their abundance: relatively more Mallard and Teal were shot early in the season, and more Wigeon in mid-season. The February foreshore season being closed on the 20th has the effect of lowering that month's kill. Nevertheless it is probable that each species was still shot relatively less in relation to the numbers available.

Since most Mallard shooting occurs early in the season it is mainly the resident British population which sustains it. This population continues to maintain itself (Salmon and Moser 1984). Migratory Mallard comprise more of the kill later in the season. Most Teal and Wigeon are taken from the migrant populations and the numbers shot, not unexpectedly, are more closely related to their abundance during the winter. Schifferli (1982) found some evidence that Swiss hunters shot ducks according to their availability.

Conclusions

This first quantitative appraisal of duck shooting in the United Kingdom both confirms previous suppositions and provides new information on certain aspects of shooting. Furthermore, it enables a start to be made in assessing and then monitoring the likely impact of shooting on British duck

populations: this is the main role of the B.A.S.C.'s National Shooting Survey. The estimates of numbers shot are provisional, however, and their accuracy is unknown, although they are consistent with those of other European countries. Equally, current wintering population estimates are subject to error. These factors combined with our incomplete understanding of compensatory mortality mechanisms permit only preliminary assessments of impact.

Further work is needed on the biases affecting N.S.S. estimates, quantifying migratory passage between counts of wintering duck populations, the unretrieved kill and compensatory mortality mechanisms in British wildfowl populations. In the meantime the wildfowl counts indicate that, whatever the numbers currently being shot, wintering duck populations in the U.K. are stable or increasing. Such assessments are important for the understanding of duck shooting in the United Kingdom, for the development of policies for its management and for the conservation of quarry populations throughout their migratory range.

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Summary

Quarry species of ducks are traditionally shot throughout the United Kingdom, currently by some 160,000 sportsmen. The British Association for Shooting and Conservation's National Shooting Survey, for the first time, indicates the likely numbers shot each year. The U.K. total is about one million annually, comprising predominantly Mallard *Anas platyrhynchos* (60+%),

Teal *A. crecca* and Wigeon *A. penelope* (together 34%) and other species (about 5%). This total compares well with the national kill of other wildfowling countries.

The numbers shot form a large proportion of, or even exceed, the currently estimated wintering populations for several species which in the U.K. are stable or increasing. The estimate of numbers shot are provisional and their accuracy is not known. The population sizes, based on the Wildfowl Trust's National Wildfowl Counts, probably miss birds moving between monthly counts. Many Mallard, including those released by sportsmen, also are missed by the counters. Improvements in the estimates of both numbers shot and wintering population sizes are needed to assist in the management of shooting and conservation of the quarry duck populations.

One-quarter of the ducks shot are from coastal areas particularly in north-western and south-eastern counties of England: most shooting overall takes place in Lancashire. Much inland shooting, particularly of Mallard, also takes place in north-west England and eastern/south-eastern counties. Inland shooting is predominantly of Mallard.

Most ducks are shot between October and December with Mallard as an early-season, Teal mid-season and Wigeon later-season quarry. Most shooting occurs at weekends, particularly around dawn and dusk, but 6% of the ducks are shot at night. The average duck-shooting B.A.S.C. member goes shooting fewer than 12 days a season.

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