

Differential migration of the sexes and other aspects of the recovery overseas of Mallard ringed at Borough Fen Decoy, Northamptonshire

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Introduction

Large numbers of Mallard *Anas platyrhynchos* are ringed in Britain each year by the Wildfowl Trust, which operates the five principal duck ringing stations. The most successful station for catching Mallard is Borough Fen Decoy, Northamptonshire, where an average of 1,800 are ringed each season between July and March.

The conversion of Borough Fen Decoy from commercial catching began soon after the War but it did not become fully operational as a ringing station until the summer of 1957. Some of its earlier recoveries were included in the analysis of Boyd and Ogilvie (1961). They examined recoveries, by date and location, of all Mallard ringed in southern England. They showed that a considerable proportion of these Mallard originated from breeding areas on the continent of Europe, embracing a wide zone round the Baltic. These immigrants showed marked traditional preferences for wintering in the same parts of England each year. There they joined a larger, mainly sedentary population which rarely wandered more than 50 miles in the course of their lives.

It is the intention to bring all this material up to date, and to make annual analyses, now that Automatic Data Processing facilities are becoming available at the Nature Conservancy's Biological Records Centre, Monks Wood, Huntingdon. Meanwhile, and pending the development of an appropriate computer

programme, a hand-analysis has been made. This paper deals with one aspect, the recoveries overseas.

Detailed analyses were required to provide a sound basis for deciding whether there could usefully be a restriction of catching to save work and expense at the central office of the ringing scheme operated by the British Trust for Ornithology. This analysis will also provide the background to the continuing series of investigations into Mallard 'nonsense' orientation undertaken since Matthews (1963). These had indicated orientation patterns at release which clearly varied through the season at Borough Fen, and were probably related to the geographical origins of the birds concerned. It was further hoped to throw more light on the perplexing problem of abmigration, whereby ducks mate with migrants from a 'foreign' area and return with them to breed. The phenomenon has been much discussed since it was indicated by Thomson (1931), but relatively little factual data have been put forward.

Material and methods

The ringing activity at the Borough Fen Decoy, basic to the study, is shown in Table I. Here the numbers ringed each month are set out for the ten seasons 1957-58 to 1966-67. The reason for not considering more recent ringing is given below. Following an earlier, unpublished analysis, efforts have been made to increase the catch in July and August, to provide a larger sample of British-bred

Table I. Numbers of Mallard ringed each month at Borough Fen Decoy, Northamptonshire, 1957-58 to 1966-67. Also given are the overall sex ratios.

Season of ringing	Month of ringing										
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total	% male
1957-58	0	5	736	102	211	190	73	57	34	1408	48.5
1958-59	0	78	592	386	341	207	63	36	39	1742	47.6
1959-60	0	322	1031	548	331	164	105	66	7	2574	47.2
1960-61	3	130	515	238	67	28	59	29	10	1079	48.0
1961-62	0	516	479	271	187	65	90	102	73	1783	47.7
1962-63	10	88	663	257	170	50	0	0	20	1258	49.8
1963-64	14	209	648	338	170	42	95	46	29	1591	51.0
1964-65	135	531	1027	454	326	22	26	21	54	2596	50.8
1965-66	112	301	523	123	17	14	25	14	13	1142	46.8
1966-67	24	457	986	217	209	108	53	81	32	2167	52.8
Totals	298	2637	7200	2934	2029	890	589	452	311	17340	49.2
% male	43.3	52.2	50.4	48.6	46.8	43.9	42.4	46.7	53.1		

birds before the shooting season opened on 1st September. Attempts have also been made to increase the catch at the end of the season. Other fluctuations are due to factors beyond the decoyman's control. These may include variations in breeding success, floods, frosts and farming activities.

Recoveries received up to April 1970 have been included in the analysis. With an annual adult mortality rate of around 48% and a juvenile mortality around 68% (Bauer and Glutz 1968), the bulk of ringed birds will soon be dead. Only three seasons will account for some 90%, so analysis for factors other than longevity can begin after such an interval. However, the actual recoveries overseas build up rather more slowly, since most of the first season mortality takes place in Britain, few birds moving abroad before the shooting season ends. This is well illustrated in Table II where the cumulative overseas recoveries for the first three seasons of ringing at Borough Fen Decoy are shown. Only 6.4% of the recoveries

easily distinguished throughout the study and at all times of year, by plumage and/or cloacal examination. Overall the sexes are ringed in almost equal numbers (males 49.2%) with minimal variation from season to season (Table I). Within seasons there is a distinct shift in the ratio, reflecting the later migration of females and, possibly, differential susceptibility to different catching methods, by 'dogging' or feeding. In Britain itself, 3,347 subsequent recoveries of Borough Fen Mallard had a slightly higher proportion of males, 51.7%. Overseas recoveries, however, had a much greater imbalance of the sexes, the investigation of which is a major aim of this paper.

The general method of analysis used is to relate the location of a recovery with the date of ringing (rather than that of recovery). Thus the basic assumption is made that the immigrant is ringed soon after its arrival in Britain. Then we can investigate the way in which the migration to Britain proceeds, from different geographical areas.

Table II. Overseas recoveries of Mallard ringed at Borough Fen in 1957-58 to 1959-60 and recovered each season since ringing, up to April 1970.

	Same	2nd	3rd	4th	5th	Season					
						6th	7th	8th	9th	10th	11th
Number of recoveries	19	121	58	46	20	10	8	5	4	5	2
Cumulative percentage	6.4	47.0	66.5	81.8	88.5	92.0	94.6	96.2	97.6	99.3	100.0

were in by the end of the first season whereas more than half the birds ringed were probably already dead. The 81.8% overseas recoveries reported by the end of the fourth season is clearly highly representative. This study therefore can consider ringing up to and including the 1966-67 season, the fourth season recoveries of which will have been notified by the cut-off date of April 1970.

Since the bulk of overseas recoveries are of birds which are then adult, there is no need, in the general analysis, to differentiate according to age at ringing. New techniques of determining age by plumage examination were introduced during the period under review. It is now possible to allocate females into juvenile or adult categories with some confidence right through the catching season; there is still no certain method of ageing males beyond about November. So the proportion of birds which could be correctly aged would in any case vary according to sex and the year or month in which caught.

The sex of Mallard was, however,

The range of overseas recoveries has been divided into three areas, following national boundaries for convenience:—

Area 1: Soviet Union, Finland, Sweden, Norway (244 recoveries)

Area 2: Poland, East Germany, West Germany, Denmark (201 recoveries)

Area 3: Netherlands, Belgium, France (214 recoveries).

Only a small number of recoveries fell outside these three areas and were excluded from this analysis.

The number of recoveries will obviously bear a relation to the number of birds ringed. This is taken into account by using the parameter number of recoveries per thousand birds ringed in the appropriate category. Of course, the birds ringed will include a probable majority of British-bred birds. If the British breeding success varied widely from season to season this might result in apparent, but false, variations in the proportion of foreign immigrants. However, the Wildfowl Counts (Atkinson-Willes and Frith 1965, and unpublished)

gave a valuable clue here. The September index of the British Mallard population has varied from September 1957 to 1967 as follows: 75, 74, 100, 85, 114, 85, 92, 90, 92, 105, 126. Only in the first two and the last years were there major departures from the mean index, of 94, which might have led, respectively, to over-estimates and an under-estimate of the importance of Continental immigration.

We cannot so readily allow for variations in the likelihood of Mallard being shot and/or reported in the different areas overseas. Fortunately we are dealing with the North-west European flyway made up of conservationally progressive countries with reasonably short shooting seasons, except for France. Some of the countries to the north and east used to indulge in spring shooting, particularly of male Mallard, but this is now largely abandoned. The details of current European shooting seasons have been published by Lampio and Michaelis (1971).

Recoveries in Area 1

The easternmost area is the simplest to deal with as the recoveries reported will be of birds that bred within it, and will not include any passing through to other areas.

Earlier, Matthews (1963) had demonstrated that Mallard from this area did not reach Britain in appreciable numbers until November. He found that of the 61 Mallard ringed in Area 1 from 1911 to April 1962 and recovered in Britain, only 5% were before the end of October. He checked this conclusion by examining all recoveries in Area 1 of Mallard ringed in southern England from 1947 to April 1962. Again only a small proportion had been ringed early in the season.

If we examine the Borough Fen data, as in Table III, we see that the females

confirm Matthews' finding, the bulk clearly arriving in Northamptonshire after the beginning of November. Only recoveries made in the first four seasons after ringing are used so that the data for each ringing season are more nearly comparable. The males give quite a different picture, at least for the last seven years of the period under investigation. Now there appears little difference in the proportion present before and after 1st November. However, the first three seasons do appear to have been quite different, with much greater influxes of males after 1st November. This state of affairs perhaps was normal in earlier years. To check this we re-examined the Mallard ringed in Area 1 between May and October (mostly as pulli) and recovered in Britain, of which 95 are now available. Unfortunately, in only 27 cases was the sex given. If we exclude the 12 known females, the combined recoveries, split at 1959-60, are given in Table IV. This does suggest that in the earlier years more Mallard from Area 1 were coming to Britain later than they did after 1959-60. The difference is not significant, but might

Table IV. Recoveries of Mallard ringed in Area 1 and recovered in Britain up to December 1968. Known females (12) excluded.

<i>Month of recovery</i>	<i>Ringed up to 1959-60</i>	<i>Ringed after 1960-61</i>
August	1	—
September	—	1
October	1	5
November	9	6
December	18	12
January	15	6
February	5	1
March/April	3	—
	52	31

Table III. Rate of recovery (per thousand ringed) of Borough Fen Mallard in Area 1, for the first four seasons after ringing.

	<i>Males ringed July/October</i>	<i>Males ringed November/March</i>	<i>Females ringed July/October</i>	<i>Females ringed November/March</i>
1957-58	9	72	0	52
1958-59	12	34	7	38
1959-60	10	23	5	32
1960-61	14	11	4	19
1961-62	10	13	0	18
1962-63	12	9	2	38
1963-64	13	11	0	25
1964-65	10	14	2	13
1965-66	2	0	0	100
1966-67	14	9	4	32
All seasons	11	24	3	33
Total No. recoveries	70	47	17	76

have been more marked if other females could have been removed from consideration.

It is possible that the late-arriving males came from areas where spring shooting was previously practised. It has not been possible to get a clear understanding as to when spring shooting in the Soviet Union was effectively brought to a stop, but such a change might reduce recoveries in the way observed. Alternatively, of course, the males might just be wintering further east.

The proportion of male Borough Fen Mallard recoveries are shown in Table V.

stock, others will be passing through to or from Area 1. The recovery rates for the first four seasons after ringing are set out in Table VI. This indicates that Area 2 males are present in Northamptonshire in numbers similar to, though somewhat greater than, those from Area 1. From November onwards Area 2 males nearly double in proportion to the situation in the early part of the season. There is no indication of any abrupt and continuing change around 1960. There are, however, indications of massive changes in individual seasons, very few immigrants in 1964-65, unusually many in 1966-67.

Table V. The proportion of males in overseas recoveries of Borough Fen Decoy Mallard in different geographical areas (defined in text).

Season of ringing	Area 1		Area 2		Area 3	
	No.	% male	No.	% male	No.	% male
1957-58	46	48	22	82	25	60
1958-59	40	50	29	65	30	60
1959-60	43	47	30	67	33	55
1960-61	12	67	15	80	22	68
1961-62	19	63	21	76	19	53
1962-63	15	33	11	91	10	90
1963-64	18	61	17	59	15	67
1964-65	19	74	20	80	27	78
1965-66	6	17	16	81	16	50
1966-67	26	58	20	85	17	77
	244	54.6	201	75.0	214	63.0

In Area 1, with an overall 54.5%, the sex ratio is only slightly more biased towards the males than for recoveries in Britain. Certainly the small difference could be explained by such factors as the males completing their moult, and so coming under fire, earlier in the season than the females.

Recoveries in Area 2

Mallard recovered in Area 2 are clearly of mixed origin. Some are local breeding

These presumably relate to weather conditions in the years concerned.

The Area 2 females appear to be present in Northamptonshire in only small numbers before November. Thereafter they fluctuate widely from season to season, but the usual situation seems to be that many fewer come than do from Area 1. The seasons of influx, 1958-59, 1959-60, 1963-64, 1965-66, do not coincide with those of the males.

The outstanding feature of Area 2 recoveries is the astonishing imbalance

Table VI. Rate of recovery (per thousand ringed) of Borough Fen Mallard in Area 2, for the first four seasons after ringing.

	Males ringed July/October	Males ringed November/March	Females ringed July/October	Females ringed November/March
1957-58	16	30	3	6
1958-59	16	22	2	22
1959-60	13	17	2	19
1960-61	21	22	4	0
1961-62	13	17	3	7
1962-63	10	27	0	7
1963-64	10	22	3	25
1964-65	11	9	2	4
1965-66	22	30	2	20
1966-67	7	47	3	4
All seasons	13	23	2	12
Total No. recoveries	84	46	15	28

of the sex-ratio. Table V shows this to be consistent through the years and, overall, that there are 75% males, three to every female. One would not expect such a difference from Area 1 (55% males) because many of the explanations for the Area 2 ratio would also seem to apply to Area 1. For instance, adult males are on the wing earlier in the autumn than the females, so more males are at risk at the beginning of the shooting season, when shooting pressure is likely to be at its highest.

Abmigration could be biasing the sex-ratio if sedentary British males were selectively pairing with foreign females and following them on migration. But there appears little difference in the numbers of Area 2 and Area 1 females arriving in Britain before November, and thereafter Area 1 females are much more plentiful. Again, the seasons when there were late influxes of Area 2 females do not consistently coincide with or precede seasons with large numbers of male recoveries. Another postulate is that males of sedentary British stock, although willing to pair off with a foreign female, have an inbuilt resistance to flying long distances. A mixed pair might thus come to rest in the intermediate area as a compromise between conflicting tendencies.

Recoveries in Area 3

The Mallard recovered in this Area will be of the most mixed origins, including not only those breeding there but others passing through on the way to and from both Areas 2 and 1. The recovery rates are set out in Table VII. These indicate that before November males from Area 3 are about as plentiful in Northamptonshire as those from the other two areas. From November onwards they are rather

more likely to be present, but not markedly so. Some fluctuations between seasons are indicated but on the whole the results are pretty homogenous.

The females again lag behind the males in coming to England, but rather more have reached us by the end of October than from the other areas. This probably reflects an early completion of the breeding season. However, no more seem to come from November onwards than from the more distant Area 2. Likewise, there are wide fluctuations from season to season.

The males are still predominant among the recoveries, comprising 62.9%. However, this is unexpectedly lower than that for the more distant Area 2. If abmigration is playing a part it would seem that the rather higher incidence of Area 2 females early in the season would provide more, not less, opportunities for inter-population crosses. However, it might be also argued that, if the Area 3 females finish breeding earlier, there is more chance of them mating up with their own males and migrating with them to England. The situation can hardly be said to be clear.

Further considerations on abmigration

If abmigration is a possible explanation of the sexual imbalance of the overseas recoveries, it might be expected to show more clearly in juvenile males. These could be expected to have less attachment to their homeland than mature birds that had bred there for at least one season. It was explained earlier that the ageing of males was not a reliable technique after the end of October, which greatly reduces the sample available for comparison. This does show a slight tendency for juvenile males to have a higher recovery

Table VII. Rate of recovery (per thousand ringed) of Borough Fen Mallard in Area 3, for the first four seasons after ringing.

	<i>Males ringed July/October</i>	<i>Males ringed November/March</i>	<i>Females ringed July/October</i>	<i>Females ringed November/March</i>
1957-58	9	29	5	12
1958-59	8	37	7	16
1959-60	10	23	6	13
1960-61	16	78	9	20
1961-62	8	21	8	11
1962-63	10	18	2	0
1963-64	8	22	3	10
1964-65	10	32	3	9
1965-66	14	30	11	40
1966-67	11	9	4	4
All seasons	10	27	6	12
Total No. recoveries	67	54	36	36

rate abroad, though the difference is not significant in itself (Table VIII). However, one must take into account the much higher mortality among juveniles. For birds ringed before the end of October, this will mostly be in the autumn and winter in Britain. There will thus be proportionately less birds marked as juveniles left to give overseas recoveries. If we express the latter not per thousand ringed but per estimated thousand ringed and surviving to, say, the following April, we have overall rates juveniles 89, adults 66. This does provide some rather stronger suggestion that the juveniles are more prone to abmigrate.

Table VIII. Rate of recovery (per thousand ringed) of Borough Fen Mallard males, ringed July/October.

	Juveniles		Adults	
	No.	%	No.	%
Area 1	64	11	6	7
Area 2	70	12	10	12
Area 3	72	12	10	12
All areas	206	35	26	29

Rather few wild Mallard are ringed in England as pulli and thus of undoubted English origin. However, the Wildfowlers' Association of Great Britain and Ireland (W.A.G.B.I.) have reared over 126,000 young Mallard of wild stock over the last twelve years. These have been ringed and released on reserves, i.e. not for immediate shooting. Nearly 9,000 subsequent recoveries have been reported. Post-fledging dispersal may carry some birds, especially from the southern English counties, overseas to the mainland continent. Harrison and Wardell (1962) therefore restricted the term abmigrant to those recoveries overseas made after the end of the year of release. Wardell (1967) reviewed the situation when 130 such probable abmigrants were known and records in succeeding W.A.G.B.I. Annual

Reports to 1969-70 have raised the total in this category to 150 recoveries. But since by no means all of the birds have been sexed on release (giving a sex-ratio near unity), only 79 are useful for our present purpose. In Area 1 there were 12 males against seven females; in Area 2, 16 males against six females. As far as they go these figures would confirm the selective abmigration of males, even to the higher ratio in Area 2. However, the recoveries in Area 3 completely confuse the issue for here there were 13 males and 25 females. One would need to postulate that not only were post-fledging dispersals predominantly in this area, but also that young females were more prone to wander than males. It would seem safer at present to accept the indication of the overall sex ratio of the recoveries, 41 males: 38 females, that abmigration is not predominantly confined to males.

The W.A.G.B.I. results did indicate a higher proportion of abmigrants (2.8-5.0 per thousand birds released) from the eastern regions of Britain than from the midland and western regions (0.4 to 1.9 per thousand). This accords well with the observation that Continental immigrants are recovered mainly in eastern Britain (Matthews 1963), i.e. where they provide greater opportunities for inter-population crosses.

Variation of immigration within and between seasons

The data are not extensive enough to allow a consideration of immigration influxes on a monthly basis Area by Area. However, we have seen that, apart from the first three seasons in Area 1, the males from the three areas have given rather similar results. We can, therefore, with some confidence, combine the results for the males for consideration on a monthly basis (Table IX). Those months marked

Table IX. Rate of recovery (per thousand ringed) overseas of Borough Fen male Mallard, for the first four seasons after ringing.

	July	Aug.	Sept.	Males ringed in				Year	Total recoveries	
				Oct.	Nov.	Dec.	Jan.			
1957-58	x	x	35	26	144	48	257	x	67	46
1958-59	x	79	31	55	72	85	x	x	58	48
1959-60	x	20	42	27	43	30	72	200	x	40
1960-61	x	0	69	80	64	x	x	x	62	32
1961-62	x	14	68	0	38	x	48	38	79	47
1962-63	x	96	27	34	38	x	x	x	33	22
1963-64	x	23	36	25	70	x	68	x	35	29
1964-65	16	48	28	32	25	x	x	124	36	46
1965-66	22	7	59	54	x	x	x	x	39	21
1966-67	x	28	32	63	55	38	x	108	x	39
Ten years	16	29	40	38	57	47	96	86	90	37
Total recoveries	2	40	143	54	54	19	24	18	15	369

(x) are when insufficient birds were ringed to give a reasonable chance of a recovery. The limit has been taken, rather arbitrarily, as 30 birds per month (see Table I).

Taking the male ten-year figures first, it is clear that the foreign element is lowest in July and August and slightly larger in September and October. It rises sharply in November, falls again in December (perhaps as migrants disperse or pass through) and reaches its highest value in January and February and maintains it in March. When we consider the results season by season, the foreign element has been remarkably stable in the more recent years, settling down from the early high level, due mainly, as we have seen, to the change in the Area 1 pattern.

Turning to the consideration of months within particular seasons, it is noticeable that for males August is a month of wide variations. However, the August values, high or low, are not continued on through the succeeding months and it is probable that movements separate from the main seasonal migration, e.g. the moult migration, are involved. September is a homogenous month, with only two values

of duck decoys, that their catches of Mallard fall away at the interesting time of the year as far as foreign immigrants are concerned. As can be seen from Table I efforts have lately been made to boost the catch at Borough Fen during the winter months. An inland decoy faces particular difficulties in severe weather since not only will the pond freeze, but the Mallard will tend to move coastwards to the still open estuaries. The Trust's recently-acquired decoy at Nacton, Suffolk, may be better placed in this respect and clearly emphasis will have to be laid on late winter catches here and at the trapping station on Abberton Reservoir, Essex.

Turning to the females, one should exercise more caution in combining the results from the three areas, when quite considerable differences have been detected between their migratory patterns. However, for the sake of completeness, and to draw comparisons with the males, this has been done in Table X.

The ten-year figures indicate that the foreign female element is lower than the male in every month except December. It builds up more strongly and smoothly to a peak in that month which is carried

Table X. Rate of recovery (per thousand ringed) overseas of Borough Fen female Mallard, for the first four seasons after ringing.

	<i>Females ringed in</i>										<i>Total recoveries</i>
	<i>July</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Year</i>	
1957-58	x	x	12	16	55	75	48	88	x	35	26
1958-59	x	25	12	37	48	89	88	x	x	41	37
1959-60	x	18	15	7	24	41	176	111	x	28	37
1960-61	x	0	20	32	56	x	0	x	x	22	12
1961-62	x	8	12	13	28	26	20	80	29	18	17
1962-63	x	0	6	0	44	x	x	x	x	14	8
1963-64	x	24	3	12	20	x	59	x	x	20	16
1964-65	0	0	10	10	24	x	x	x	x	10	13
1965-66	15	13	15	0	x	x	x	x	x	24	15
1966-67	x	15	6	19	20	89	29	0	x	18	18
Ten years	6	10	11	15	33	72	75	74	62	19	
Total recoveries	1	13	39	22	36	36	25	18	9	198	

deviating widely from the mean. In 1960 the high value was continued into October and we can properly speak of an unusually marked early autumn wave of migrants. In 1961, however, the October value was low. There was another low October in 1963 and a high one in 1966. November values were not widely spread, but there were obviously extraordinarily many foreign males in 1957 and rather few in 1964.

From December onwards the picture with regard individual months largely collapses because of inadequate numbers of birds caught. This is a serious weak-

ness of duck decoys, that their catches of Mallard fall away at the interesting time of the year as far as foreign immigrants are concerned. As with the males, the female foreign element has remained remarkably consistent from season to season, after dropping from a high level in the first two. We have seen, however, that a low British-bred Mallard population in those years may have inflated the apparent proportion of foreign birds present.

On the individual months level, August is again variable, but the female high and low incidences seldom coincide with those of the males. Likewise September is more homogenous for arrivals and a high value

for 1960 is recorded for females as well as males, and again carries forward into October. The rest of that month appears more variable than, and not coincident with, the male pattern. In November the high and low of the males in 1957 and 1964 are matched by the females, but the latter's high in 1960 is more exaggerated. From December onwards the monthly picture is again incomplete.

The general lack of coincidence between male and female peaks and lows suggests that they do not reflect population changes but, rather, changes in weather conditions. As the males and females time their migrations differently, they will seldom be influenced by the same weather unless it is very widespread.

Conclusions

It is clear that in any programme of research, or management, concerned with the immigration of foreign Mallard into Britain, we must differentiate between the sexes.

If the requirement is to study definitely British-bred stock then it is best to concentrate on females from July to September though even as late as October their foreign element is small. It is relatively high in the males throughout the season, though much higher after the turn of the year.

There has been relatively little variation in the foreign element over ten years and it is probable that, as in Britain itself, there are seldom wide fluctuations in the breeding success of Mallard in the North-west European flyway.

The problems of abmigration appear to have been added to, rather than solved by the present study. The extraordinary imbalance of the sexes in Area 2 remains a mystery.

As far as planning of the ringing effort is concerned it is clear that the late-winter results are inadequate and must be increased, in conjunction with the east coast

stations. A theoretical alternative would be to abandon late winter ringing in Britain and rely on the birds coming to us being adequately ringed in their natal areas. However, international co-operation is not yet sufficiently far advanced for such a rationalisation.

It has been suggested that ringing of Mallard could be reduced earlier in the season to cut administrative costs at the ringing office. The companion study of the recoveries in Britain will enable decisions to be made on the quota of birds needed to be ringed per unit time to provide statistically satisfactory data on such aspects as changes in dispersion and mortality from year to year. The indications already are that current levels are seldom enough when one researches in depth. What the present study does show is that there are no grounds for cutting down on any one autumn month because the birds caught then are particularly mixed in their origins. October in fact differs little from September in this respect. The foreigners really only start to mount up in November, by which time the difficulties of catching are already providing their own ceiling.

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Summary

Mallard *Anas platyrhynchos* ringed at Borough Fen Decoy, Northamptonshire, include a proportion of winter visitors of foreign origin. The sex ratio at ringing is close to 1:1 but the overseas recoveries show a marked preponderance of males in Denmark, Germany and Poland (75%) but only slightly larger numbers in France and the Low Countries or in Scandinavia and the U.S.S.R.

Much larger numbers of males from the most eastern area came to Britain after 1st November in the first three years of the study (1957-58 to 1959-60) than have since. Recoveries in Britain of Mallard ringed overseas appear to confirm this finding. No such changes have occurred relating to areas closer to Britain.

Abmigration may be a cause of the sexual imbalance of the recoveries. Differences between seasonal recovery patterns are examined.

References

- ATKINSON-WILLES, G. L. and J. C. FRITH. 1965. Trends in the populations of British wintering ducks 1961-64. *Wildfowl Trust Ann. Rep.* 16 : 21-29.
- BAUER, K. M. and U. N. GLUTZ VON BLOTZHEIM. 1968. *Handbuch der Vögel Mitteleuropas*. Vol. 2 : 408-10. Frankfurt am Main: Akademisches Verlagsgesellschaft.
- BOYD, H. and M. A. OGILVIE. 1961. The distribution of Mallard ringed in southern England. *Wildfowl Trust Ann. Rep.* 12 : 125-36.
- HARRISON, J. G. and J. WARDELL. 1962. W.A.G.B.I. hand-reared Mallard as abmigrants. *W.A.G.B.I. Ann. Rep. 1961-62* : 29-33.
- LAMPPIO, T. and H. K. MICHAELIS. 1971. Wildfowl hunting seasons and methods in Europe 1969-70. *Proc. Int. Conf. Conservation Wetlands and Waterfowl, Ramsar*.
- MATTHEWS, G. V. T. 1963. 'Nonsense' orientation as a population variant. *Ibis* 105 : 185-97.
- THOMSON, A. L. 1931. On 'abmigration' among the ducks: an anomaly shown by the results of bird-marking. *Proc. 7th Int. Orn. Congr., Amsterdam*.
- WARDELL, J. 1967. W.A.G.B.I. hand-reared Mallard as abmigrants. *W.A.G.B.I. Ann. Rep. 1966-67* : 51-53

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