HARRISON, J. M. and J. G. HARRISON and P. J. S. OLNEY. 1962. A gravel pit wildfowl reserve. *Wildfowl Trust 13th Ann. Rep.*: 101-108.
KEAR, J. 1963. The agricultural importance of wild goose droppings. *Wildfowl Trust 14th Ann. Rep.*: 72-77.
MATTHEWS, G. V. T. 1960. An examination of basic data from wildfowl counts. *Proc. 12th Int. orn. Congr., Helsinki, 1958*: 483-491.
MILLS, D. H. 1962. The Goosander and Red-breasted Merganser in Scotland. *Wildfowl Trust 13th Ann. Rep.*: 79-92.
OLNEY, P. J. S. 1963. Wetland wastage. *Wildfowl Trust 14th Ann. Rep.*: 78-80.

A nesting study of Mallard in Berkeley New Decoy, Slimbridge

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Summary

Mallard nesting in the Decoy wood were studied in 1961-63. 224 nest-sites used are discussed in relation to available habitat. There is some evidence that individual females have traditional sites. The onset of laying was 3 weeks later in 1962 and 1963 than in 1961, when it began in mid-February. The average size of early clutches was 12·6 eggs and that of later ones 9·9 eggs. Though one egg was usually laid each day, there was often a gap of a day during the laying of the first seven eggs. The average incubation period of 51 clutches was 27·6 days, the range 24-32 days. 88·7% of 180 nests were successful and 82·4% of eggs hatched. The association of first laying with spring temperatures is examined and compared with Continental studies.

During the three breeding seasons of 1961-63, a study was made of the Mallard (*Anas platyrhynchos* L.) nesting in the wood surrounding the pool of Berkeley New Decoy at Slimbridge, Gloucestershire. The wood is four acres in extent and encloses the decoy pool of 0·85 acre. It is divided into many small parts by the four pipes leading off the pool, and by numerous connecting paths. The trees are mostly deciduous with a few large oaks, elms and in particular willows, with dense thickets of hawthorn and bramble, and considerable areas with nettle and rush undergrowth. Two rhines, or drainage ditches, run along most of the perimeter.

Once a nest was found it was visited daily while laying was in progress and then only occasionally until hatching was due. If laying had been completed before the nest was discovered it was visited every second day so that the hatching date was not missed. Table I gives the number of nests found in the three years, distributed in seven categories of nest-site. Nests that for some reason were not completed are included here, but re-nestings in the same site in one year are not.

The drop in the number of nests in 1962 is mostly due to the removal from the area of some of the breeding birds at the end of the previous summer. This was part of the campaign to reduce the number of Mallard living in the Wildfowl Trust's pens adjoining the Decoy wood. The effect was short-lived, as will be seen from the total for 1963.

Differences in site-preference between the three years are not great. The major variation, that of an increased proportion of nests in thick cover in 1963, was due to the only noticeable habitat change in the period which was the compressing of areas of rather straggly bush cover into thicker scrub by the heavy snowfalls of the previous winter. The first four categories show a remarkably consistent use of the constant quantity of available sites. There did not appear to be a directional preference in the positioning of nests at the foot of trees or fences.

Table I. Distribution of nest sites used by Mallard in 1961-63

description of site	*1961*	*1962*	*1963*	*total*
crown of pollarded willow	5	5	4	14
inside base of tree or stump	11	6	9	26
foot of tree	12	8	10	30
foot of board fence	4	2	2	8
thick cover: brambles, shrubs	29	15	33	77
thin cover: nettles, rushes	25	16	17	58
open	3	4	4	11
	89	56	79	224

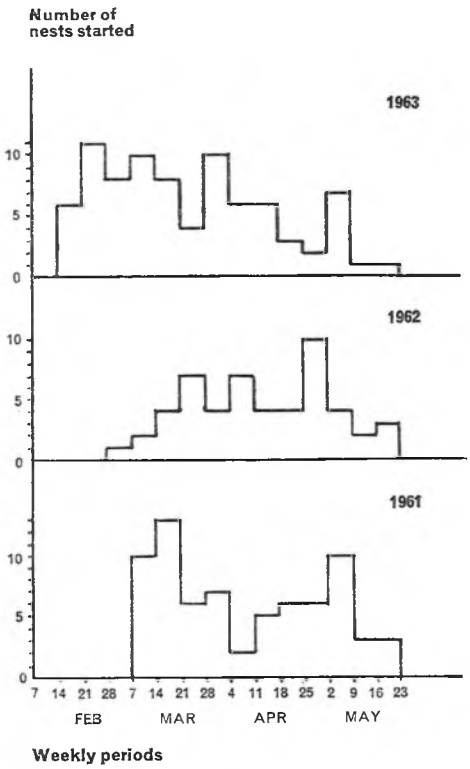

Figure 1. Dates of laying of first eggs in Mallard clutches at Slimbridge in 1961-63. Records grouped in weekly intervals.

In 1962 seven females were caught by hand on the nest and ringed. Five of these were re-caught the following year, three in exactly the same nest-site, one within five yards, and one a considerable distance away, though still on the same side of the pool. This last bird nested both years on the ground in thick cover. The other four were all in clearly-defined sites, inside a hollow tree or on the ground at the foot of a tree. A further thirteen birds were caught on the nest in 1963 and this study of tradition in site-selection will continue.

The dates of laying of the first egg in each clutch in the three years are compared in the histograms of Figure 1. Few nests were located when containing only one egg and extrapolation has been used to discover the date, based on an average laying-rate derived from those nests found before the completion of laying. Just over 40 nests were found sufficiently early in the laying period for the information to be useful.

The birds studied here quite often missed a day early in the laying period. Of 16 nests found with five eggs or fewer, 10 missed a day, and 3 missed two days during the laying of the first seven eggs. This is at variance with the generally accepted laying rate of one egg per day (Eygenraam 1957, Hochbaum 1944, Sowls 1955). A possible cause is the disturbance involved in locating the nest, but on only two occasions was the female present when the nest was found, and over half the nests were in situations which it was possible to reach without leaving a trail.

The histograms record the number of nests started in seven-day periods. There is a three-week difference between the onset of breeding in 1961 and in the two subsequent seasons. Evidence from previous years suggests that the second half of February is the normal starting period for the population of Mallard at Slimbridge following a mild winter. 1961 is therefore taken as an average season. In 1963 nesting was delayed by the hard weather, but, within one week of the cessation of the continuous frosts at the beginning of March, the first birds were laying. In 1962 the picture is less clear-cut with periods of ground frost in the second week of February and in early March when the birds might have been laying and temperatures remaining below average until late March. This probably accounts for the slow start to the season compared with the other years. The timing of the breeding season at Slimbridge is compared with other European studies in a later section.

A well-marked reduction in the number of clutches started occurs about five weeks after the onset of breeding but is soon followed by an increase. This increase can be attributed to the laying of second (repeat) clutches by the early nesters. Collecting eggs has also been undertaken in recent years to try and reduce the number of Mallard in the enclosures of the Wildfowl Trust. The eggs from the nests in the Decoy in the three years of the study were collected at the pipping stage and hatched in an incubator. The ducklings were subsequently reared by hand away from Slimbridge. Thus the female Mallard were relieved of their maternal duties to their first brood and free to make a second attempt. The occurrence of second clutches produces a slight lowering of the mean size between clutches laid in the first five weeks of the season and those laid subsequently (Table II). The average size of 95 early clutches is $12 \cdot 60 \pm 0 \cdot 220$ eggs and that of 114 later ones $9 \cdot 88 \pm 0 \cdot 203$ eggs. The means for the three seasons are very similar. The largest clutch for which only one female was believed responsible was 18. Five nests were found with clutches of 18 to 20, which could definitely be attributed to two females. In four of them eggs were laid at two

Table II. Clutch size and date of laying of Mallard. Completed clutches only

maximum clutch size	*1961 begun*			*1962 begun*			*1963 begun*		
	before 20 Mar	*after 20 Mar*	*total*	*before 5 Apr*	*after 5 Apr*	*total*	*before 7 Apr*	*after 7 Apr*	*total*
4								1	1
5		2	2		1	1			
6				1	1	2			
7		2	2	1	2	3		3	3
8	1	3	4		4	4	2	3	5
9		12	12		5	5		10	10
10	3	3	6		8	8	4	10	14
11	5	12	17	2	7	9	10	3	13
12	12	3	15	5	6	11	5	2	7
13	7	1	8	3	1	4	5	3	8
14	5	1	6				7	1	8
15	3	2	5	3		3	3		3
16	2		2	3		3	1	1	2
17							1	1	2
18	1		1						
total	39	41	80	18	35	53	38	38	76
mean	12·6	10·0	11·3	12·6	9·8	10·8	12·3	10·1	11·2

a day for at least part of the laying period, and in the other some of the eggs were of a markedly different colour and size from the rest. At no nest was more than one female seen at a time. In one nest with 19 eggs the female was clearly unable to cover all the eggs properly and only 9 hatched, though the rest had developed partly before dying. All the other females on large clutches brooded them successfully, usually by arranging the eggs in two layers.

The incubation period of a clutch was measured from the day the last egg was laid (Day 1) to the day the last egg hatched. The spread of hatching was usually about 24 hours, extending in a few cases to as long as 36 hours. Of the 51 clutches for which these data were available the incubation period varied from 24 days to 32 days with a mean of 27·6 $\pm$ 0·23 days, a figure in close agreement with other results (Witherby *et al.* 1939). The proportion of successful nests was high; 180 nests (88·7%) of the 203 completed nests recorded in the three years. (A successful nest is one in which at least one egg of the clutch hatches.) Of the 23 completed nests that failed entirely, 12 (5·9%) were deserted by the female and 11 (5·4%) suffered predation.

A more detailed analysis of hatching success is given in Table III. Here the figures used refer to the eggs rather than nests. Percentages are used to allow direct comparison between seasons. Eggs that failed to hatch were opened to determine whether or not they were fertile and if possible to learn why hatching did not take place. In 1961 (but only in that year) a number of congenital deformities was found in embryos from unhatched eggs (Harrison and Kear, 1962; Napier, 1963; Kear, 1964). Included in the losses to predators is a small number of eggs that disappeared from nests in circumstances where predation was not the cause. Some of the tree-top sites had room for only a small clutch of eggs and one or two instances were recorded of females knocking an egg out of an overfull nest.

The outstanding feature of Table III is the constant hatching success. 1963 shows the most variation with a marked decrease in the infertility rate and an increase in the amount of predation. In the previous two seasons there were females which laid com-

Table III. Fates of eggs in Mallard nests, 1961-63

fate	*1961* %	*1962* %	*1963* %	*total frequency* %
hatched	81·2	83·3	83·1	82·4
failed to hatch	4·1	3·4	3·0	3·5
infertile	4·7	6·3	1·4	3·8
predation	6·0	4·5	10·0	7·1
desertion	4·0	2·5	2·5	3·1
total eggs in sample	959	527	806	2,292

plete clutches of infertile eggs and the drop may be because these particular birds had failed to breed at all in the third year. However, the number of nests with one or two infertile eggs, which are not uncommon, was also reduced. Predation increased in 1963 in both the number of nests completely robbed and in the number that lost part of their clutches. The Decoy wood is trapped for rats, stoats, etc., and crows and magpies are actively discouraged from the area. There was no direct evidence for an increase in predators but this would appear to be the explanation. In two cases eggs disappeared from the nest at the rate of one a day for seven successive days. This was probably the work of a mammalian rather than an avian predator.

This study of nesting Mallard shows a close agreement in the proportion of successful nests and eggs with two American studies (Tables IV and V).

The success of females rearing broods has not been studied because very few clutches have been left to hatch in the nest. However, there is probably a very high mortality of newly-hatched ducklings in the Decoy due to the obstacles in the way of the female leading her brood from the nest to the pool. As well as the fences shown on the map, the outside curves of all four pipes are lined with overlapping straw or reed screens and there is no access to the water at ground level. If a brood does reach the pond, survival is again small which may well be partly blamed on the steep banks with a shortage of places where the ducklings can be brooded on dry land. The broods that find their way into the two rhines are more often reared successfully.

Comparable material from Europe for any part of this study is slight. The start of nesting is the only subject given any widespread attention. Bezzel (1962), working near Munich, found that the first nests appeared from the third week in March to the third week in April. He correlates first laying dates with the occurrence of above average spring temperatures seven to nine days before laying. This is evidence of a slower reaction to temperature than that shown by the birds at Slimbridge. Using the grass temperatures measured at the nearest Meteorological Station, 15 miles away near Bristol, laying began in 1961 five days after the end of a week of near zero readings. In 1963 the time interval was just four days after the last ground frost which ended a nearly continuous spell of ten weeks. In both years subsequent single nights of frost

Table IV. Success of Mallard nests at Slimbridge and in Idaho and California

	Gray's Lake, Idaho 1949-51 (Steel et al. *1956)*	*Tule Lake, California 1952 (Miller & Collins, 1954)*	*Slimbridge, Glos. 1961-63*
successful	85 (*68·6%*)	178 (*85·1%*)	180 (*88·7%*)
predation		8	11
destroyed (flood, cattle)	39	7	–
deserted		16	12
total	124	209	203

Table V. Fate of eggs in successful nests of Mallard at Slimbridge and in Idaho and California

	Gray's Lake, Idaho 1949-51 (Steel et al. *1956)*	*Tule Lake, California 1952 (Miller & Collins, 1954)*	*Slimbridge, Glos. 1961-63*
	%	%	%
hatched	89·8	91·4	92·6
failed to hatch	5·2	4·9	2·9
infertile	3·0	1·6	2·2
predation	1·9	2·1	2·3
total number of eggs	689	1,622	2,039

produced a corresponding gap in the appearance of first eggs. The picture is less clear in 1962 when there was a very gradual start of laying with the first seven nests appearing over a fortnight compared with under a week in the other two seasons. Temperatures were below average throughout February and most of March, 1962, though with few extremes recorded. Eygenraam (1957) gives hatching dates in Holland for the years 1950-54, and laying dates estimated from his results indicate that nesting was nearly a fortnight later than average in 1954, when there was a cold spell over much of Europe in February. The normal appearance of nests in Holland is in the last week of February and the first of March; a fairly close parallel with Slimbridge. Eygenraam's material was gathered from populations in town parks as well as from more natural areas. He concludes that there is little difference between the two.

In England there is a need for further work concerning the variation in different years of the onset of laying and into the factors which govern it. A closer understanding is required of the relationship of the nesting bird to its environment.

I wish to thank Dr. Janet Kear and Miss Susan Loader for ensuring continuity in the nest-records during my brief absences from Slimbridge in each of the three seasons.

References

BEZZEL, E. 1962. Beobachtungen über Legebeginn und Legezeit bei Entenpopulationen. *Anz. orn. Ges. Bayern* 6: 218-233.

EYGENRAAM, J. A. 1957. The sex-ratio and the production of the Mallard *Anas platyrhynchos* L. *Ardea* 45: 117-142.

HARRISON, J. and J. KEAR. 1962. Some congenital abnormalities in the beaks and skulls of wildfowl. *Vet. Rec.* 74: 632-633.

HOCHBAUM, H. A. 1944. *The Canvasback on a Prairie Marsh*. Amer. Wildlife Inst., Washington. 201 pp.

KEAR, J. 1964. Congenital malformation in birds bred at Slimbridge. *Wildfowl Trust 15th Ann. Rep.*: 99.

MILLER, A. W. and B. D. COLLINS. 1954. A nesting study of ducks and coots on Tule Lake and Lower Klamath National Wildlife Refuges. *Calif. Fish and Game* 40: 17-37.

NAPIER, A. 1963. Congenital malformations of the feet of Mallard ducklings. *Wildfowl Trust 14th Ann. Rep.*: 170.

SOWLS, L. K. 1955. *Prairie Ducks*. Stackpole, Harrisburg. 184 pp.

STEEL, P. E., P. D. DALKE and E. G. BIZEAU. 1956. Duck production at Gray's Lake, Idaho, 1949-1951. *Journ. Wildl. Mgt.* 20: 279-285.

WITHERBY, H. F., F. C. R. JOURDAIN, N. F. TICEHURST and B. W. TUCKER. 1939. *The Handbook of British Birds*, Vol. III. London. 387 pp.

Birds at Borough Fen Decoy in 1963

W. A. COOK

In the Fourteenth Annual Report (at pp. 150-152) an account was given of the habitats provided by Borough Fen Decoy and of the birds other than ducks which occur there. The progress of ringing in 1960-62 was also described. Counting and ringing was continued in 1963. Though these activities remain secondary to the main activity of the decoy, which is to catch ducks, they provide information which is of general interest, particularly in respect of the effects of the cold winter of 1962-63 on the small birds of the area.

Seven new species were recorded for the first time in 1963: Bewick's Swan[1] (an adult, 2nd-3rd April); Common Sandpiper and Greenshank (both irregularly during August); Nightjar (10th-18th September); Icterine Warbler (trapped and ringed 10th July); Siskin (trapped and ringed 19th October); and a Little Bunting, seen 4th-5th April.

[1] scientific names of species mentioned are listed at the end of the paper.

The cold spell

The pond was frozen from 18th December, 1962, and most of the duck had left by 22nd, though two Teal appeared on 27th and flocks of 4 to 10 flew over the pond up to 8th January. The Wash area was more fortunate than most of the rest of the country in that there was little snow. At no time during the winter was the top of the stubble covered in the fields surrounding the Decoy. The