A survey of the ducks breeding at Loch Leven in 1966

H. BOYD and C. R. G. CAMPBELL

Summary

Seven species of ducks nested on Loch Leven in 1966. Seven hundred and five nests were found, nearly all on one island, of 105 acres: Tufted Duck 323, Mallard 285, Gadwall 41, Wigeon 41, Teal 9, Shoveler 6, and 5 broods of Shelducks. About two-thirds of the nests of dabbling ducks and a third of the Tufted Ducks' nests were known to have been successful. Predation by Jackdaws caused most egg losses, which were heaviest in June. Rough estimates from changes in brood-size suggest that not more than 1,900 young ducks reached the flying stage, about three-fifths of those hatched.

Introduction

Loch Leven has long been famous as one of the few places in Britain where a large number of ducks breed. When the Loch was declared a Nature Reserve in the spring of 1964 it became possible to consider intensive research on the breeding wildfowl. Some preliminary work was done in the summer of 1965. In 1966 the authors, members of the Wildfowl Trust research unit, were able to devote most of their time from April to August to finding out how many ducks tried to breed in the Reserve and how many ducklings were reared. Since much of the work was concerned with the practical difficulties of operating on the Reserve and how far they might limit the possibilities for long-term studies and since any population study gains greatly in value by being continued for several years, it would be inappropriate to present the results obtained in 1966 in a definitive form. This brief account may, however, be of use in suggesting what kinds of questions might be answered by sustained investigations at Loch Leven.

Loch Leven is at Kinross, in central Scotland. It lies at 350 ft. above sea level, with the Lomond Hills to the north and Benarty Hill to the south. The Firth of Forth is some nine miles distant to the south and the Firth of Tay eleven miles to the north-east. There are many other natural lochs and reservoirs within 20 miles, but none comparable in size with Loch Leven itself, which has a water area of about 3,350 acres and a perimeter of some eleven miles. The loch is comparatively shallow, with a mean depth of just under 15 ft., and half of it is less than 10 ft. deep. Since 1830 the water level has been controlled by sluices at the outflow of the River Leven, which permit a maximum draw-down of $4\frac{1}{2}$ ft. The day-to-day level is determined by the needs of the industrial users of the water a few miles east along the river, not by the condition of the loch itself. Work has recently begun to determine the feasibility of increasing the use of the loch as a reservoir by intermittent additions of water from the River Devon (six miles west of the loch) to offset greater withdrawals. Biologists must be concerned about the consequences of even more "unnatural" changes in the water level.

The loch has been chosen as the site of a major investigation of eutrophication and freshwater productivity as part of the British contribution to the International Biological Programme. This is primarily the responsibility of a team from the Nature Conservancy and the Freshwater Fisheries Laboratory at Pitlochry. The wildfowl studies are being incorporated into this effort, with special emphasis being put on

the productivity of the Tufted Duck, since this species, unlike the dabbling ducks, feeds almost entirely on the loch itself.

The principal economic value of the loch lies in the trout fishing which lasts from April to September and which is carried out entirely by anglers fishing from boats. Though they are free to choose where to fish on the loch, the points where they may land around its shores or on its islands are greatly restricted. The general public have access to the shore only near Kinross town, on part of Castle Island, and along two short stretches at the north and south-east.

There are six permanent islands in the loch of which St. Serf's Island, of 105 acres, is much the largest and most important to ducks. There is a shelter for fishermen at the south-east corner and they are also permitted to land at one other point but no one is allowed to move about on the island without permission. Rather more than half the island is covered in rough pasture, grazed by sheep in summer. The vegetation of the northern half comprises tracts dominated by tufted hair grass *Deschampsia caespitosa;* by low trees, mostly willows *Salix* spp.; by reed grass *Phalaris arundinacea*; and another seven acres where these dominant plants are mixed and where tracts of nettles *Urtica* spp. also occur. The pasture and the tree-covered areas are relatively little used by ducks but the remaining 33 acres are extremely attractive to them.

Duck numbers in April-June, 1966

The numbers of ducks on and near the loch in the spring were determined by a series of counts made early in the morning (when the ducks tend to be most visible and before the fishermen's boats are out). The whole loch and some of the adjacent fields, particularly in the south-east, were searched, and the numbers of males and females of each species seen in different sectors were recorded separately. The pooled figures for the entire area are shown in Table I. Detailed mapping of the distribution on different sectors on successive days was attempted early in April. This proved unsatisfactory and was abandoned in favour of quick complete circuits, but as a result no full counts are available before late April. This was certainly too late to detect many nesting Mallard and early-nesting individuals of the other dabbling ducks. After the first week in June these counts were discontinued, as the male dabbling ducks were going into eclipse and disappearing or becoming unrecognisable.

A second source of information was a search for ducks' nests. This was largely concentrated on St. Serf's Island, where most of the nests were, though the other islands were visited at intervals of about ten days and the suitable areas around the perimeter of the loch were also looked at, with diminishing frequency as the season progressed and so few nests were found there. The nests found are recorded in Table II.

Table I. Numbers of ducks seen on Loch Leven N.N.R. from late April to early June, 1966.

n.s. = not sexed; — = no successful count; 0 = none seen.

		Teal *Anas crecca*		Mallard *A. platyrhynchos*		Gadwall *A. strepera*		Wigeon *A. penelope*		Shoveler *A. clypeata*		Tufted Duck *Aythya fuligula*		
Date		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	n.s.
Apr.	20		—		—		—	47	31		—			953
	28		—		—	12	11	19	14a)		—		—	
May	6	3	1	168	70	25	22	21	12	2	1	533	386	16
	17	2	0	123	47	15	11	19	7	13	1	442	281	7
	24	5	2	218	70	8	4	17	7	10	2	511	323	
June	1	1	1	311	74	22	9	13	3	9	0	832	556	
	6	4	2	256	66	26	9	19	5	13	2	565	334	52
	7	2	2	117	30	16	11	12	2	6	1	628	403	36

a) + 29 n.s.

Table II. Number of ducks' nests found on Loch Leven, N.N.R., April—July, 1966.

Species	*St. Serf's Island*	*elsewhere*	*most in use at one time*
Teal	9	—	6
Mallard	268	15	156
Gadwall	41	(2?)	25
Wigeon	41	—	28
Shoveler	6	—	5
Tufted Duck	320	3	200
Total	685	20	420

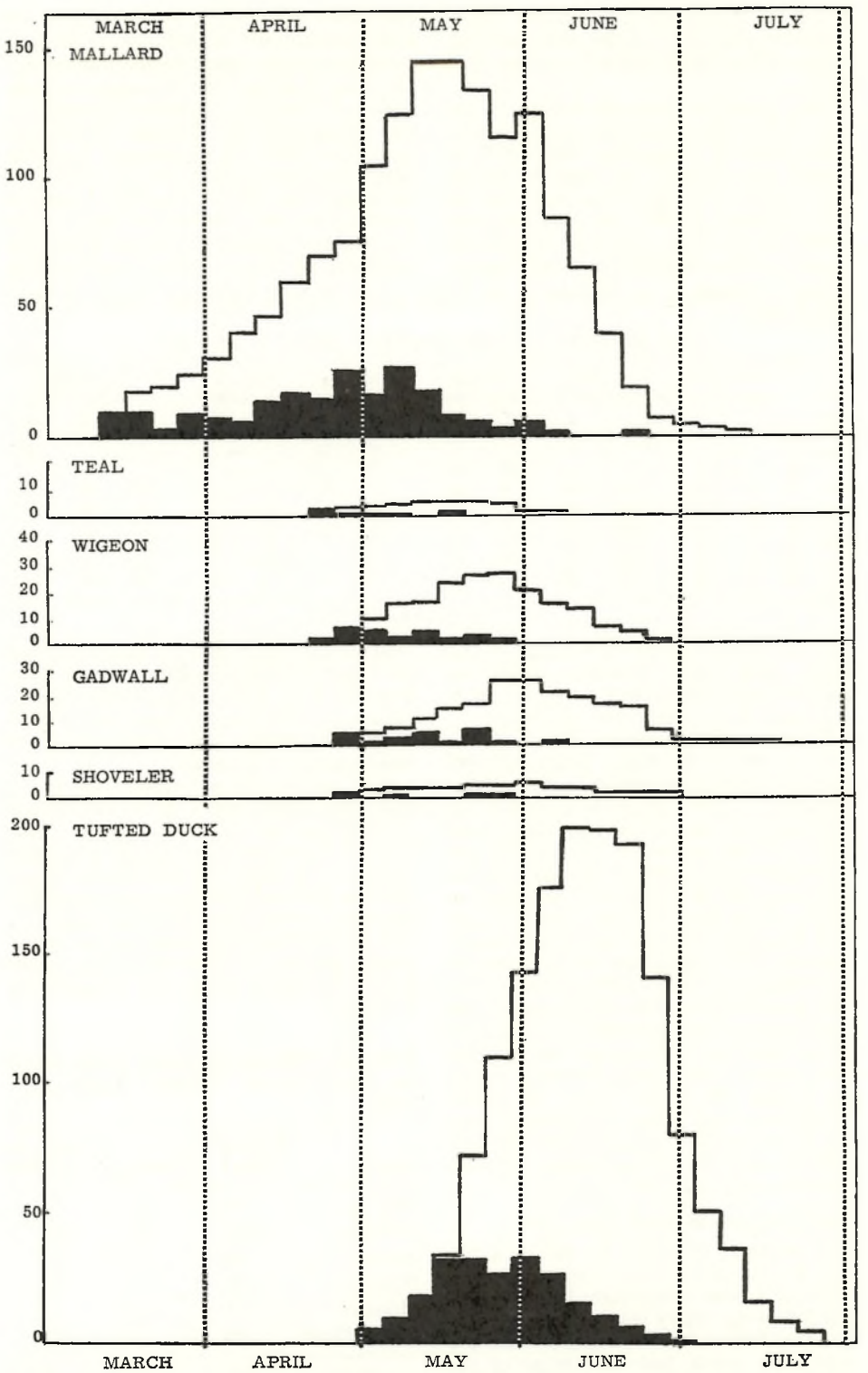

Figure 1. Progress of nesting on St. Serf's Island, 1966. Solid histograms show the number of nests in which laying began during each five-day period. Open histograms show the number of nests known to be in use during each period.

The column in Table II headed "Nests —most in use at one time" provides absolute minima for the numbers of ducks that nested, with the exception of the Shelduck. No serious attempt was made to find the Shelducks' nests, in old rabbit burrows on St. Serf's Island.

Further experimental work is planned for 1967 to determine the likely accuracy of counts and the proportion of nests found. It is certain that not all the nests in which eggs were laid were found. Yet it is obvious that the numbers of female dabbling ducks laying were greater than the numbers of either females or males seen in the area in late April and early May. This confirms what has repeatedly been demonstrated in studies elsewhere that counts of ducks seen in the nesting season tend to under- rather than over-estimate the size of the breeding population. This is a point of considerable importance in interpreting the results of the National Summer Wildfowl Survey and contrary to the conservative attitude generally adopted by the editors of local bird reports.

Enough female Tufted Ducks were seen to account for the nests found, but the picture is obscured by the fact that most *Aythya* females do not breed at one year old. Discovering what proportion of Tufted Ducks are non-breeders, and how many of these are sexually mature, will be one of the more difficult tasks for the future.

Pochard *Aythya ferina* and Pintail *Anas acuta* used to nest at Loch Leven. A few Pochard were present in May and a nest found on Alice's Bower, one of the small islands, may have been a Pochard's but was destroyed before this could be confirmed. No Pintail were seen in the nesting season.

Nesting chronology and success

Each nest found was marked and its history followed by repeated visits at intervals of five to ten days. Though various technical improvements need to be made in recording and in procedures for determining when the first egg was laid and when the eggs hatched or were lost or deserted, it was possible to date events at most of the nests sufficiently accurately to provide an outline of the progress of the nesting season.

The timing of nesting is depicted by the histograms in Figure 1. These are incomplete for the Mallard as nest-recording did not begin early enough, but the general picture is clear, and unremarkable.

The success of the nests of different species is recorded in Table III. The dabbling ducks did well, though the Gadwall markedly less so than the others. The Tufted Ducks did much less well. It is apparent from Figure 2 that the difference was associated with the later start of nesting by the Tufted Duck. The nest losses increased very rapidly during June. Most of the dabbling ducks had hatched before the most dangerous period was reached. Most of the losses for which some cause was evident was due to predators, of which the Jackdaw *Corvus monedula* was much the most important. Several hundred Jackdaws nest in burrows on the higher parts of St. Serf's Island. The increase in nest predation in June coincided with the appearance of many newly-fledged Jackdaws which spent much of their time sitting in the trees overlooking the principal duck-nesting areas. Both adult and juvenile Jackdaws were seen to visit ducks' nests, usually in the absence of the owner. It was surprising that little activity by Jackdaws was apparent in April when the

Table III. Success of ducks' nests found on St. Serf's Island, 1966.

Species	*nests found*	*fate known*		*fate unknown*	*% successful of*	
		hatched	*failed*		*fate known*	*all found*
Teal	9	6	2	1	75	*67*
Mallard	268	180	51	37	78	*67*
Gadwall	41	21	13	7	62	*50*
Wigeon	41	30	6	5	83	*73*
Shoveler	6	5	1	0	83	*83*
All dabbling ducks	365	242	73	50	77	*66*
Tufted Duck	320	98	148	74	77	*31*

Table IV. Distribution of nests in different types of cover on St. Serf's Island, 1966.

Cover	Area (acres)	*Mallard* nests	*Mallard* per acre	*Gadwall* nests	*Gadwall* per acre	*Wigeon* nests	*Wigeon* per acre	*Tufted Duck* nests	*Tufted Duck* per acre	*All species* nests	*All species* per acre
Deschampsia	18	159	*8.8*	21	*1.2*	24	*1.3*	130	*7.2*	343	*19.0*
Phalaris	8	70	*8.8*	8	*1.0*	5	*0.6*	113	*14.1*	198	*25.4*
Low mixed	7	11	*1.6*	5	*0.7*	7	*1.0*	48	*6.9*	73.	*10.0*
With trees	17	9	*0.5*	4	*0.2*	2	*0.1*	6	*0.4*	21	*1.3*
Pasture	55	0	*0*	0	*0*	0	*0*	13	*0.2*	14	*0.3*
Total	105	268	*2.5*	41	*0.4*	41	*0.4*	320		685	*6.5*

Thirty-six nests are omitted from the cover type classification but are included in the "total" row.

Teal: 7 in *Deschampsia*, 1 *Phalaris*, 1 not classed. Shoveler: 2 each in *Deschampsia* and low mixed, 1 each in *Phalaris* and pasture.

Table V. Success of nests in different types of cover on St. Serf's Island, 1966.

Success expressed as (hatched)/(hatched + failed) %.

	Mallard	*Gadwall*	*Wigeon*	*Tufted Duck*	*All species*
Deschampsia	80	68	90	41	66
Phalaris	78	40	100	41	58
Low mixed	82	40	43	46	53
With trees	38	75	100	0	40
Pasture	—	—	—	38	44

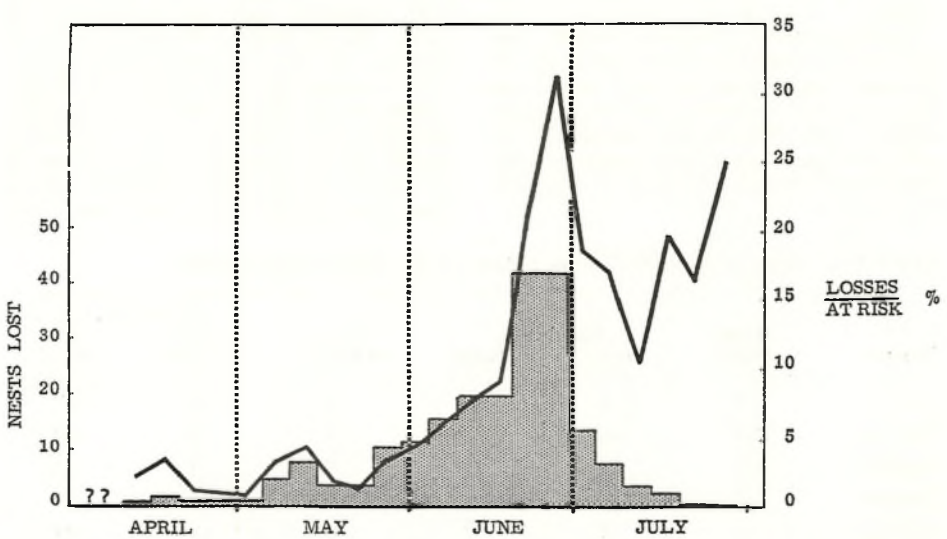

Figure 2. Losses of ducks' nests on St. Serf's Island, 1966. Data for all species are taken together. Open histograms show the numbers of nests that were destroyed or abandond during each five-day period. The line records these losses as a percentage of the number of nests known to be in use at the start of each period. Note that the scale for the percentage loss is twice that for the actual numbers lost.

cover for ducks' nests was relatively sparse and when many of the nests contained incomplete clutches and were left unoccupied for much of the time. One long-dead Brown Rat found early in July was the only evidence of the presence of any of the common mammalian nest-predators but a number of clutches of eggs were eaten by sheep. This unexpected activity needs more careful investigation: from observations on the distribution of the sheep in the different types of vegetation on St. Serf's Island it seemed likely that only a very few of the ewes and lambs on the island were interested in finding ducks' nests.

Table IV demonstrates that the use made of the five cover-types by the various species differed appreciably. A more remarkable, if negative, result (Table V) was that nesting success of Mallard and Tufted Duck was much the same in each of the two preferred cover types (*Deschampsia* and *Phalaris*).

The size of each clutch of eggs was determined for those nests found in use on more than one occasion but the investigation of this material and of many other aspects of nesting biology is best postponed until results from several years are available.

Rearing of young

Much less attention was paid to the success of ducks in rearing their young than to the study of nests because with the man-power available it was impracticable to deal thoroughly with both. Observations on broods are hard to make on Loch Leven. Most of the shores of St. Serf's Island and of the loch itself are very inhospitable to ducklings. The shores are sandy, lack emergent vegetation and are frequently subject to quite heavy wave action. Most broods are therefore taken by their mothers into thick cover at the south-east corner of the loch, or on to the River Leven below the outfall, or to two rather inaccessible sites on the south-west and north-west shores. Generally, duck broods are least invisible very early in the morning or late in the evening, when they are often led on to open water. In the middle of the day most broods are usually kept in cover. Unfortunately, at Loch Leven disturbance by fishing boats is at its worst in the evening, right up until dark, so that the opportunities for looking at broods are greatly reduced.

It is possible to obtain a rough guide to the numbers of ducklings likely to have been reared to the flying stage from knowledge of the number of clutches hatched and the observed diminution in the mean brood size from those recently-hatched to those approaching full growth (class Ia and class III in the terminology commonly used in North America). These calculations (Table VI) tend to exaggerate production because they do not take into account the losses of entire broods.

Little was learned in 1966 about the causes of duckling death. The periods of greatest loss were during spells of wet cold weather in June and July and it seems likely that bad weather killed more ducklings than did predators. Some ducklings were killed by gulls — though very few Herring, Lesser or Great Black-backed gulls (*Larus argentatus*, *fuscus* and *marinus*) were present and Black-headed Gulls *Larus ridibundus*, though very numerous, paid little attention to young ducks. No raptors in the area are likely to have attacked ducklings. Dogs roaming the shore in some places probably caught a few. In the course of routine sampling of fish in the loch, Miss D. M. Witcomb found a duckling in the stomach of a pike, but the magnitude of predation by fish remains to be established.

Table VI. Estimated survival of young to flying stage, from changes in mean clutch- and brood-size, Loch Leven, summer, 1966.

	Production of eggs				*Survival of ducklings*		
	Mean clutch size	*Average number per successful nest*	*nest (incl. failed)*	*Ducklings leaving nests*	*mean brood size class Ia*	*class III*	*Ducklings reared to flying*
Teal	8.7	7.8	5.9	53	—	—	v. few
Mallard	8.2	7.5	5.8	1640	6.5	4.4	1100
Gadwall	8.4	8.1	4.9	211	8.1	3.7	96
Wigeon	7.4	6.4	5.4	221	6.9	1.3	42
Shoveler	10.5	9.8	7.8	47	—	—	(9)a
Tufted Duck	9.1	7.9	3.1	1000	6.8	4.3	630
Approx. total				3200			1900

(a) most seen

Marking

Some preliminary attempts were made to catch ducks on nests for ringing. These were very promising in that they showed that trapping at a late stage in incubation did not cause the females to desert their eggs or affect hatching and that a simple hand-net proved more effective than traps set up over the nests. But the numbers of females caught were small and much remains to be done before it can be claimed that a high proportion of the nesting ducks of any species are known as individuals.

One hundred and sixty-four ducklings were also marked with monel wing tags and some trials made of a method of ringing young birds that has been developed in Latvia. It seems likely that in future it will be more rewarding to catch young birds in baited cage-traps when they are old enough to carry conventional rings than to mark very young ducklings.

A female Gadwall caught on a nest on 8th June, 1966, was shot on Lough Corrib, Co. Galway, on 3rd November, 1966, and a female Wigeon, also nesting, marked on 30th May, 1966, was shot 8th January, 1967, near Ballycotton, Co. Cork.

Possibilities for future work

There are so many ducks nesting at Loch Leven that it should be a valuable site for research. The survey in 1966 made clear, however, that there are formidable practical difficulties to be overcome in achieving results of sufficient precision to make possible comparisons from year to year of the numbers of females attempting to breed, of the eggs they lay and the young they rear and to find out why these change. To do this for all the breeding species seems likely to be beyond the resources available and it will probably be necessary to concentrate on more intensive studies of particular importance or promise. Because of the needs of the I.B.P. research, special attention must be given to the Tufted Duck, which has one considerable advantage in that it is comparatively easy to study at the pre-fledging stage. And because the Gadwall colony is the biggest in Scotland and that of the Wigeon is the largest available for study in Britain they too should receive particular attention.

Acknowledgements

This work was made possible by a grant to the Wildfowl Trust by the Natural Environment Research Council and by permission from the owner of Loch Leven, Sir David Montgomery, Bt., and from the Nature Conservancy, to move about within the National Nature Reserve. We are further indebted to members of the staffs of the Conservancy and of the Kinross Estate Company for help on many occasions and for making equipment available. We are especially grateful to Mr. J. Taylor of Levenmouth Farm, Scotlandwell, for his friendly and practical help.