Wildfowl on hydro-electric reservoirs in the Scottish Highlands

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Summary

The value of hydro-electric reservoirs as wildfowl habitats is discussed, on the basis of a large number of counts made from April, 1962 to March, 1964 at Meig reservoir, Ross-shire. This was formed by the construction of a concrete dam across the River Meig by the North of Scotland Hydro-electric Board in 1956. The numbers of wildfowl were small, though above the average to be found on many neighbouring natural lochs and other reservoirs. Possible ways of making reservoirs more attractive to ducks include fencing stretches of shore to stop grazing, planting with semi-aquatic herbage, and the use of artificial islands.

Introduction

The recent trend in British wildfowl management has been towards the awareness of the need for conserving present wildfowl habitats, protecting existing wetlands (Olney, 1963) and making use of areas of water resulting from the activities of man (Atkinson-Willes, 1961; Harrison, Harrison and Olney, 1962; Atkinson-Willes, 1963). Developments of this kind have, however, mainly taken place in England and Wales.

In Scotland many reservoirs have appeared and existing bodies of water have been increased in area in the last decade as a result of the construction of dams by the North of Scotland Hydro-electric Board. The value of these waters as wildfowl habitats has not been assessed hitherto. This paper discusses their value in the light of intensive observations of the wildfowl using Meig reservoir in Ross-shire.

Meig reservoir lies in Strathconon and was formed after the completion of a dam 52 ft. high on the River Meig, a tributary of the River Conon, in September, 1956. The bed of the reservoir lies at a little over 240 ft. above sea level in a narrow valley with hills rising to a height of 1,176 ft. from the north shore and to 2,199 ft. from the south shore and is 12 miles from the sea. The reservoir, which is approximately 2½ miles long, has an average area of 117 acres (47 hectares) increased to 165 acres (67 hectares) when filled to capacity. The water level is subject to frequent fluctuations and during heavy rainfall may rise at the rate of a foot an hour. The average annual rainfall at this point is 50 in. but a few miles to the north west, in the same watershed, it reaches over 80 in.

The surrounding terrain consists, on the high ground, of heather moor, *Molinia-Myrica* swamp and *Sphagnum* bog lying over peat and morainic deposits with outcrops of pelitic gneiss and siliceous schists. Reafforestation with spruce and larch has been carried out by the Forestry Commission on the hill slopes on the north side of the reservoir. Along the shores at the west end of the reservoir the terrain is alluvial pasture with *Juncus effusus* in the damper areas. This pasture was previously cultivated from a number of crofts which were demolished immediately prior to impoundment. Some of the pasture is permanently submerged, other parts are temporarily flooded while the remainder is permanently above water level. Sheep graze over the latter and also move on to the pasture which is exposed at average water level. Only this western end of the reservoir provides feeding for surface and diving ducks. The water has a pH of 6·6 and an alkalinity of only 6·2 parts per million (expressed as calcium carbonate). The fish present in the reservoir are salmon (*Salmo salar*), brown trout (*S. trutta*) and eels (*Anguilla anguilla*). The effects of impoundment on the growth of brown trout and on the invertebrate fauna in Highland lochs are described by Campbell (1957, 1963). Post-impoundment shore line development was similar to that described by Campbell (1963) for similar lochs and reservoirs in the Highlands. At the west end of the reservoir permanently submerged clumps of *Juncus effusus* were intact throughout 1957 but by 1959 only decayed stumps remained. In 1959 *Elodea canadensis* had established itself but only in small amounts and only isolated plants occur at the west end of the loch. In the shallow water, part of which is stagnant at certain water levels, *Lemna* spp. occur.

Results

Counts of wildfowl were made practically each day, and on many occasions twice daily, during the period April, 1962, to March, 1964. Where there were two counts on the same day one was made in the morning and the other in the late afternoon. The numbers of ducks seen and the number of days in each month on which counts were made are given in Table I. The counts are almost certainly affected by the presence of

Table I. Average numbers of ducks on Meig reservoir each month from April, 1962, to March, 1964

Number of days on which counts were made shown in parenthesis after each month. Figures in parenthesis after averages record number of days on which birds were seen.

month		*Mallard*	*Wigeon*	*Teal*	*Goldeneye*	*Goosander*
1962						
April	(25)	1·5 (7)	2 (2)	2·3 (3)	16 (12)	2·4 (10)
May	(30)	4·3 (17)	1 (1)	1 (1)	0	2 (13)
June	(24)	3 (5)	0	0	0	0
July	(31)	0	0	0	0	0
August	(19)	30·5 (3)	0	0	0	0
September	(26)	50·7 (26)	8·5 (2)	0	0	0
October	(31)	45·1 (31)	7 (1)	0	1·3 (3)	3·5 (13)
November	(27)	17·2 (23)	0	8·3 (3)	7·3 (20)	2·4 (7)
December	(20)	10·2 (17)	0	4 (2)	12·5 (17)	5 (1)
1963						
January – wholly frozen, no ducks						
February – wholly frozen, no ducks						
March	(24)	4·8 (16)	8 (11)	0	13·3 (21)	3·2 (12)
April	(27)	1·7 (15)	3·2 (16)	0	10·4 (22)	2·5 (6)
May	(23)	3·6 (14)	3·5 (2)	0	1 (1)	0
June	(23)	3·5 (2)	2 (1)	0	0	0
July	(31)	2·5 (2)	8 (1)	0	0	0
August	(15)	0	0	0	0	0
September	(17)	30 (14)	8·6 (8)	0	0	0
October	(29)	25 (11)	9·7 (8)	0	3 (9)	2 (1)
November	(27)	13 (18)	8 (9)	0	7 (26)	1·5 (2)
December	(25)[a]	6·1 (9)	0	0	5·8 (10)	0
1964						
January	(22)[b]	9·6 (13)	0	0	9·4 (15)	1 (1)
February	(23)	10·7 (19)	6·5 (15)	0	14·4 (22)	1·7 (4)
March	(18)	1·6 (3)	5·3 (15)	0	12·8 (18)	0

[a] complete ice cover on 13 days.

[b] complete ice cover on 5 days.

anglers during the period 1st June to 30th September. In January and February, 1963, the reservoir and all other lochs and reservoirs in the area were completely frozen over and the only open waters near at hand were the neighbouring rivers on which Mallard and Goldeneye were seen over the whole of this time in small numbers. Both Mallard and Goldeneye returned with the first appearance of open water on 6th March. Similarly, in December, 1963, wildfowl reappeared as soon as there was a small amount of open water.

Matthews (1960) discusses the value of daily counts and states that 'when a near daily count has been made, the mean value of these counts gives a good measure of the population level within the month'. In discussing the time of day on which counts are made he found that only Mallard and Wigeon showed any noticeable effects, both giving rather fewer birds and more variation in the afternoon. On Meig reservoir it was found that fewer Mallard were recorded in afternoon counts than morning counts in the spring but that the reverse was the case in the autumn (Table II), while Goldeneye showed the opposite tendency, more birds being present in the afternoon in the spring and fewer in the afternoon in the autumn.

Mallard (*Anas platyrhynchos* L.). The Mallard is the commonest duck occurring on the reservoir. In the spring practically all Mallard seen are drakes and the largest number seen at one time was 14. This is the only duck which has been recorded nesting by the reservoir: one nest with nine eggs was found in a clump of *Juncus* but was later found destroyed. There is very little nesting cover at the west end, but the southern shore along the eastern half of the reservoir has heather and birch scrub. However, no young ducklings have ever been seen and most nesting Mallard are recorded on the neighbouring hill lochs. The

Table IL Variations in numbers of Mallard and Goldeneye on Meig reservoir in twice-daily counts, 1962 and 1963

	number of pairs of counts	days with more or less ducks seen in afternoon than in morning		
		more	less	no difference
Mallard				
spring	24	8	12	4
autumn	24	13	9	2
Goldeneye				
spring	24	14	5	5
autumn	12	2	5	5

numbers of Mallard increase in August and September, presumably being family parties coming down from the hill lochs, and the maximum number recorded is 70. The birds appear to use the water more as a roost than a feeding area and visit the neighbouring cornfields in Strathconon. The corn is not gathered in usually until late in the season and in 1963 some of it was not off the fields until the end of October. Mallard occasionally feed in some of the smaller bays, usually after the reservoir has risen and some of the neighbouring pasture has been flooded. After October the numbers of Mallard on the reservoir drop and probably many have moved further down the valley to the low-lying arable country around the Cromarty Firth.

Wigeon (*Anas penelope* L.). Few Wigeon were seen in spring in 1962, but rather more in 1963. Those present in autumn in each year probably represented one family party. Wigeon are known to nest at the west end of Strathconon and also in Strathbran to the north.

Teal (*Anas crecca* L.). A few Teal were seen in spring 1962 and a small flock was present that autumn, feeding in the shallow water and on the mud at the west end of the reservoir.

Goldeneye (*Bucephala clangula* (L.)). Goldeneye are present throughout the winter and spring with maximum numbers of up to 30 in the spring. The latest spring records were on 28th April, 1962 and 17th May, 1963. They were first seen in autumn on 20th October, 1962, and on 17th October, 1963. They feed mainly at the shallow, west end of the reservoir. Because these birds are continually diving there is the likelihood that fewer birds were counted than were actually present.

Goosander (*Mergus merganser* L.). The Goosander occurs in spring when flocks of up to seven have been seen. Birds shot on the reservoir at this time were found to have been eating salmon parr and smolts. None is seen from May until October when flocks of up to eight, which include young birds, have been counted. In 1959 Goosanders were seen on Meig reservoir in September (Mills, 1962). He also gave dedetails of their density on the River Meig itself.

The Tufted Duck (*Aythya fuligula* (L.)), although it nests locally, has only been recorded on the reservoir occasionally. The Pochard (*Aythya ferina* (L.)) has never been seen on the reservoir although it occurs in the spring on Loch a' Chuilinn only a few miles to the north. The Red-breasted Merganser (*Mergus serrator* L.) has been seen on the reservoir once and in 1963 a nest was found a few miles further up Strathconon at Strathanmore. The eggs were sent to the Wildfowl Trust, where they duly hatched.

In 1962 Whooper Swans (*Cygnus cygnus* (L.)) were on the reservoir from October to December, averaging six in October with a maximum of eight; and five in November and December with maxima of six.

Flocks of up to 50 Greylags (*Anser anser* (L.)) have been known to rest for a few hours at the west end of the reservoir on two occasions, once in the spring and once in the autumn.

Other waterfowl occurring on the reservoir include the Black-throated and Red-throated Divers (*Colymbus arcticus* L.) and (*C. stellatus* Pontoppidan) which are frequently seen in the spring; the Cormorant (*Phalacrocorax carbo* (L.)), which is present singly or in twos and threes, in the spring and autumn; and the Heron (*Ardea cinerea* (L.)). The Common Sandpiper (*Tringa hypoleucos* (L.)) and Oystercatcher (*Haematopus ostralegus* (L.)) nest close to the reservoir and the Greenshank (*Tringa nebularia* (Gunnerus)), present in the spring, nests only by the hill lochs. The Common and Black-headed Gulls (*Larus canus* (L.) and *L. ridibundus* (L.)) are frequently on the reservoir and nest locally.

The value to wildfowl of natural lochs and of hydro-electric reservoirs in the Highlands

The factors governing the suitability of lochs and reservoirs in the Highlands for wildfowl appear to be far more complex than would at first appear to be the case. One explanation for the presence and absence of certain species on stretches of water may be the availability of certain foods. For example, the presence of up to 10 Pochard on Loch a' Chuilinn, a natural loch the area of which was increased by the construction of Achanalt Barrage at its foot, and not on Meig reservoir, might be explained by the presence in Loch a' Chuilinn of Horned

Pondweed, *Zannichellia palustris*, which Atkinson-Willes (1963, p. 312) quotes as being one of its foods. Similarly the Tufted Duck is rarely seen on Meig reservoir but occurs more often on Loch Achilty, a natural loch, where one of its known food organisms, the freshwater shrimp, *Gammarus lacustris* is plentiful, and also on Loch a' Chuilinn and Loch Achanalt (a natural loch joined to Loch a' Chuilinn by a 100 yd. stretch of river) where the related organism *G. pulex* occurs. The Goldeneye occurs in smaller numbers on Loch a' Chuilinn and Loch Achilty than on Meig reservoir, although on an assessment of available food more might have been expected on Loch Achilty, particularly as the clarity of its water is locally unique and the bed of the loch is chiefly gravel and stones. Furthermore, the tree line comes down to the shore and extends around the whole of the loch. Another natural water similar to Loch Achilty is Loch Ussie which has clear, rather than the more normal peaty, water and probably a big *Gammarus* population. Loch Ussie, which is frequented by Goldeneye in some numbers, lies above Dingwall and close to the Cromarty Firth and appears to serve chiefly as a roost during the winter for Mallard and Wigeon. Those species using lochs chiefly as roosts will not occur on the more inland waters in the Highlands in winter where arable land, to which they are likely to flight, is some distance away. From observations of a general nature, the numbers of wildfowl occurring on Meig reservoir appear to be slightly above those to be found on many of the natural lochs in the district.

It remains to compare Meig reservoir as a wildfowl habitat with other hydro-electric reservoirs, including natural lochs whose waters have been dammed, in Ross-shire and other parts of the Highlands. These reservoirs can be divided into two categories: (a) those with steep, heavily eroded and frequently rocky shore lines running directly into deep water and with little in the way of shallow water at the head of the impoundment; and (b) those with a more gently sloping shore line and consequently more shallow water and exposed areas of grassland or mud at certain water levels. Those in category (a) are generally main storage reservoirs, usually situated in the upper reaches of the river system and consequently at a higher altitude than those in category (b), which are temporary storage or balancing reservoirs where the drawdown, instead of being roughly seasonal in pattern as in the main storage reservoirs, is short term and the water levels may fluctuate rapidly, depending on generation demands from the associated power stations. Some of the reservoirs coming into category (a) are listed in Table III. Casual observations indicate that these are less frequently used by wildfowl, partly due presumably to lack of shelter and food, than those in category (b). From Table III it can be seen that Meig compares favourably with the others in this category as a wildfowl habitat. The general impression gained is that reservoirs in category (b) are better wildfowl habitats but further investigation is merited, particularly as data on wildfowl on a large number of hydro-electric reservoirs are completely lacking.

Habitat improvements would seem to be most worthwhile on waters with gently sloping shores. Some of the more obvious and practicable improvements are: (1) increasing the cover along the shore by marginal planting and (2) the provision of artificial islands. (1) Increased cover could be produced by fencing off the shore for several yards back to prevent grazing by sheep and allow natural regeneration of the birch scrub and heather. This has already been done, for amenity reasons, by the North of Scotland Hydro-electric Board, on Glascarnoch reservoir. As the seasonal draw-down on this reservoir exposes a large expanse of mud at its upper end they have fenced off this portion of the southern shore and planted with a mixture of coniferous and deciduous trees. Berry (1955) in discussing shore erosion suggests the planting of margins of reservoirs with alders, some kinds of willows and poplars and some of the larger rushes, sedges and reeds as these would also withstand a considerable range of fluctuation in water level. He suggests, however, that they should be transplanted when well grown, otherwise wave action may prevent such plants gaining a roothold on a bare shore. (2) The provision of artificial islands in the form of rafts described by Harrison and Harrison, (1959), might provide useful nesting or roosting sites safe from flooding should the water levels in the reservoirs rise during the nesting season and wickerwork nesting baskers (Harrison and Harrison, 1961, pp. 223-228) might also be of value. Nesting boxes have already been set up near a small number of reservoirs and lochs with a view to encouraging Goldeneye to breed in this country. Even if this proves unsuccessful the nest boxes may be occupied by Goosanders and other birds (Grenquist, 1962). The introduction of certain wildfowl might also be considered on selected reservoirs. Three Greylag and two Canada Geese have already been released on Loch Faskally. Though the introduction of some wildfowl is desirable, due regard must be paid to other interests and the introduction

Table III. Wildfowl reported on some Highland hydro-electric reservoirs

Former natural lochs shown in italic. I = Inverness-shire.
P = Perthshire, RC = Ross and Cromarty. ms = main storage.
bal. = balancing, bar. = barrage, d = diversion.

reservoir	*Mallard*	*Wigeon*	*Teal*	*Tufted Duck*	*Pochard*	*Goldeneye*	*Goosander*	
(a) reservoirs with steep, heavily-eroded sides								
L. Fannich (RC, ms)							occ.	
Glascarnoch (RC, ms)	few wildfowl seen							
L. Luichart (RC, bal.)	occ.					few	few	
Achonachie (RC, bal.)	up to 50					occ.	occ.	[1]
(b) reservoirs with gently sloping sides								
L. a' Chuilinn (RC, bar.)	up to 20	15	5	20	10	4	4	[2]
Meig (RC, d) maxima	70	14	10			25	7	[1, 3]
L. Garry (I, bal.)	up to 20					occ.	occ.	
L. Tummel (P, bal.)	150	80						[3]
Faskally (P, bal.)	max. 75	10	40	145	5	65	5	[3]

([1]) Red-breasted Merganser occasional.
([2]) also up to 5 Mute and 5 Whooper Swans.
([3]) data from Atkinson-Willes (1963).

of fish-eating birds might have serious disadvantages.

The presence of increased numbers of wildfowl on some reservoirs might help to fertilize these waters. Fraser Darling (1947, p. 237) refers to a loch on Priest Island, Wester Ross, where the accumulated effects of Greylag Geese, Cormorants and gulls defecating in the water raised the pH from 6·0 to 7·6 in spring and early summer. However, Kear (1963) has shown that to add the equivalent of 10 pounds of nitrogen per acre per annum, the amount required to produce a significant effect, calls for use by roosting wildfowl at the annual rate of 10,000 goose-nights per acre. This level of usage is known to be achieved at some major goose roosts on shallow permanent lochs but is far in excess of that at present prevailing on the hydro-electric reservoirs.

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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