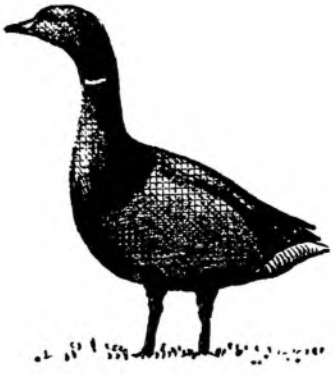
THE TENTH ANNUAL REPORT OF

THE WILDFOWL TRUST

1957 - 1958

EDITED BY PETER SCOTT
AND HUGH BOYD



Price Ten Shillings Net

Printed for The Wildfowl Trust by
F. BAILEY & SON, LTD.,
Dursley, Glos.
1959

THE WILDFOWL TRUST

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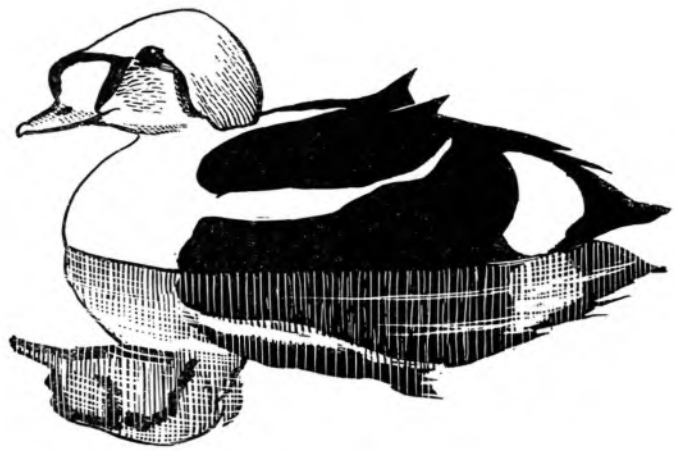


NEW DEVELOPMENT AT SLIMBRIDGE

THE most important development in the Trust's year has been the substantial expansion of the grounds at Slimbridge.

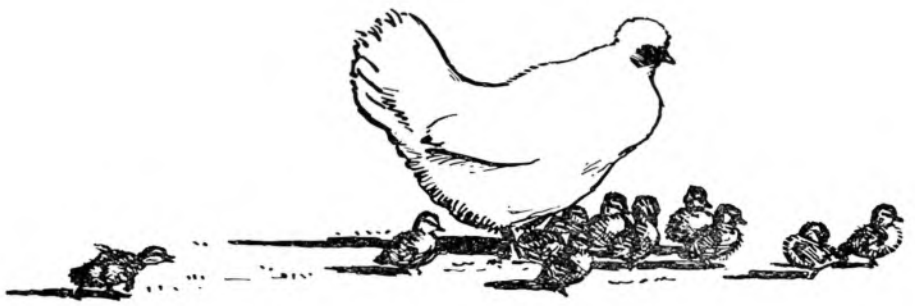
In November, 1957, through the co-operation of Mr. O. W. Fisher and the Berkeley Estates Ltd., we were able to enclose a further eight acres of marshy ground adjoining the Big Pen and here, during the past twelve months, the wardens and maintenance staff have with extended effort and much physical application constructed roads, pens, ponds, and an aviary eighty yards long. Not the least of the tasks was the taking down and re-erecting on the new site five hundred yards of perimeter fencing, which feat was accomplished in one day. The ponds and lay-out were carefully designed by the Director to combine the optimum scenic effect with conditions most beneficial to the birds.

We are now in a position to allocate pens to the birds of Australia, New Zealand, Africa, Asia and Europe, as well as to provide pens for breeding birds—swans in particular. A feature of the new development is a hillock which in the surrounding flat meadows is reminiscent of a miniature Wrekin. It had been hoped that " the Tump " could be raised to some 30 or 40 feet in order that those who are unable to climb the Acrow Tower might have a view of the Severn Estuary by walking up the gentle slope of our Tump. But soil mechanics experts have advised that the summit cannot be raised above its present fifteen feet. Nevertheless, an excellent view of the new area can be obtained from the apex.

The aviary, most generously presented to us by Messrs. Arthur Guiness Ltd., has been sited with a southern aspect; it has ten compartments, each with an independent water supply and heating system. Here it is intended to keep Pygmy Geese and other species that are in need of protection against our winter.

Large numbers of flowering shrubs have been planted, both to beautify and to give nesting cover, and we are most grateful for the many gifts received—in particular to Bees Ltd. for a large and varied consignment of shrubs.

It is hoped to open the new area to the public by Easter, 1959, and perhaps one of the best features of this development is that visitors going to the Acrow Tower will be able to return by a different route from that by which they went.



NOTES ON THE 1958 BREEDING SEASON

S. T. Johnstone

DURING the breeding season every clutch of eggs is incubated and the effect on every egg is duly recorded as infertile, addled or hatched. Whilst such pre-natal trouble is taken, it is after hatching that the real task commences. The death of all those young birds that succumb is noted and the carcases are sent to the School of Veterinary Medicine at Cambridge University where, through the kind offices of Mr. A. R. Jennings, they undergo a thorough post mortem examination. Finally, a pathological report on each corpse is sent to us. In the 1958 season we lost some 30% of the babies hatched. A great many of these deaths were due to chilling, and " the wettest June for fifty years " undoubtedly contributed in no small measure to this loss. It is therefore with some satisfaction that we have to record better figures than in any previous year. Some 850 birds were reared, there being over 230 goslings and cygnets and 640 ducklings. If we combine the figures for Slimbridge with those for our collection at Peakirk we get a total figure of over 1150 birds reared. But perhaps more gratifying than this large number is the fact that 97 kinds bred in our collections and over eighty forms were reared, amongst these being, we believe for the first time, the Black Brant (*Branta bernicla orientalis*) and the New Zealand Scaup or Black Teal (*Aythya novæ-zeelandiæ*). Hartlaub's Duck (*Cairina h. hartlaubi*) bred for the first time but unfortunately the ducklings were weakly and were not reared. The Mallards did very well, being represented by eleven forms. Magpie Geese (*Anseranas semipalmata*), Bewicks Swan (*Cygnus columbianus bewickii*), Chinese Spotbills (*Anas pœcilorhyncha zonorhyncha*), Brazilian Teal (*Amazonetta brasiliensis brasiliensis*), Red-breasted Merganser (*Mergus serrator serrator*), and Goosander (*Mergus merganser merganser*) were among the more interesting species produced.

As ever, the early effort and interest was concentrated on the Hawaiian Geese. Nineteen birds were reared out of twenty-one hatched. The casualties were one deformed gosling that lasted three days and a second that was crushed by the hen on hatching. The high losses from gapes that had occurred in 1957 were avoided through the kind offices of our farmer neighbour, Mr. Fisher, who gave us facilities for rearing the birds on some clean pasture in one of his fields. Mr. Terry Jones, who for the last three years has been devoting time and effort to rearing Ne-nes on our behalf, sent us seven fine birds, giving an overall total for the season of 26. The flock at Slimbridge now numbers 53, and we have sent nine pairs to other establishments, at Basle, Cleres, Leckford, Rotterdam, Whipsnade, the United States, and our branch at Peakirk. These figures mean that the birds bred at Slimbridge now represent about 45% of the world population.

Each year all three forms of Brent Goose—*hrota*, *bernicla* and *orientalis*—have become 'heavy' but no attempt at nesting has occurred. We have even gone so far as to subject likely birds to flood lighting at night in the hope that 24 hours of light might be an encouragement. Hormonic implantation did cause a goose to lay but obviously the act was quite involuntary as the eggs were dropped indiscriminately on the greensward where they were eaten by crows. Again this year the females duly 'dropped,' but what interested us was the increased aggression, particularly in the case of the Black Brant. This was very evident to some visitors to our Rushy Pen on 12 May who found themselves being attacked by an irate male Black Brant, the reason being that they had approached too near his consort who appeared merely to be sitting on the greensward but was actually covering a slight indentation which contained the first egg. The next day however the birds decided that they would move house and the female selected a deeper depression, but again right in the open, away from any form of cover. Here a further five eggs were laid and swathed in an abundance of exquisite silvery down. The last two eggs were laid whilst the goose was incubating. When laid the eggs had a pinkish tinge reminiscent of that of the Ross's Goose, but this faded to a milk white after a matter of hours. When first feathered the goslings' flanks were uniformly dark and the primary and secondary feathers being white-tipped gave the impression of white bars across the wings.

We are particularly pleased to have bred the New Zealand Scaup; all eight birds that hatched were reared. One was impressed by the enormous size of this little duck's eggs, much bigger than of a Tufted Duck.

The Hartlaub's Duck in our small aviary laid three clutches of eggs. The pair of birds, reared in the Congo in 1957, became very aggressive, killing a second male that had been living in peace with them for the previous nine months. Fertility of the eggs was very poor—out of 24 eggs only 5 hatched and these were very weakly ducklings that never seemed likely to survive. The female made no attempt to incubate, and after laying four or five eggs in the nest she then proceeded to lay the rest all over the enclosure.

During 1958 some interesting additions were made to the collection which, at the time of writing, contains 160 forms—the most in its history. New species include Laysan Teal, Longtail Duck, Harlequin Duck, Australian White-eye, Cotton Teal, African Pygmy Goose, White-backed Duck, and Black-headed Duck. Further specimens of Hooded Merganser and King Eider have been acquired.

At Peakirk Major Mark Fisher reports that the season started badly when, in January, the hen rearing the Cereopsis goslings decided to kill them off, one only being rescued from her just in time. This one was reared but grew up with a badly deformed beak. Later on in the breeding season constant and continual rain made things very difficult and a good many ducklings and goslings were lost. It was particularly disappointing to lose a brood of Garganey as well as several young Puna Teal. These young ducklings, though they lived in some cases up to feathering, could not start growing properly with so little sunshine. Ringed Teal, Brazilian Teal, Puna Teal, Fulvous Whistling Duck, Lesser Whitefronted Geese were all new species to breed in the collection and were reared successfully.

One hen managed to rear seventeen out of eighteen Red-crested Pochard and four more stalwart deep-litter matrons reared forty Carolina ducklings between them, a fine achievement for any hen.

TABLE I

Breeding Analysis 1958—Slimbridge

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Hatched	Reared	Remarks
Magpie Goose	1	6.6	9	9	8	All reared by parents.
Wandering Whistling Duck	1	24.5	7	7	1	
Fulvous Whistling Duck	6	4.3	130	60	50	3 broods. 15 reared by parents.
Cuban Whistling Duck	1	13.4	8	—	—	
White-faced Whistling Duck	1	15.6	17	10	2	
Southern Red-billed Whistling Duck	1	12.5	28	13	4	
Black Swan	2	14.2	16	8	8	All reared by parents.
Bewick's Swan	1	30.4	8	3	1	Reared by parents.
Swan Goose	2	13.4	14	5	4	
Bean Goose	2	23.4	7	3	1	
Whitefront	1	6.5	5	2	1	
Greenland Whitefront	1	23.4	16	4	2	
Lesser Whitefront	2	15.5	10	4	2	
Western Greylag	4	10.4	26	18	18	10 reared by parents.
Eastern Greylag	1	25.3	4	4	4	All reared by parents.
Barhead	3	25.4	39	13	6	4 reared by Snow Geese.
Emperor Goose	4	28.4	26	13	12	
Lesser Snow Goose	1	14.3	5	—	—	
Blue Snow Goose	1	12.4	6	4	3	
Greater Snow Goose	6	30.4	52	22	12	3 reared by parents.
Ross's Goose	3	8.5	17	13	10	
Atlantic Canada Goose	2	20.4	14	14	14	Reared by parents.
Taverner's Canada Goose	4	12.4	19	7	7	Reared by parents.
Dusky Canada Goose	1	14.4	5	—	—	
Cackling Goose	1	14.5	6	2	1	
Hawaiian Goose	8	7.2	77	21	19	
Barnacle Goose	7	2.5	64	31	27	5 reared by parents.
Black Brant	2	12.5	9	5	2	1st breeding record for Slimbridge.
Red-breasted Goose	3	10.5	23	11	10	
Cape Shelduck	2	3.4	14	10	10	2 reared by parents.
New Zealand Shelduck	1	12.4	3	—	—	
Radjah Shelduck	1	23.4	6	3	3	
Common Shelduck	—	—	9	8	8	From eggs brought in.
Egyptian Goose	1	3.3	8	2	2	Reared by parents.
Orinoco Goose	2	27.3	24	20	15	

TABLE I—*continued*

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Hatched	Reared	Remarks
Abyssinian Blue-winged Goose	1	21.6	7	1	1	
Ashy-headed Goose	1	15.4	8	6	6	
Ruddy-headed Goose	1	20.4	5	2	2	
Upland or Lesser Magellan Goose	1	3.4	5	3	3	
Falkland Upland or Greater Magellan Goose	1	15.4	14	12	12	1 reared by parents.
Cereopsis	2	25.12.57	14	4	4	2 reared by parents.
Andean Crested Duck	1	28.3	17	13	10	
Marbled Teal	2	1.5	23	8	7	
Cape Teal	3	17.3	37	31	31	7 reared by parents.
Versicolor Teal	3	30.3	36	12	7	
Puna Teal	1	12.4	7	1	1	
Southern Bahama Pintail	3	6.5	16	13	6	
Chilean Pintail	1	15.4	5	4	4	
Northern Pintail	2	28.3	13	9	5	
Chilean Teal	1	30.4	6	—	—	
Falcated Duck	1	—	1	—	—	
Australian Grey Teal	1	6.6	6	2	2	
Chestnut-breasted Teal	6	8.2	49	39	33	
Hawaiian Duck	2	24.4	14	7	5	
Florida Duck	1	24.4	18	18	18	2 broods reared by parents.
Mottled Duck	1	20.5	7	7	7	Reared by parents.
N. American Black Duck	1	15.4	7	6	5	
Indian Spotbill	2	25.4	17	13	9	
Chinese Spotbill	2	2.5	14	12	10	
Australian Black Duck	1	18.4	9	9	9	
Philippine Duck	3	25.4	46	32	21	3 reared by parents.
African Yellowbill	2	7.4	21	14	9	
African Black Duck	2	22.2	10	8	1	
Gadwall	1	12.5	8	—	—	
European Wigeon	2	20.4	20	16	12	
American Wigeon	1	30.4	8	6	6	
Chiloe Wigeon	3	20.4	59	26	24	5 reared by parents.
Cinnamon Teal	3	15.4	39	25	4	
Red Shoveler	1	15.4	8	5	—	

TABLE I—*continued*

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Hatched	Reared	Remarks
Cape Shoveler	2	10.5	29	19	16	5 reared by parents.
Common Shoveler	—	16.4	17	10	3	
Ringed Teal	3	3.4	54	40	27	5 reared by parents.
European Eider	2	13.5	12	10	10	
Red-crested Pochard	4	6.3	80	52	29	
African Pochard	2	16.5	16	11	11	
Canvasback	1	20.5	12	8	2	
European Pochard	2	16.4	10	9	9	
Redhead	2	18.4	16	12	11	Including 8 hybrids with Ringneck.
Ferruginous Duck	2	20.5	16	13	8	
New Zealand Scaup	1	18.5	14	8	8	1st breeding record for Slimbridge.
Tufted Duck	1	20.5	7	4	4	
Lesser Scaup	1	20.5	9	6	3	
European Greater Scaup	2	25.5	22	9	6	
Brazilian Teal	1	17.6	9	7	7	
Mandarin Duck	5	15.4	69	26	13	
Carolina Duck	10	2.3	261	103	52	1 reared by parents.
Comb Duck	1	20.5	8	5	—	
S. American Comb Duck	1	30.6	16	12	6	
Hartlaub's Duck	1	16.5	24	5	—	
Barrow's Goldeneye	1	1.5	7	2	—	
European Goldeneye	1	3.4	5	2	1	
Red-breasted Merganser	1	22.5	9	4	3	
Goosander	1	15.4	7	7	3	
North American Ruddy Duck	10	1.5	58	13	1	In addition 40 reared by parents from an unknown number of eggs.

TABLE II
Breeding Analysis 1958—Peakirk

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Hatched	Reared	Remarks
Fulvous Whistling Duck	2	2.5	26	22	11	
Swan Goose	1	5.4	8	5	3	
White-fronted Goose	1	10.5	5	—	—	
Greenland White-fronted Goose	1	2.5	5	—	—	
Lesser White-fronted Goose	1	20.4	4	3	2	
Western Greylag Goose	2	3.4	12	6	6	
Eastern Greylag Goose	3	9.3	15	2	2	
Bar-headed Goose	1	19.4	4	3	1	
Emperor Goose	1	4.6	5	—	—	
Lesser Snow Goose	1	14.5	4	—	—	
Blue Snow Goose	1	18.5	4	2	2	
Ross's Goose	1	14.5	1	—	—	
Dusky Canada Goose	1	18.4	4	2	1	
Barnacle Goose	1	8.5	4	—	—	
Red-breasted Goose	1	22.5	11	—	—	
Cape Shelduck	1	2.3	18	15	15	
Common Shelduck	1	13.4	11	9	7	
Ashy-headed Goose	1	13.4	6	—	—	
Upland or Lesser Magellan Goose	1	29.4	10	6	—	
Falkland Upland or Greater Magellan Goose	1	15.3	14	12	3	
Cereopsis	1	17.12.57	16	9	7	
Puna Teal	1	24.4	10	8	1	
Southern Bahama Pintail	5	10.5	31	23	19	
Northern Pintail	3	10.4	18	9	7	Eggs broken by hen.
Chilean Teal	2	21.4	11	11	9	
Chestnut-breasted Teal	3	32.3	20	20	16	
Hawaiian Duck	1	23.4	3	2	2	
Mottled Duck	1	12.5	6	—	—	
Philippine Duck	4	20.4	26	10	4	
Gadwall	2	18.5	18	18	15	
European Wigeon	2	15.6	12	10	3	
Chiloe Wigeon	1	2.6	10	—	—	
Northern Cinnamon Teal	4	20.4	26	23	4	
Garganey	2	26.5	10	5	—	1 killed by hen when feathered.

TABLE II—*continued*

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Hatched	Reared	Remarks
Common Shoveler	4	15.5	27	25	18	2 reared by parents.
Ringed Teal	1	20.6	1	1	1	
Red-crested Pochard	6	1.4	58	37	31	
Rosybill	3	27.5	28	18	12	
European Pochard	1	15.5	9	5	4	
Redhead	1	1.5	12	10	7	
Ferruginous Duck	1	10.6	—	—	—	Vermin destroyed nest and eggs.
Tufted Duck	2	2.6	12	4	2	
European Greater Scaup	2	20.5	15	8	4	
Brazilian Teal	1	9.6	5	1	1	
Mandarin Duck	4	10.4	42	21	12	
Carolina Duck	13	14.3	278	114	81	
Comb Duck	1	6.7	11	—	—	
North American Ruddy Duck	1	14.3	—	—	—	Vermin destroyed nest and eggs.

New Zealand Scaup

OBTAINING NEW BIRDS

THE Trust's collection can still be improved considerably by the co-operation of Members in various parts of the world. Birds can be sent fairly easily these days by air. We shall be most grateful to anyone who can obtain any of the species shown in the lists which follow—ideally five pairs of each kind.

If you can help, this is what you should do:

1. Arrange for the catching of adult birds or well-grown young, or the collection of absolutely fresh eggs, or alternatively, if they can be put under a hen or in an incubator within 72 hours, of eggs a few days from hatching. Of these adult birds are much the most satisfactory.

2. Write to tell us about it mentioning the route and airline by which the birds will be sent.

3. Obtain small light boxes to hold preferably not more than two and ideally one bird in each compartment. A suggested design for such a box is shown in the diagram.

Each bird must have access to a small tin of food and water and this container should be able to be filled from outside the compartment containing the bird. It should have very little water as if it slops over and wets the birds they may die. If possible it should be contrived that the birds cannot foul the containers. This can be done either by siting the container above the level of the birds tails or preferably in such a position that the birds put their heads out between bars in order to feed and drink. Care must be taken that a bird cannot get its head caught by a tapering space between such bars. For a long journey the box should have a floor of small mesh wire-netting on which the birds stand and keep themselves clean and dry, with a removable tray underneath it for cleaning. If wire netting is not used for the floor this should be covered with sawdust. Neither hay nor straw should be used as these have to be removed at the port of arrival owing to special restrictions against animal diseases.

All boxes should have good ventilation but not too much light.

4. Send the birds off addressed to The Wildfowl Trust, Slimbridge, Gloucestershire, via Stroud station. Besides the address the outside of the box should:

i. Be labelled " Live Birds—Urgent "

ii. Have a notice giving instructions for feeding if the journey is more than two or three days.

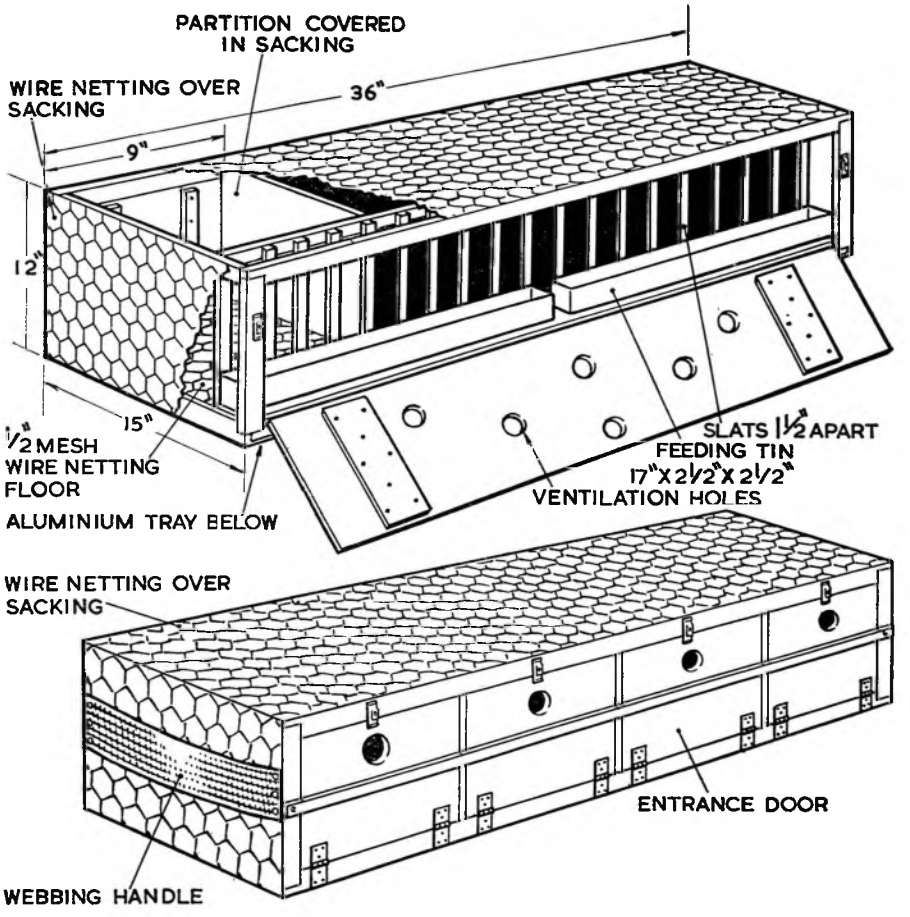
iii. Have a small bag of food (grain of some kind for most species) attached for replenishing the containers during the journey.

The birds should be sent as soon as possible after catching. They can manage without food for 4-5 days (but need water), and if for any reason it is necessary to send them by sea most species will survive a journey of several weeks. In the case of a sea journey it is preferable to consult the Trust before making arrangements for despatch.

5. Send us a telegram giving the date and, if possible, time of arrival and the flight number, prior to despatch of the birds. If sent by air they must go to London Airport as our import licences are only valid here.

We are permitted to import birds from any country in the world, with the exception of the North American Continent. We can, however, make arrangements to have any birds from there quarantined in Holland and later sent on to us. Therefore no birds should be despatched from North America without previous consultation with the Trust.

TRAVELLING CRATE
FOUR COMPARTMENTS



This is suitable for four ducks up to Mallard size, a relative increase in size being necessary for the larger birds—a single goose would need a compartment 18″ x 18″ x 15″ wide.

LIST OF SPECIES REQUIRED

(In many cases the Species are already represented in the collection, but the Trust is anxious to obtain additional specimens).

NORTHERN EUROPE

Velvet Scoter (*Melanitta fusca*)
Harlequin Duck (*Histrionicus histrionicus*)
Long-tailed Duck (*Clangula hyemalis*)
Smew (*Mergus albellus*)

SOUTHERN EUROPE AND NEAR EAST

White-headed Stifftail or Spiny-tailed Duck (*Oxyura leucocephala*)

INDIA, PAKISTAN, BURMA AND CEYLON

Burma Spotbill (*Anas poecilorhyncha haringtoni*)
Pink-headed Duck (*Rhodonessa caryophyllacea*)
Indian Pygmy Goose or Cotton Teal (*Nettapus coromandelianus coromandelianus*)
Asiatic Goosander (*Mergus merganser orientalis*)

EAST INDIES AND MALAYA

Spotted Whistling Duck (*Dendrocygna guttata*)
Black-backed Radjah Shelduck (*Tadorna r. radjah*)
Salvadori's Duck (*Anas waigiuensis*)
Pygmy Goose or Cotton Teal (*Nettapus c. coromandelianus*)
Green Pygmy Goose (*Nettapus pulchellus*)
White-winged Wood Duck (*Cairina scutulata*)

CHINA AND JAPAN

Middendorf's Bean Goose (*Anser fabalis sibiricus*)
Eastern Bean Goose (*Anser fabalis serrirostris*)
Eastern Scaup (*Aythya marila mariloides*)
Baer's Pochard (*Aythya baeri*)
Pygmy Goose or Cotton Teal (*Nettapus c. coromandelianus*)
Chinese Merganser (*Mergus squamatus*)

AFRICA AND MADAGASCAR

Hottentot Teal (*Anas punctata*)
Black Duck (*Anas sparsa*)
Cape Shoveler (*Anas smithi*)
African Pygmy Goose (*Nettapus auritus*)
Hartlaub's Duck (*Cairina hartlaubi*)
Maccoa Duck (*Oxyura jamaicensis maccoa*)
White-backed Duck (*Thalassornis leuconotus*)
Bernier's Teal (*Anas bernieri*)
Meller's Duck (*Anas melleri*)
Madagascar White-eye (*Aythya innotata*)

Borough Fen is now operated by Mr. W. A. Cook, who was assistant to the late Mr. Billy Williams. During the summer of 1958 a great deal of effort was put into repairs and reconstruction of the decoy, which had been severely damaged by snow in recent winters, and seven of its eight pipes were put into full working order. The catch of only 56 Teal in 1957-58, though better than that of 1956-57, is very far below those formerly made. 900 in 1951-52 was the last large catch of Teal. It now seems possible that a return to that level will never again be made, because the surrounding district may have become less attractive to Teal.

Fortunately, the Mallard ringed at Borough Fen are yielding recoveries of considerable value, as are those marked at Ludham in Norfolk, where Messrs. C.A. and M.R. Boardman were able to resume trapping early in 1958. Both stations catch a high proportion of immigrants.

Mr. D. Dandridge ringed only a small number of ducks at Deeping Lake but, as usual, his catch included a very useful number of Tufted Ducks and a wide variety of species. His most remarkable capture was a Pink-footed Goose, apparently wild and in good health.

At all the permanent ringing stations recaptures of ducks previously marked make up an important part of the total catch. Most of these recaptures are of ducks ringed in the same season ('repeats' in ringing jargon) whose principal uses are in determining the habits of " trappable " ducks, but they also include a valuable number of ducks marked in earlier years, or at other ringing places. Table II illustrates the relative importance of recaptures at Abberton.

TABLE II

Captures and Recaptures of Ducks at Abberton, 1957-58 showing intervals since first marking

Species	Newly ringed	Number of individual ducks *recaptured* for the first time during the year and ringed n seasons before									Ringed elsewhere	Useful catch
		0	1	2	3	4	5	6	7	8		
Shelduck ..	7	6	—	—	—	—	—	—	—	—	—	13
Pintail ..	8	2	—	—	—	—	—	—	—	—	—	10
Teal ..	2140	288	48	26	1	—	—	—	—	1	8	2512
Mallard ..	579	160	17	9	3	—	—	1	1	—	1	771
Gadwall ..	12	2	—	—	—	—	—	—	—	—	—	14
Wigeon ..	111	19	5	1	—	—	1	—	—	—	—	137
Garganey ..	10	1	1	—	—	—	—	—	—	—	—	12
Red-crested Pochard ..	2	—	—	—	—	—	—	—	—	—	—	2
Pochard ..	6	1	—	—	—	—	—	—	—	—	—	7
Tufted Duck	21	1	—	—	—	—	—	—	—	—	—	22
Smew ..	1	—	—	—	—	—	—	—	—	—	—	1
Total ..	2897	480	71	36	4	—	1	1	1	1	9	3501

Goose Ringing

After two disappointing years, the Pinkfoot-netting expedition in October 1957 proved highly successful. 3282 geese were caught, over twice as many as during the best previous trip, in 1954. This increase was not due to any radical new change in the equipment—although the modification of the

rockets made in 1956 (see *9th Annual Report*, p.34) undoubtedly contributed. It may be attributed to a combination of two factors: large numbers of geese in the places visited and reorganization of some of the netting operations, allowing more catches to be made—in 1957 13 catches were made in 26 days, compared with 9 in 21 days in 1956. The first catch of the season was of 490 geese, an increase of 46 on the previous record. A Bean Goose and a Greylag were the only ' accidentals ' included in the total bag but the 490 catch included a leucistic (off-white) Pinkfoot which has joined the one caught in the previous year in the Big Pen at Slimbridge.

Two catches of Whitefronts were made at the New Grounds in February and March. 153 geese captured including one previously ringed in Holland and another that had been ringed at Slimbridge in February 1953.

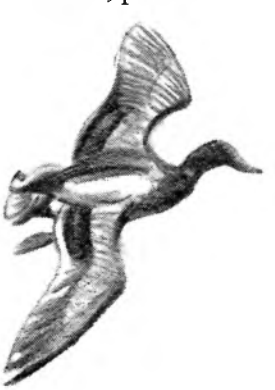
No captures of moulting Canada Geese for ringing were made in the summer of 1958. The Wildfowlers' Association has taken over with enthusiasm the redistribution of surplus geese for which the Trust had been largely responsible in the previous five years.

THE DUCK ADOPTION SCHEME

1957 WAS the tenth year of life of this scheme and it continued to show regrettable signs of increasing age, with a further reduction in the number of ducks adopted, to 1200—compared with nearly 3000 in 1955-56. After deducting the costs of administration of the scheme, it yielded a little over £300 towards the cost of ringing, that is only about one-tenth of the expenditure incurred. Much of this expenditure is, of course, met from the Nature Conservancy research grant, but, if our ringing programme is to expand it is essential to raise more money by voluntary contributions within the Adoption Scheme, or by other donations. The assistance of Members is requested.

Adopters pay 5s. for each duck, goose or swan adopted. The subscriber is allotted a ringed bird (of the species of his choice as far as possible) and told when and where it was ringed. Should the duck be recaptured or recovered the subscriber is notified of the date and place of recovery and of any other details given by the finder. All adopters receive, in the two years following their subscription, an annual report summarising interesting recoveries and the uses of information obtained in this way.

Ducks may be adopted by applying to the Assistant Secretary, The Wildfowl Trust, Slimbridge, and enclosing 5s. for each bird. Adopted Duck Tokens, suitable as gifts, are available, price 6s.



NATIONAL WILDFOWL COUNTS

G. L. Atkinson-Willes

AFTER ten seasons of counting wildfowl intensively the time is ripe for a review of what has been achieved so far and for a forecast of what the future may hold. Inevitably the first few years were fully occupied with forging the investigation, working out the details and recruiting the army of enthusiastic volunteers who alone make it possible. During this time the scheme existed solely by faith, for it was not until 1953 that a long enough series of data had been collected for recourse to be made to the statisticians, who gave their provisional stamp of approval. The start therefore was slow and counters had to wait for a long time before seeing any real return for all their efforts.

In 1954 however a first assay was made to study an individual species, the Mallard, which showed promise but emphasised that a great deal more thought and a more critical technique of analysis was needed. Two years later this bore fruit in a more detailed survey of the flutuations of the Tufted Duck in Britain during the previous six years. Although this was an improvement on the earlier study it was nevertheless still bedevilled by the need for guesswork to fill the gaps in the records left by the vagaries of weather, sickness and plain domestic crisis.

Since there is no reason to hope that these hiatuses will not continue to occur, our efforts during the past two years have been devoted to devising still further improvements in analysis and towards streamlining the investigation. A part of this programme, entailing a return to first principles and an almost daily study of the wildfowl on one or two waters, is discussed by Matthews in "Basic data from wildfowl counts". This paper, which is summarized on page 24 produces comforting confirmation of one of the earliest precepts, that errors in counts due both to the birds' mobility and to the observers' mistakes cancel out provided that large numbers of counts and observers are involved. It also appears that, at least in the areas investigated, the effects of tide and moon are much less important than supposed.

For a long while the tying of the count dates to the new moon period has proved inconvenient, since it entails comparing years when the dates fell early in the month with years when they fell late. Furthermore for coastal counts a high tide in the middle of a short winter's day is needed for best results, but such conditions *never* occur on parts of the European seaboard at the new moon, and even in Britain there are radical differences in the state of the tide in various areas at the same time. It has therefore been agreed internationally that counts should in future take place in the middle of the calendar month, on the Sunday nearest to the fifteenth.

Experience has also shown that summer holidays interfere with the early counts and that enthusiasm tends to wane by April. It has thus been decided, again with international accord, that attention should be focussed on counts between September and March inclusive, although counts outside these limits are in no way discouraged. Indeeed it is hoped to increase their usefulness by developing a separate, intensive study in the breeding season by relatively few observers. Records from past years for example show that certain large waters scattered over the country often carry a big assembly of birds in the early autumn which is presumed to be a concentration of the home population. If this is so a comparison of these gatherings from year to year may give an indication of the size of the breeding population and the success of the season.

Whilst all this has been going on, the records already collected have not been lying idle. In early 1957 all available information on the Brent Goose was assembled and despatched to Dr. Finn Salomonsen in Denmark who had been asked by the International Wildfowl Research Bureau to report on the status of the species in N.W. Europe. His recently published findings, which are summarised on page 93 are a milestone in international co-operation, for Britain was only one of many countries to make their records available.

Since then a second combined operation has been mounted with the appointment by the Bureau of C. S. P. Van Dam of Holland to study the European Mallard. Beginning with the British data, which he found to be the most comprehensive, he spent ten days at Slimbridge in January 1958 testing various methods of analysis and deciding on the best course to adopt. On his return in July to collect the final correlation of the British figures, he met Dr. H. M. Thamdrup, the national organizer of the Danish wildfowl counts, and many of our mutual problems were discussed at length.

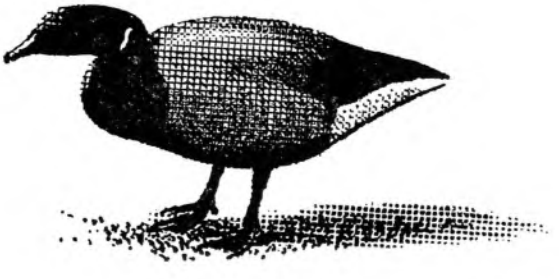
In many ways Van Dam's task is more complex than Salomonsen's in that Mallard have a much wider distribution than Brents, and he is faced with a mass of data of widely varying quality. In fact one of the more important parts of his work is to assess the merits of wildfowl counts in each country and to recommend a standard method. In the past each country, although using the same count dates, has developed its own system of analysis in the light of its own peculiar problems, but with this new phase of international co-operation, and with many new countries beginning to participate, some conformity is essential.

Hugh Boyd has also used the wildfowl count records extensively in his detailed work on the status and distribution of the Greylag Goose in Britain which is published in this report. It is a further example of the uses to which the data can be put, as although the counts were never designed to give such a complete picture as this, they do provide a generous framework on which to base more detailed enquiries. Nor do we keep all these records for our own sole use, for there is a steady demand from workers outside the Trust for information to assist them in their researches. Indeed at one time the spate of requests became so heavy that it threatened to interfere with our own work and we had to insist that people must come and extract their own data. They have, of course, also to establish their bona fides and to conform to certain restrictions, as the records are confidential and detailed information may not be published without the permission of landowners.

One rather unusual study has also been carried out by S. McClelland who for three seasons ran a British Trust for Ornithology investigation into the status of the Coot. Normally this species is not included in the wildfowl counts but at the special request of the B.T.O. wildfowl counters were asked to help and so save a vast duplication of effort. In addition to these national investigations many counters use the data which they themselves have collected in specialised studies of the wildfowl in their area or even on a particular water. R. C. Homes, for example, who has been organising counts in the London area since before the war, has just published a paper on the wildfowl in that area during the past ten years, whilst A. R. M. Blake is studying the importance to wildfowl of minor waters in the west Midlands. Such work is of the greatest value to us in our more general research on wildfowl as the very detail of it brings to light points which might otherwise go unnoticed, and which often have a wider application.

In particular these local studies are complementary to the wildfowl counts in yet another form of analysis which is being undertaken. In 1955 the Nature Conservancy asked the Wildfowl Trust to consider the status of the British population of all species of wildfowl with particular reference to distribution, to the amount of habitat available and to the degree of conservation already afforded. This work, now nearing completion, takes the form of a survey of the wildfowl in each region, and in years to come will serve as a contemporary record of present conditions. It is far from relying solely on the results of the counts for its information, although they are much used, but incorporates the advice and criticism of many other people, including wildfowlers and wildfowling clubs. As each instalment is completed it is presented at informal meetings in London to which the Director-General of the Nature Conservancy invites representatives of the Wildfowlers' Association of Great Britain and Ireland, the British Field Sports Society and the Wildfowl Trust to discuss with him in confidence matters of future policy and the need for further conservation. This review, which aims to give a balanced perspective of current conditions, is probably amongst the most important uses to which the wildfowl count data has been put at the present time.

Such then are the ramifications of the wildfowl count scheme which have built up during the first ten years. The counts have already proved to be an invaluable source of information, and will increase in value with every year that passes. Some areas however are still hardly covered at all and it is hoped that this report may stimulate new recruits to offer their services for one Sunday afternoon a month. Anyone living in Cornwall, Wales, Ireland or N.W. Scotland and the Outer Isles is assured of a rapturous welcome, but there is room and to spare for everyone, everywhere.



BASIC DATA FROM WILDFOWL COUNTS

G. V. T. Matthews

A Summary

IT was desired to test the assumptions that errors due to the spacing of the counts, to the mobile nature of the birds and to the estimation of numbers will cancel out. The detailed results of the study are being published in the Proceedings of the 12th International Ornithological Congress 1958.

Miss Eileen Palmer, in the course of three seasons (late July to early April) counted the duck present on Durleigh Reservoir, Somerset on 565 days. In the last two seasons she hardly missed a day. Although Miss Palmer's marathon efforts are unmatched, less complete data over single seasons from Barn Elms and Lonsdale Reservoirs in London (108 counts) and Blagdon Reservoir, Somerset (67 counts) collected by teams led by Mr. D. A. Pomeroy and Mr. B. King are used for some comparative purposes.

The mean value of near daily counts gives a good measure of the population level within the month. The count made on the Count Date was found to err, on the average, by between a quarter and a half of this true monthly mean value. Some species are more likely to deviate in this way, due to more rapid fluctuations in their population. This instability is measured by a statistic (V), the coefficient of variation. For Durleigh the species present can be arranged in increasing order of V (i.e. increasing instability):— Mute Swan, Tufted Duck, Teal, Shoveler, Mallard, Pochard, Wigeon. The value of V is not wholly a species characteristic, but will be affected by the topography of the water, its degree of disturbance, relation to migration flyways, etc. Thus Blagdon gave similar values for Teal and Wigeon, but both there and on the London reservoirs, Tufted Duck gave a higher and Mallard a lower value. Extensive data from other waters are badly needed.

Under Durleigh conditions only the Swan and Tufted Duck populations are sufficiently stable to be adequately described on that one water by monthly counts. This stability is affected by short-term fluctuations caused by disturbance, feeding flights and movement in and out of cover; by medium term fluctuations caused by weather movements; and by long term fluctuations caused by seasonal migrations. By grouping the data into periods of varying lengths it was shown that counts would have to be made at weekly intervals if there was to be a substantial improvement in accuracy over the monthly counts. The improvement would not be commensurate with the increased effort involved.

The assumption that movements of birds between waters would cancel out was tested by comparing the values of V obtained from two waters considered first as separate units and then as one unit. For Lonsdale and Barn Elms, only half a mile apart, a big reduction in V (i.e. considerable cancelling out) did occur in the latter instance. Reductions of the same order were obtained when Durleigh and Blagdon, 18 miles apart, were combined. There is not necessarily an interchange between these two waters, but at least fluctuations in different senses were occurring on them.

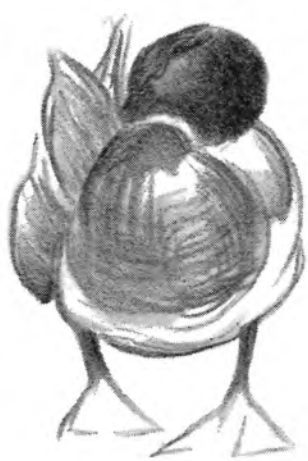
A number of phenomena, particularly weather, affect stability but, being largely unpredictable, cannot be allowed for in planning. Predictable

phenomena could be taken into account if it were shown that they produce important effects. Stability is greatest in certain months, but not the same for all species, and the monthly counts have to extend over a sufficient period to cover all these. No great difference was found between morning and afternoon counts; between counts made at high tide and low tide (Durleigh is only 6 miles from the coast); between counts made at the full moon and new moon periods. The latter result contrasted with suggestions that there would be much greater variation at Full Moon on account of increased migration activity and nocturnal feeding.

In most British wildfowl counts the individual birds can actually be *counted* and errors from this source would be small. When large numbers of birds are present, when they are restless or liable to disturbance or when they are in flight it is necessary to make *estimates*. The accuracy of such estimates was tested by asking more than a hundred people, of widely differing experience, to estimate the numbers (71—948) of geese, in flight and on the ground, on a series of twelve full plate photographs. Errors were large, averaging about one-third. Persons with much field experience of counting were only slightly better than those with none, but they were more consistent in their estimates. From a relatively low level there was no tendency for the errors to become proportionately larger as the number of birds increased. The errors of individuals tended to cancel each other out, the overall error for the whole series of tests being less than 10%.

Problem

Photographs of geese in flight appear on page 207. It would further our investigations if you could *estimate* the number of geese in each case, looking for 30 seconds *only*. Please send your honest answer on a postcard, indicating whether you have had experience of counting and estimating in the field. The correct answer will be published in the next Bulletin, but you can, of course, count the birds yourself if you like.



AERIAL SURVEY TECHNIQUES

S. K. Eltringham

THE use of aerial survey in the census of wildfowl is new to Britain and techniques are, as yet, in an experimental stage. However, the system has been employed on a large scale in Canada and the United States for a number of years and routine methods have been evolved by the U.S. Fish and Wildlife Service which carries out the surveys.

The object of the aerial surveys in North America is to provide data from which shooting regulations may be drawn up, and as these regulations are made in advance, it is necessary to make a forecast of what the duck crop is likely to be. The success of a breeding season depends on many factors, not the least of which is the amount of water available. The duck breeding grounds in Canada are covered with small ponds or sloughs which fill up in the spring from the melting snow and their permanence depends on the subsequent rainfall. A wet spring means full sloughs in the summer for the young ducklings and is a harbinger of a good shooting season. Other important factors which obviously affect the success of a breeding season, are the number of birds which pair up after the spring migration and the number of young which are successfully reared. Thus, a forecast of next winter's duck population must take into account the amount of water available and the number of breeding pairs in the spring as well as the number and average size of the broods in the summer. From this information an index of the duck population is derived. In order to collect these data, a breeding population survey is flown in May and a production survey in July. For administrative reasons this information has to be submitted to headquarters by the end of July so that surveys cannot be continued later than about 25 July, when many broods are not yet hatched. The major duck breeding areas in North America are to be found in the Canadian provinces of Alberta, Saskatchewan and Manitoba. This is a vast area and as one obviously cannot hope to make a complete inventory, a sampling technique is necessary. The sampling procedures were determined by statistical methods outlined by Crissey in 1957. (Forecasting waterfowl harvest by flyways. *Trans. 22nd N. American Wildlife Conf.* pp. 256-268). The area to be sampled is divided into units of states or provinces and straight line transects are flown across them. The distance between each transect varies with the density of the population; in the prairie provinces, where the highest population densities occur, and from which the data are most variable, transects are flown at intervals of from 7 to about 20 miles. In northern areas with lower densities and less variability, an interval of 60 miles between transects is sufficient to reduce the sampling error to the required level of not more than 20%. Sampling error was determined from the variability imposed upon the data by sub-dividing transect lines into 18 mile segments and recording the data separately for each segment. The transects may extend up to 200 miles in length and altogether about 12,000 miles are flown in the May survey which takes six crews about 3 weeks to complete. The same transects are flown again in July but sometimes flying is not completed before the reports have to be submitted. An aerial survey crew consists of a pilot-biologist and an observer. The aircraft belong to the U.S. Fish and Wildlife Service and are flown by the Service pilots, but the observer is frequently a member of the Canadian

Wildlife Service. Light aircraft are generally used, high winged monoplanes being best because of the good visibility from this type of machine. For the Arctic surveys an amphibious twin engined aeroplane is preferred, either a Grumman Widgeon or the larger Grumman Goose. Although used primarily as land planes these have the advantage of being able to come down on one of the many lakes in case of engine trouble over wooded country. The surveys are flown at a height of about 100 ft. and at an air speed of 100 miles per hour. In all aspects of the procedure, great attention is paid to uniformity and as far as possible the same crew is used to fly the same transects each year.

Each member of the crew records the number and sex of each species seen on his side of the aircraft, using a dictaphone for the purpose. Because of his preoccupation with flying the machine, the pilot tends to see fewer birds than the observer, but tests have shown that the difference is not more than 20% and in any case the difference is immaterial in deriving an index of birds present provided the same pilot is used each time. In addition the observer notes the number of wet sloughs. In the spring the birds are recorded as pairs or as lone drakes, which are presumed to have mates remaining on the nest. Groups of birds are omitted if it is thought that these are transients. Only wildfowl within 220 yards of the aircraft are considered, hence the transect comprises a strip $\frac{1}{4}$ mile wide across the territory. For the July surveys great detail is attempted in the data. Because of this and of the greater difficulty in seeing the birds below leaf cover, the transect width is reduced to $\frac{1}{8}$ mile. The information collected consists of:

1. Number of broods
2. Age class of broods (using the abbreviated I, II, III classification)
3. Number of ducklings in the Class II and III broods
4. Number and species of adults without broods when these are single ducks of either sex or in pairs.
5. Number of water areas (recorded by observer only).

The number of Coot broods are also noted as this species is an important game bird in the States. Groups of two or more drakes and groups of three or more adult birds of mixed sexes are not recorded as they do not provide information on production. The number of water areas counted by the observer are those in the 1/16 mile stretch that he is searching.

In all cases the survey flights are made in the early morning, usually between 6 and 10 a.m., for the following reasons. First, it has been clearly established from many experimental flights that more birds are out on open water at this time of day than at any other time. Secondly, in the early morning the strong wind which is a feature of the prairie during the day has not developed. Calm air conditions are desirable as wavelets on the water surface reduce visibility and tend to drive the birds under cover and it is generally considered impracticable to fly surveys in winds above 20 m.p.h. The ideal weather conditions for optimum visibility are considered to be a light overcast with a slight wind, sufficient to keep ponds from appearing glassy. It is desirable that all flights should be standardised at the same time of day for the diurnal movements of wildfowl might otherwise obscure the picture. This is a factor reducing the value of ground surveys which, of necessity, have to be continued throughout the day.

In addition to these production surveys, autumn and winter inventories are carried out and are of greatest use with species which form very large aggregations in a limited number of localities at some time during their annual migrations. These are best surveyed photographically from high flying aircraft. Greatest success is found with those birds, such as Snow Geese, which contrast most with their background.

The accuracy of the aerial surveys in North America is examined by comparing results from air and ground coverage of selected study areas which are extensively worked from the ground. This is an invaluable technique which has shown that, under standard conditions, a significantly constant proportion of the birds is seen from the air. The visibility of all species is not the same: for example, Mallard are more easily seen than Teal, and some method of applying a correction factor to the number is being investigated.

If the American survey regions are related to British conditions the most notable difference is found in the homogeneity of the habitat. While it is possible in Canada to fly for one or even two hundred miles over the same type of country, it is very unlikely that one would be able to fly very far in this country without encountering a major ecological change in the countryside. Hence a large scale transect system would not be appropriate here because the transects would not be sampling a uniform population. In any case in an overcrowded country like Britain it would be very difficult to plan straight line transects which would avoid towns and built-up areas. Navigation would present a problem too, for here there are no long straight mile roads which are used as navigational aids in Canada. Finally, weather conditions are such as to render it likely that a 200 mile flight across England would lead one through frontal conditions. Photographic inventories of geese are not as easily effected in this country as in America, chiefly because we have no very large concentrations in a few localities and because our grey geese do not contrast as sharply with stubble and grass background as do Snow Geese on water. With these considerations in mind we can detail some of the techniques which are being developed by the Trust for the aerial survey of wildfowl in Britain. These surveys can be broadly classified into those concerned with geese and those concerned with ducks and swans; the principal difference being that the former are usually found on land and the latter on water. Geese surveys are of necessity restricted to the winter months and so far very little summer flying has been done although it is hoped to carry out experimental surveys of breeding ducks in the spring and summer of 1959. The geese that have been surveyed to date include two ' black ' and two ' grey ' species, each presenting its own particular problems. A survey of Barnacle Geese in the Hebrides and Western Scotland in 1957 by Boyd and Radford showed that such flights by light aircraft in this part of the world are possible in winter, but the uncertain weather conditions and the lack of detailed weather forecasting facilities render this type of survey somewhat hazardous. The use of a more suitable aircraft might make further flights too expensive but as there is no other way in which a survey can be carried out this possibility must be considered. The other ' black ' goose that has been investigated is the Brent, which occurs primarily along the coast between the Thames Estuary and the Wash. This is a species which lends itself to aerial survey for it lives largely between the tidemarks and is therefore quite simple to find, provided the tide is not too low. Such coastal birds are very difficult to see and count from the shore

and aerial survey can make an important contribution to our knowledge of the status of these birds. Interest in the status of these two geese is acute as both have shown signs of serious decline in recent years and have been afforded a trial period of protection. English Brents are of special interest in that the east coast forms the meeting point of the light and dark bellied races.

The two grey geese which have been investigated so far are the Pink-footed and the Greylag Goose. The Pinkfoot was the more difficult bird to survey owing to its habit of feeding far from its roosts. It was necessary systematically to quarter large areas of arable land before the birds could be found, although from prior knowledge only limited regions needed to be searched. The Greylag feeds nearer to its roost and consequently the searching time was much reduced. All species were counted from a height of about 4-500 ft. Visual estimates are made of large flocks by counting the birds, on a hand tally, in units of 10 or 50, depending on the size of the flock. Photographic techniques are being explored as these are potentially greatly superior in that there is no question of the accuracy of a good photographic count. Two K20 aerial cameras have been obtained, using Kodak Super XX aerial film. However, under the poor lighting conditions of a winter survey and with the lack of contrast between birds and background, a photographic record cannot be relied upon and the visual counts will continue to be necessary. In this respect it is desirable that the same crew is used each time so that the individual tendency to under-for—or over-estimate numbers will be a constant factor.

Aerial surveys of ducks have been made on reservoirs, gravel pits, rivers, flood water and along the coast. For these surveys it is necessary to fly at about 100 ft. in order to identify the birds. The flocks on large reservoirs are extremely difficult to count as the approach of the aircraft scatters the birds, mixing those that have been counted with the uncounted ones. It is also a formidable problem to count the separate species when these are mixed up together. Such difficulties do not arise on small ponds and gravel pits or on rivers where only small concentrations of ducks are encountered. Flights along rivers seem to be fruitful and ' replicate flights ' along the same routes are being made to test the consistency of the observations. These flights are usually made at a cruising speed of about 90 m.p.h. Data are recorded on a Minifon wire recorder which has the advantage over notebook and pencil in that notes may be made without taking one's eye off the birds. The only coastal duck that has received attention is the Shelduck in Bridgwater Bay, which is the only known moulting area for this bird in the British Isles, and several flights were made last summer and autumn to determine the number of moulting birds.

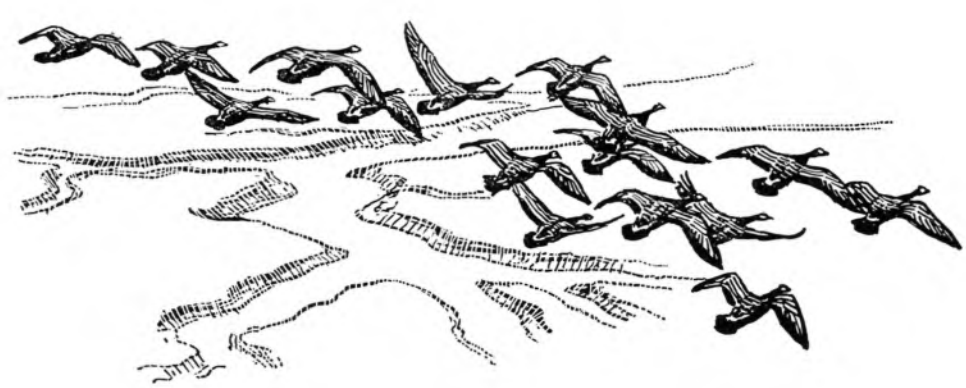
Swans are easily seen and counted both on reservoirs and rivers and experience has shown that a single pilot-observer can make an adequate census of these birds. It is possible from the air to distinguish juveniles from adults and information on brood size and adult/juvenile ratios is being collected.

Most of the surveys have been made with Auster aircraft, which are high-wing monoplanes similar in design to the aircraft used by the U.S. Fish and Wildlife Service. A Miles Messenger, which is a low-wing monoplane, was used for surveys in Scotland when an Auster was not available and the visibility was found to be better than anticipated, although, of course, inferior

to that from the Auster. The disadvantage of the poor visibility from low-wing aircraft may be offset by the observer being able to see out of both sides of the aeroplane, at least in those with tandem seating. However, the Auster is preferred because it is cheap, manoeuverable and has good slow-flying characteristics.

The advantages of aerial survey should now be apparent. First, with an aircraft all birds are accessible. Second, aerial survey is " instantaneous " within a particular area and there is little danger of counting the same birds twice (this probably happens not infrequently when ground counters are out at various times of the day). The use of the same observer each time is a great advantage when comparing annual fluctuations, for the changes are not likely to be a reflection of differing abilities to assess numbers as might be the case with a number of ground counters.

Aerial survey has, however, its limitations. Perhaps the greatest of these, in the winter at least, is the weather. Fog and low cloud will prevent flying altogether while high winds make it somewhat dangerous to fly too near the ground. The long sequence of foggy days in November and December 1958 seriously curtailed our flying programme. Aircraft availability has in general been good although the locally hired Auster is not available at weekends or on summer evenings, and for flights away from base, special arrangements have to be made. Flying restrictions have proved less irksome than was anticipated except that five areas dangerous to flying (firing ranges) are located within the Brent regions on the east coast. Airfield availability leaves much to be desired and re-fuelling problems are often serious in Scotland where the geese may sometimes be found more than an hour's flying time away from the nearest airfield with fuel. It is not anticipated that aerial survey will replace ground counts but it is hoped that the method will be of value in supplementing ground observations, especially in areas where few counters are available. When once the limitations and the possibilities of the method have been evaluated it should be possible to design flying programmes that will be of considerable assistance in the general problems of wildlife conservation.



TECHNIQUES IN WILDFOWL TAXONOMY

G. V. T. Matthews

(*The names of scientists who have collaborated with the Trust are shown in italics*)

A better understanding of the taxonomy of the *Anatidae*—the evolutionary relationships within the Family and its position with regards to other groups of birds—has from the start been one of the main aims of our research programme. The unique comparative Collection of wildfowl at Slimbridge, in which five-sixths of the living species have been represented at some time, offers outstanding opportunities for such work. Their study has gone forward both by work carried out at Slimbridge and by the provision of material for workers in other institutes. Many and diverse methods have been used and here an attempt is made to draw the threads together and indicate the scope of present researches, without reporting on the results in detail. It is intended that this should be done in a later paper.

External form and colouration have long been used in drawing up classificatory schemes. More and more it has been realised that attention should be directed to features not likely to be altered by adaptations to the immediate environment. Much of the assessment of similarities and differences is of an intuitive nature. *Mr. Peter Scott's* wide and intimate knowledge of the Family—he has seen all but seven of the 145 full species *alive*—both in captivity and in the wild has been particularly fruitful. His "*A Coloured Key to the Wildfowl of the World*" has recently appeared. Its 23 full-colour plates represent all the 247 known forms in the Family and, being a publishing venture of the Wildfowl Trust, has been produced at a price (8/6d.) which brings it within the reach of every student. Full detail and absolute faithfulness of colour reproduction cannot be expected at such a price. These are more nearly achieved in his illustrations for M. Jean Delacour's monograph " Waterfowl of the World." The sixty-four plates represent a definitive work of illustration. Of especial value are the plates depicting all forms of downy young. The patterns and colours of these are now recognised to be of great assistance in pointing relationships between birds which may appear very dissimilar in the adult form. The importance of the fact that 112 of the known forms have bred at Slimbridge is apparent. The case of the young of the Magpie Goose (*Anseranas semipalmata*) serves as an example. When the first volume of Delacour was being illustrated only a description was available and the downy young was depicted accordingly. Soon afterwards this species bred for the first time at Slimbridge and the young were found to be strikingly different from what is now recognised as the erroneous description.

Downy young are only available alive for short periods of the year and museum collections are generally very deficient in them. The Trust is therefore building up a reference collection of such skins as and when the birds die in good external condition. 97 skins of 68 forms of downy young are now preserved. Similarly the adult birds of the 173 forms which have been represented alive in the Collection are not all available at any one time and are in full plumage for only part of the year. 88 skins of 65 forms have been preserved. Two new cabinets of advanced design have recently been acquired from Copenhagen to house the growing collection.

The study of comparative internal anatomy, after many years of unfashionableness in the taxonomic field, has recently become a live subject again. The Trust has been able to assist in such work by the provision of post-mortem material. A number of trachea-and-syrinx preparations have been sent to *Dr. P. S. Humphrey,* now at Yale University, who is making a monographic study of these structures and the indications they provide of relationships. Dr. Humphrey also studies the musculature, requiring the provision of complete corpses when this can be done without conflicting with post-mortem requirements. *Dr. G. Kramer* of the Max Planck Institut, Wilhelmshaven is another bidder for complete bodies as he is studying the relation between bone size and structure and the bird's size, weight and method of flying. This is an investigation of functional anatomy and is not so likely to unravel evolutionary relationships. *Dr. J. G. Harrison's* work on the pneumaticity of the skull is likewise basically concerned with function but has in addition thrown light on taxonomic problems.

The development of behaviour studies reverses the usual trend whereby techniques from diverse and unrelated disciplines are pressed into the service of taxonomy. Heinroth (1910) realised that patterns of instinctive behaviour may be more stable than, say, plumage patterns. From the requirement for the precise description of such patterns of behaviour has stemmed a whole new discipline—*ethology*. This lays emphasis on the detailed observation of behaviour, and on the recording of all the facets of the pattern in an objective fashion, quantifying as far as possible. Important new advances in our concepts of behaviour have resulted. One of the pioneers of the method, *Dr. Konrad Lorenz,* has worked at Slimbridge for several periods and has continued Heinroth's original use of behaviour studies in the taxonomy of this Family, concentrating on courtship behaviour. *Dr. P. A. Johnsgard* of Cornell University, who will, it is hoped, be working at Slimbridge next summer, has been extending the work of Lorenz in this connection. *Dr. D. F. McKinney* worked for four years on comparative behaviour at Slimbridge, particularly on preening and other " comfort movements." He concluded that these were too uniform throughout the Family to be of taxonomic value. Dr. McKinney is at present continuing his investigations at the Delta Waterfowl Research Station, Manitoba, and is one of a group of workers in North America particularly concerned with the behaviours of Eiders and sea-ducks. The use of cine-film, both frame by frame and in slow motion has long been a vital tool in the analysis of movements that are too quick or occur in such rapid sequence that detailed recording by eye and brain are impossible. New types of high-speed camera and accurately-calibrated film projectors are being used by this group.

A fascinating field that has yet to be fully explored is the behaviour of hybrids. Already Lorenz has demonstrated certain ' basic ' behaviour patterns in duck hybrids that were not present in either parent. Such ' throwbacks ' in behaviour are paralleled by the emergence of ' ancestral ' types of plumage such as have been discussed by *Dr. J. M. Harrison,* in concurrence with Mr. Scott. Sometimes hybridisation produces a type closely resembling a third species. Thus the cross between Scaup and Tufted Duck is much like the Lesser Scaup, and Yamashina (1948) has suggested that the Marianas Mallard is a hybrid population derived from the Mallard and the Australian Black Duck. The extent to which hybridisation is an effective mechanism in the production of new species remains to be seen.

So far hybrids in the Collection have arisen by accident, but if opportunity for a full-scale investigation arose any number of known parentage could be produced. In some instances the intervention of artificial insemination would be needed to overcome gross anatomical discrepancies. In her book "*Bird Hybrids,*" *Dr. A. P. Gray* has listed more than four hundred types of hybrids as occurring in the Family *Anatidae,* part of her data being derived from the Trust's breeding records. The ease with which hybrids are produced seems to bear little relation to the similarity of the forms concerned. Intergeneric crosses are frequently reported, such as the bizarre result of a Goosander x Shelduck mating, whereas the closely related Carolina and Mandarin Ducks never produce hybrids.

As more refined physical and chemical techniques have become available, taxonomists have turned their attention to the structure and composition of the tissues themselves. Often such work has tended to take on the character of a search for the 'philosopher's stone,' for one character whose variations will enable all species to be fitted into a coherent evolutionary arrangement. It is more realistic to regard the results of such studies as additional information, to be used together with all existing data to draw up as natural a classification as possible. This point was emphasised by Delacour & Mayr (1945) in their classical appreciation of the Family which is taken as the starting point for subsequent investigations.

Yamashina (1952) has done a good deal of work on the numbers and shapes of chromosomes, the bearers of the hereditary particles, in the cell nuclei. This is a very delicate and laborious technique that has given interesting results, but also produced some odd conclusions. Probably it is too much to expect that the gross characteristics of the chromosomes reflect accurately the inheritance they bear. In time it may be possible to analyse the various types of DNA, the complex proteins of which the chromosomes are composed, and assess the similarities and dissimilarities between one type and another. There are a prodigious number of proteins, the building-bricks of the animal body, and it would be reasonable to expect related forms to have similar proteins in similar proportions. Work is being done now in making such assessments. A Collection such as that at Slimbridge can be used to full advantage if the source of protein can be obtained from the living birds without harming them. Feathers would be ideal from this point of view, but unfortunately their constituents are very closely bonded and extremely hard to analyse without destruction. Moreover the protein composition of feathers from different parts of the body appears to differ.

The egg is, of course, a source of proteins conveniently separated from the bird itself. Often infertile eggs are available so that it is not even necessary to sacrifice a potential young bird. Externally the eggs of the Family show a remarkable sameness. This is very apparent in the reference collection of infertile eggs from 82 of the forms that have bred in the Collection. Some differences in texture do appear to run through natural groups but when it is a question of identifying a nest, more reliance can be placed on the down lining the nest and the few breast feathers therein. Samples of such down from 78 forms are in the reference collection. A duplicate series has been passed to *Colonel R. Meinertzhagen* who is working on the structure and variation in down. His results are mainly of a functional rather than a taxonomic nature.

Professor C. Tyler of Reading University has been studying the egg shell in more precise detail, investigating the structure of the pores, the arrangement of the layers of the shell and the chemical nature of the proteins forming them. He has been using an ingenious series of methods, dissolving away the inorganic calcium carbonate, impregnating with plastic, selectively grinding away layers and staining them. His work with eggshells from the Collection is by no means finished but the indications are that their characteristics are remarkably uniform throughout the Family and will not be very useful in assessing where its subdivisions should lie.

Egg-white is another source of proteins. These are identified by separation, taking advantage of the fact that different proteins migrate over a strip of paper at different rates by simple capillary attraction (paper chromatography) or when an electrical potential difference is applied (paper electrophoresis). The various proteins are identified by the distance they have moved in a standard time and the relative proportions determined by their differential reaction to staining agents. Final representation is in graphic form so that each sample has its own " profile " that can be compared with those of other samples.

Professor C. G. Sibley of Cornell University is engaged in a far reaching survey of egg-white proteins by electrophoresis and has already examined some 400 species. The Trust has been able to supply him with many of the *Anatidae* specimens. His preliminary results also indicate a remarkable similarity in pattern which extends throughout the group, only the *Dendrocygnini* so far producing " profiles " differing markedly from others. Thus both these methods may be of more use in deciding extra-familial relationships, where the *Anatidae* stand in relation to the Flamingos and Herons, for instance.

Another source of protein from the living bird is provided by the blood, which can be drawn off in small quantities without harm. Work has in the past been done on the serum which remains when the blood corpuscles are filtered off. The serum is injected into the blood stream of rabbits resulting in the production of anti-bodies. If these anti-bodies are isolated from the rabbit and added to serum from the original bird species, a heavy precipitate is obtained. If added to the serum of an unrelated species a much lighter precipitate results. In this way the closeness of relationship can be determined. The technique is a complicated and laborious one requiring extensive laboratory facilities. Thus far the Trust has not collaborated in work of this kind, a recent example of which is that of Cotter (1957).

The properties of the protein comprising the corpuscles that contain the blood hæmoglobin were studied by Johnston and Hochman (1953) using an ingenious technique. If the corpuscles are placed in distilled water they absorb water, swell and eventually burst—a process known as hæmolysis. The time taken for this to occur will depend on the permeability of the corpuscle wall, a function of the proteins composing it. Different solutions will also penetrate at different rates, so by matching one sample of blood against a whole series of solutions an elaborate statement of its permeability properties is obtained. This can then be compared with that for other species. So far this promising and relatively simple technique has not been used in the *Anatidae*.

The hæmoglobins freed from the corpuscles can be analysed by the usual protein techniques. In human beings some nine different types of hæmoglobin have been isolated (Lehmann, 1957) and the occurrence of certain types shown to be different in various racial groups. It has even been possible to postulate the routes taken on prehistoric migrations of certain populations (Lehmann, 1954). This type of investigation therefore appeared to hold out distinct promise in our particular field. *Dr. H. Lehmann* of St. Bartholomew's Hospital undertook to make paper electrophoretic studies of material supplied by the Trust. Blood samples were taken from 118 individuals:—

25 *Anser brachyrhynchus*
13 *Branta c. canadensis*
1 *Branta sandvicensis*
1 *Tadorna tadorna*
78 *Anas p. platyrhynchos*

Using a cacodylate buffer to which a small amount of sodium chloride had been added, and working at a pH of 6.5, Dr. Lehmann was able to distinguish two types of hæmoglobins in all the samples. This confirms the contemporary results of Dunlap, Johnson and Farner (1956) and of Saha, Dutta and Ghosh (1958). But from the point of view of taxonomy the results are disappointing since no difference could be detected (in terms of the properties of the two hæmoglobins or their degree of separateness) between young and old, between broods, between sexes, between species or even between genera.

There remain two other methods of analysing hæmoglobin proteins. Transmission spectra obtained by passing light or X-rays through a solution of the protein do not appear to have much promise. Large quantities of blood are required and Winter and Honess (1952) concluded that differences in the spectra were in any case too slight to be of taxonomic use. These same workers suggested that a study of the crystallography of the hæmoglobins would be more fruitful. Such studies, involving the measurement and description of the crystal forms has been in abeyance since the massive work of Reichart & Brown (1909). These authors claimed that hæmoglobins could be distinguished by these means right down to specific level. Very small quantities of blood are required, indeed the technique has been used to examine bloodstains and so detect illegal killings in the enforcement of wildlife legislation in the United States. It is hoped that work of this nature may be started in the not too distant future.

We have seen that a whole variety of techniques are open to the modern taxonomist. Many of these techniques are incapable of assessing relationships below the Family level and are thus only of passing interest when we are concerned with relationships *within* a Family. Work with the most refined methods will be prosecuted as and when possible. But it is beginning to appear that the *Anatidae* is on the whole an unusually homogeneous and closely-knit Family.

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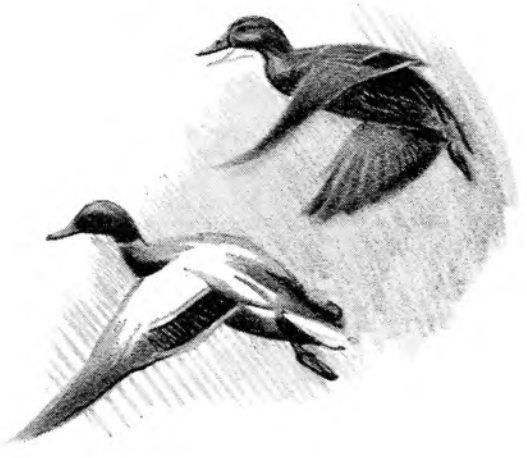

CAUSES OF DEATH OF BIRDS AT SLIMBRIDGE, 1955—1957

A. R. Jennings

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Introduction

A TOTAL of 680 birds has been examined in the period 1955-1957. Routine post-mortem examinations have been carried out and where necessary bacteriological, parasitological and histological examinations have been made. The annual mortality and the causes of death are summarised in Table I. The birds have been assigned to three main age groups; adults, immature and downy young and newly hatched chicks. The numbers of birds do not represent the total mortality at Slimbridge since not all dead birds were examined post-mortem. This is particularly the case in regard to the newly hatched young because, when very large batches of chicks were received at the laboratory, only representative samples were examined.

TABLE I

Causes of Death	Adults			Immatures			Chicks			Total
	1955	1956	1957	1955	1956	1957	1955	1956	1957	
Organic Disease ..	—	5	9	3	24	45	—	51	84	221
Parasitic Disease ..	1	6	8	6	5	3	—	—	—	29
Cysts and Tumours ..	1	6	6	1	2	—	—	—	—	16
Dietetic Disease ..	—	1	2	—	9	7	—	6	7	32
Disease of Serous Membranes ..	1	5	5	—	—	7	—	1	—	19
Trauma	—	3	4	—	1	2	—	1	2	13
Infectious Disease ..	6	7	17	49	11	28	2	4	14	138
Causes not determined	8	14	5	57	14	9	17	60	27	211

Organic Disease

Respiratory System. The largest number of deaths were classified under this heading due to the very high incidence of acute pulmonary congestion and pneumonia amongst the very young birds. Sudden lowering of the air temperature often associated with heavy rainfall brings about this pulmonary syndrome which is often referred to as "chilling." This type of acute respiratory disease is a common cause of high mortality in free living species and it is of interest that the same conditions seem to apply even under conditions of semi-captivity. The changes at post-mortem are quite typical and comprise acute congestion and oedema of the lungs, an enlarged gall bladder full of viscous bile and usually an unabsorbed yolk sac.

Circulatory System. Two cases of a congenital heart deformity were encountered, one in a N.Z. Brown Duck, and one in a Ruddy Duck. In both cases there was a large aneurysm of the left ventricle. In three birds, a Ne-Ne, a Teal and a Goosander, the cause of death was a condition macroscopically indistinguishable from the round heart disease of poultry. The hearts were greatly enlarged and barrel-shaped and there was a characteristic indentation at the apex. The fibres in this area had a whorled appearance.

Gastro-intestinal Tract. Enteritis other than that due to infectious and parasitic disease was infrequent and only eight cases were seen. The enteritis in these birds was acute and haemorrhagic in type and no cause for it was found. In three birds death was due to impaction of the gizzard and lower oesophagus with hard fibrous grass.

Urogenital Tract. Pyelo-nephritis, which is said to be the common form of nephritis in birds, was not often diagnosed. Deposits of urates in the kidneys were frequently seen but such a change cannot be regarded as specific since urates may be present in many disease conditions and such renal changes are not necessarily primary in origin. A few cases of renal coccidiosis were seen but the numbers of coccidia present were not thought to be pathogenic.

Only two cases of egg peritonitis were seen. This is perhaps surprising since large numbers of breeding birds are kept, though, on the other hand, the birds are not bred to a high pitch of egg production.

Serositis. Nineteen cases of a diffuse sero-fibrinous pericarditis and peritonitis were encountered. The condition was very characteristic, the heart and abdominal viscera being covered by a glistening white fibrinous network. In several birds the exudate showed signs of organisation. The liver and spleen were enlarged. The disease is said to be due to *Moraxella anatipestifer* but this organism was not isolated; pleuropneumonia-like organism were present in smears from the affected organs.

Cysts and Tumours. A peculiar cystic condition was noted in the liver of a female Philippine Duck. The liver was grossly enlarged and took the form of a multiloculated cyst. Histological examinations showed this to be a cystadenoma. There was no sign of malignancy. A cavernous haemangioma was present in the liver of a Coscoroba Swan and an ulcerated papilloma was seen on the neck of a Scaup. The liver of an Orinoco Goose was much enlarged and almost filled the abdominal cavity. The liver was a mottled grey in colour and of firm consistency. On section the enlargement was seen to be due to extreme infiltration by mononuclear cells chiefly lymphoblasts and lymphocytes. The appearance suggested lymphatic leucosis and a similar picture has been seen in eleven other birds from the Slimbridge grounds.

Trauma. Injuries were responsible for the death of six geese and three ducks. In the majority death was due to internal haemorrhage which followed the rupture of a fatty liver.

Parasitic Disease. Almost all the birds examined had some parasites in the gastro-intestinal tract or in the respiratory system. The parasites which were identified will form the basis of a second report, by Dr. E. J. L. Soulsby. In 29 birds parasitism was the cause of death and it is probable that the presence of parasites in many of the other birds was an important contributary lethal factor.

Dietetic Diseases. Twenty-nine birds were thought to have died as a result of dietetic disorders. In twenty cases the chief lesion was gizzard erosion. There were varying degrees of erosion of the gizzard lining so that the affected areas were brown in colour and had a frayed appearance. The condition was chiefly seen in young birds. A form of muscular dystrophy of the gizzard was also encountered and in some cases this was probably the cause of death through inanition. The gizzard in these birds was very thin and poorly developed.

Infectious Disease. The infectious diseases noted are listed in Table II. In all 138 birds died from various infections. Aspergillosis was the most frequent with 117 cases, the predilection sites for the fungus were the lungs and air sacs. The lesions were usually typical fungal granulomata but in some birds there was an acute diffuse pneumonia. Tuberculosis was the next most common disease and eight cases were seen. The lesions were principally in the alimentary tract and were in the form of large easily enucleated yellowish-white nodules. These infections with *Myco. tuberculosis* most probably arose from tuberculous bantams which had been used as brooders. One case of *Pasteurella aviseptica* was seen; this was in a Black-necked Swan recently brought into the collection. *Pasteurella pseudo-tuberculosis* was the cause of death of a Goldeneye and salmonellosis (*s. typhimurum*) was seen in a Black Swan, an Hawaiian Goose and a Ross gosling. A strongly haemolytic streptococcus was isolated from 3 adult birds and 3 downy young. It was present in pure culture from heart blood, liver and bone marrow. *Erysipelothrix rhusiopathiæ* was isolated from a Canvasback. (It is perhaps surprising that this organism was not isolated on other occasions since it not infrequently causes losses in domestic poultry and ducks and is present in the soil in many areas.)

TABLE II
The Infectious Diseases

Disease	Adults			Immatures			Chicks			
Year	55	56	57	55	56	57	55	56	57	Total
Aspergillosis	3	5	9	46	9	25	2	4	14	117
Tuberculosis	—	1	6	—	—	1	—	—	—	8
Pasteurellosis	1	—	—	—	—	—	—	—	—	1
Pseudotuberculosis	—	—	1	—	—	—	—	—	—	1
Streptococcal Infection	1	1	1	1	2	—	—	—	—	6
Salmonellosis	1	—	—	2	—	—	—	—	—	3
Haemolytic Coliforms	—	—	1	—	—	—	—	—	—	1
Swine Erysipelas	—	—	—	—	—	1	—	—	—	1
										138

TABLE III
Some species in which the cause of death was not determined.

Species	Adult	Young	Total
Red-billed Whistling Duck	3	5	8
Marbled Teal	–	12	12
Vesicolor Teal	1	11	12
Cinnamon Teal	1	20	21
Red-crested Pochard	–	6	6
Redhead	–	9	9
Mandarin	1	8	9
Carolina	1	28	29

Cause of death not determined. In 211 birds the cause of death was not determined. Individual birds from a wide range of species died and no cause could be found. In certain species (Table III), however, relatively large numbers died shortly after hatching and on post mortem examination there were no lesions and bacteriological examinations showed no evidence of infection. A probable explanation of these deaths is that they were due to a dietary deficiency.

Summary

A total of 680 dead birds has been examined post-mortem in the three year period 1955-1957. The most important cause of death was acute pulmonary congestion and oedema of the newly hatched young. This syndrome together with pneumonia in older birds accounted for about 30 per cent. of all deaths. Infectious disease was responsible for approximately 22 per cent. and of this group Aspergillosis was the most important disease. In all about 20 per cent. of all deaths were due to this fungal disease. On a relatively high percentage of cases no diagnosis was made.

Acknowledgements

I wish to record the help of Miss E. A. Robb, I.M.L.T., in carrying out these post mortem examinations.

THE CONTROL OF ASPERGILLOSIS IN BIRD COLLECTIONS

J. V. Beer

As the form and condition of avian collections vary considerably, these notes must, of necessity, be generalised, but the methods can easily be adapted to local requirements.

At present, cure of the disease is not possible as there is no reliable diagnostic method, and drugs, such as Nystatin, have yet to be proven effective. The best approach is therefore one of prevention, and the easiest way is to provide and maintain a good standard of hygiene in the collection area.

Basically any large concentration of the fungus *Aspergillus fumigatus* must be removed and destroyed, and further build up prevented. This organism is a saprophyte and grows readily on almost any moist, and in particular, warm organic debris such as old grass cuttings, damp food, old sacks, straw and the like. Pens, nesting boxes, etc. should be kept free, as far as is possible, of this organic debris, and all 'raw materials' such as food and bedding should be clean and free from dust and mould. Fungicides and disinfectants can be used to further reduce the concentrations of the fungus in the environment of the birds. The use of fungicides and the maintenance of good hygiene will in the long run keep the fungus, and consequently Aspergillosis, at a low level.

The proposed measures are primarily aimed at the disease in young birds, but they can be equally well applied to the environment of adult birds. In addition, maintenance of the general health of the birds will go a long way to combating the disease.

PROCEDURES:

1. **Removal of organic debris**
   (a) Remove any old food, mouldy straw, grass cuttings, old sacks, etc. Avoid spreading spores, if very mouldy, by damping with disinfectant.
   (b) Check that food bins do not contain mouldy food and remove any accumulated dust.
   (c) Ensure that all organic matter is removed from nests between each incubation period.
   (d) Where possible keep concrete areas washed down (into a drain).
2. **Provision of clean 'raw materials'**
   (a) Food should be clean, free of large amounts of dust and smell sweet, with no mouldy odour.
   (b) Sawdust and hay are not good nesting materials. Straw and possibly peat are better. The former should be clean, bright yellow and reasonably free of dark blotches.
   (c) Bedding material, if used, must be clean and free of any form of mouldiness.
   (d) If sacks are used for bedding, change frequently and treat as below. New, clean and *dust-free* sacks probably do not require an initial treatment.

3. **Use of fungicides**
   (a) The soil under incubation boxes can be treated with the fungicide Pentachlorphenol (PCP), at the rate of 0.5% W/W* and by damping slightly with a 1% solution in water of Sodium pentachlorphenate (NaPCP).
   (b) Sacks, if used, should be boiled in disinfectant and hung out to dry in the sun. Sacks stored during the winter should be boiled before use.
   (c) 1% NaPCP can be used in any cleaning operation particularly when mouldy material is involved. (Some little care must be taken in handling this material as the dust causes violent sneezing).

4. **Use of concreted areas**
   (a) If concreted areas can be used, it is easier to dispose of organic debris with water and a stiff broom into a drain.
   (b) Straw roofs and walls should be avoided, where possible, in favour of other materials such as asbestos boarding and concrete blocks.

5. **Incubator**
   (a) Incubators and any vacant 'rooms' should be cleaned out and fumigated with:—
   (Per 100 cu. ft.) 35 ml. formalin, plus 17.5 g. Pot. permanganate.

   These two are mixed in a large vessel and the door shut. BEWARE OF VAPOUR! The atmosphere should be warm and moist for optimum results. Leave for one hour at least, and then ventilate the room.

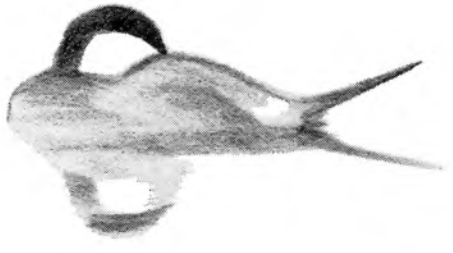
6. **General health of the birds**
   (a) Every effort should be made to ensure that the general health of the birds is kept at a high level. Weak and sick birds are susceptible to the disease.

Summary

Any one or a combination of these attacks on the fungus will reduce the likelihood of Aspergillosis appearing in the birds:

1. Remove and destroy *all* mouldy material.
2. Provide clean raw materials.
3. Use fungicides and disinfectants as indicated.
4. Consider use of concrete and like materials.
5. Fumigate incubators and 'rooms'.
6. Maintain general health of the birds.

*Weight/Weight



GREYLAG GEESE IN BRITAIN IN WINTER

Hugh Boyd

SUMMARY

PERSONAL investigations in 1957 and 1958 are combined with data contributed by more than 130 observers to illustrate the present distribution of the Greylag in the British Isles in winter. Most of the geese are concentrated in the southern half of Scotland, between 54° 40′ N and 56° 40′ N. Some 120 localities are known to have been frequented by flocks of Greylags during the winters 1955-58. Only 16 places, all in Scotland, harbour more than 1,000 Greylags for any considerable period.

No census has been achieved, but the records suggest that the population is likely to have numbered between 17,000 and 23,000 in late November 1957 and again in late November 1958. Data from earlier years, and from other times during the winter, are less complete. The numbers in the autumn of 1956 were probably similar to those in 1957 and 1958, but there may have been fewer in 1955. The impression of scarcity in the winter of 1955-56 is supported by counts in a sample of major localities, covering the years 1952-58. This sample also showed a comparatively massive peak in 1953-54 followed by a slump in 1954-55.

Maps of recoveries of ringed Greylags are used in conjunction with data on numbers to show the general pattern of winter movements. The resident Scottish population, which is very probably less than 5% of the autumn total, seems to be nearly sedentary, remaining in the Outer Hebrides and the north and west of Scotland. The Iceland-breeding geese, which comprise almost the entire bulk of winter immigrants, enter Scotland during October and November and leave again from February to April. Much of the movement in the intervening months is of a local character, shifting between roosts five to fifty miles apart, but there is a tendency for numbers to decrease in the north and increase in the south-west of Scotland from November through February. In Ireland most are seen in December and January.

The Icelandic Greylag population seems to be in a comparatively steady state at present, after increasing greatly during the last thirty years, and changes in its choice of wintering places give no cause for other than local concern. The British-breeding population, which has decreased seriously during this century, needs to be considered separately.

INTRODUCTION

The enquiry reported here had its origin in differences of opinion about the prosperity of the Greylag Goose (*Anser anser*). Its first object was to assemble a detailed picture of the numbers and distribution of the Greylag in Britain in recent years; its second, to look for changes during the last twenty years. This paper is concerned largely with the present position, because the evidence covering the longer period is too full of holes and contradictions to provide the basis for a reasoned assessment.

The Greylag is of especial interest as our only native goose. But the status of the small breeding population is deliberately excluded from treatment

here. Breeding Greylags are vulnerable to human disturbance and most of the landowners and other people with a particular interest in the scattered breeding colonies, whether of wholly-wild or feral birds, feel strongly that knowledge of their whereabouts and success should not be made public. It would be foolish to publish an account dealing only with colonies not subject to " security " restrictions.

Ringing has shown that the Greylags found in Britain in winter must nearly all breed in Iceland. A recent short paper (Boyd, *Wildfowl Trust Eighth Annual Report,* pp. 51-54, 1957) reported that Iceland-ringed Greylags have been found only in Iceland and the British Isles and that summer recoveries of Scottish-ringed Greylags have all been found in Iceland (431 Greylags were ringed in Scotland from 1950 to 1953). Greylags have also been ringed, in small numbers, in Sweden, Denmark, Austria and Hungary, but no marked geese from these countries have been found in Britain, although reported from Russia, Poland, Holland and Spain. The Icelandic-British population cannot be regarded as wholly isolated from the continental ones, because a Greylag ringed in Kirkcudbrightshire in March 1950 was shot in Jutland, Denmark, in November 1955, and because occasional individuals and small groups seen in Britain have differed strikingly in appearance from the British and Icelandic stocks. Such as, for example, three seen in Gloucestershire from December 1953 to March 1954 (*Wildfowl Trust Seventh Annual Report,* p. 13, 1955). But the extent of the mixing is so small that, though of interest from the viewpoint of genetics, it is insignificant in considering changes in numbers. Even within the British Isles, it is apparent that the breeding geese, which are nearly sedentary, mix very little with the immigrants from Iceland, so that the mobile population under discussion in the following pages is almost entirely of Icelandic origin.

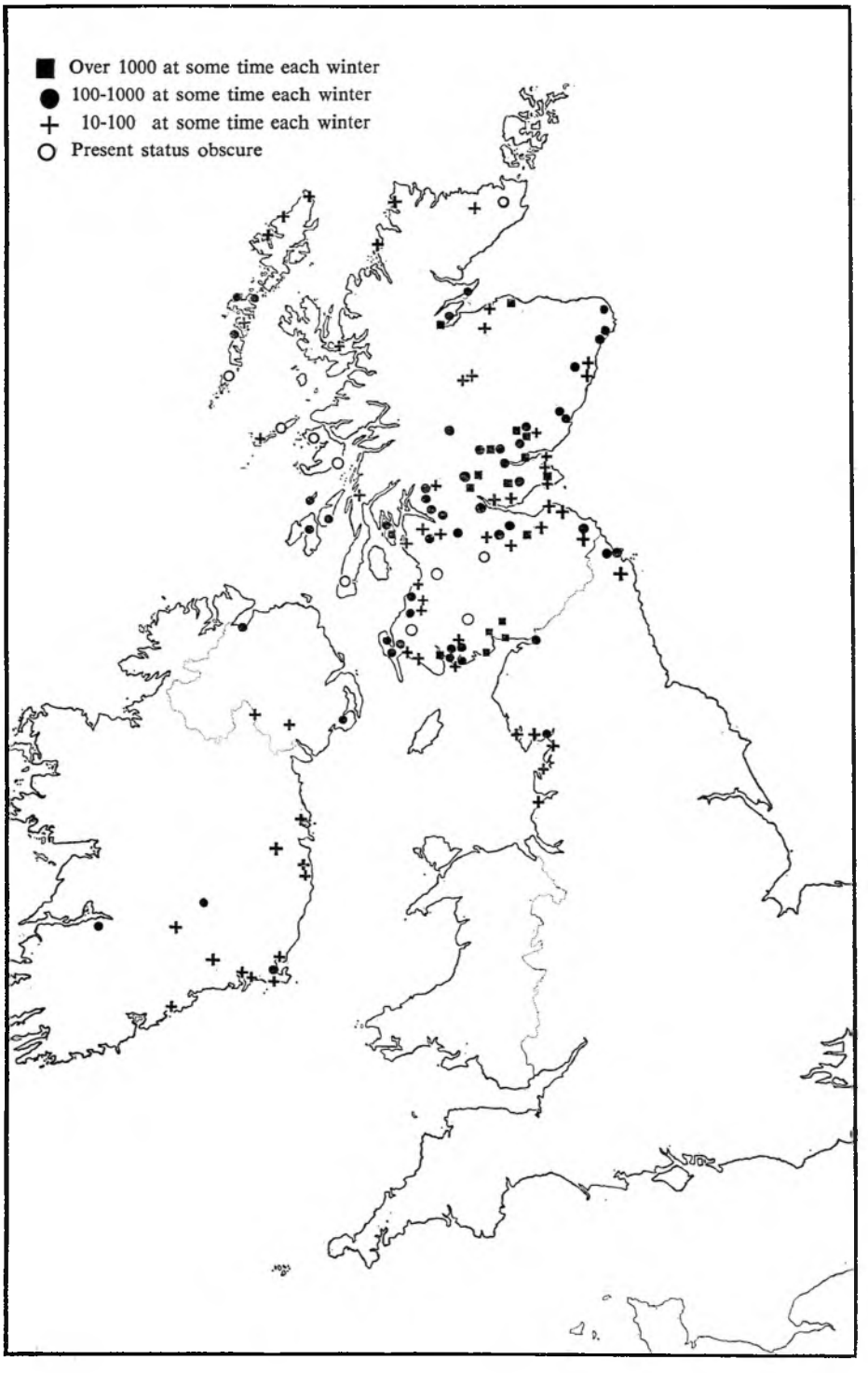
The writer has some acquaintance at first hand with Greylags in most of their wintering places in Scotland and England. But most of the data on which this account is based have been provided by others—in published reports, in letters and conversations and, especially, in observations made within the framework of the Wildfowl Count scheme. This essential help is acknowledged more fully elsewhere. This description of the present status of the Greylag is highly abstracted and condensed, but the source material remains in the Wildfowl Trust files.

THE PRESENT DISTRIBUTION

Figure 1 maps 123 localities known to have been frequented by Greylags during the winters of 1955-58, together with a further 11 places where they have been reported since 1945 but for which no very recent information is available. The marks correspond to the roosting places rather than the often quite extensive feeding ranges of goose flocks. Their location on a map of this scale cannot be very precise. This is perhaps as well. Not all the places marked are in use simultaneously, and their periods of use vary greatly in length and in seasonal occurence. " Frequented " implies that a flock has been seen for a period each winter. Records of very small numbers, or of single appearances of larger groups have been neglected in compiling the map.

The relative importance of the sites is shown crudely by symbols, corresponding to a logarithmic scale of abundance: + (class 1) 10-100 seen at winter peak; ● (class 2) 100-1000; ■(class 3) over 1000 at peak. Records

FIGURE 1: Locations frequented by Greylags in winter, 1955-58.



from three winters have been used in deciding the status, to increase the data available and so reduce errors of interpretation.

The great majority of Greylag wintering places are seen to be in Scotland, with a small number of known haunts in Ireland, very few in England and none now known in Wales. Table I summarizes the distribution of localities of the three classes of abundance: 58 in class 1, 45 in class 2, and only 16, all in Scotland, in class 3. Both the map and the table show that most of the geese are concentrated in the southern half of Scotland, from 54° 40′ N to 56° 40′ N. This presentation does not show how the population is distributed at any one time.

TABLE I
Regional distribution of Greylag wintering areas, 1955–58
Feral flocks omitted

	Class 1 (10–100 at peak)	Class 2 (100–1000 at peak)	Class 3 (1000 or more at peak)	Total	Additional localities where present status uncertain
SCOTLAND					
Outer Hebrides ..	4	3	—	7	1
North and N.East	10	6	2	18	1
East Central ..	10	11	9	30	1
West (incl. Bute) ..	5	7	1	13	2
Inner Hebrides ..	2	3	—	5	3
South West ..	7	9	4	20	2
ENGLAND					
North East (incl. Berwicks)	2	3	—	5	—
North West ..	5	2	—	7	1
IRELAND	13	5	—	18	?
	58	49	16	123	11+

THE SIZE OF THE WINTER POPULATION

No census of the Greylag population has yet been made, for a complete and simultaneous ' cover ' of the known wintering places would be difficult to arrange and much harder to achieve. The nearest approach to such cover was achieved in late November, in 1957 and again in 1958. At both times extensive aerial surveys of Scotland were made by the writer, with J. D. H. Radford and S. K. Eltringham in 1957 and with Eltringham in 1958. The combination of observations from the air and from the ground make possible reasonably complete estimates of the population of Scotland and England, which are summarised in Table II. The records used in compiling the 1957 totals were all collected in the period 20-27 November. In 1958 the period was rather longer—15 November - 3 December, but the cover was more nearly complete.

In addition to entries relating to geese seen, Table II includes two columns of figures which are speculative, headed " localities thought to be occupied " and " number of geese guessed ", to inform the reader of the reliability of the cover and the relative importance of the numbers estimated to be present at places which could not be visited during the search periods. The numbers allowed at unvisited places have been decided from all available data relating to other years or months. It will be noticed that the totals for Ireland and for the Outer Hebrides and the north west mainland of Scotland, listed apart from the other regions, are composed almost entirely of estimates. Aerial

TABLE II
Numbers of wild Greylags in the British Isles in late November 1957 and 1958

1957

Region	Number of localities known to be occupied	Number of localities thought to be occupied	Number of geese counted	Number of geese guessed
N.E. Scotland	5	3	2090	200
Central Scotland	22	9	10240	840
W. Scotland & Inner Hebrides	6	12	2790	1150
S.W. Scotland	6	7	1660	1720
N.E. England & Berwicks	3	—	300	—
N.W. England	2	2	40	70
Totals	44	33	17120	3980
Outer Hebrides & N.W. Scotland	—	6	—	600
Ireland	1	12	130	500
Totals	45	51	17250	5080

Likely limits 17,000–23,000

1958

N. E. Scotland	5	1	2900	100
Central Scotland	22	3	6140	300
W. Scotland & Inner Hebrides	8	5	2160	670
S.W. Scotland	8	7	6120	890
N.E. England & Berwicks	2	1	80	200
N.W. England	1	2	40	60
Totals	46	19	17440	2220
Outer Hebrides & N.W. Scotland	—	6	—	600
Ireland	—	13	—	500
Totals	46	38	17440	3320

Likely limits 17,000–22,000

cover of these regions could not be attempted, because of limitations of finance, and few ground observers could be found there.

The Irish total is made up of one-third the sum of the average numbers of geese found at 15 localities given in a recent paper by Ruttledge and Hall Watt (*Bird Study*, vol. 5, pp. 22-23, 1958), with an additional one hundred allowed for geese present at three places not listed in that paper but known to be in use. Greylags are most plentiful in Ireland in December and January, rather than November, and the arbitrary figure used here may be somewhat too high, since Major R. F. Ruttledge reports that numbers in Ireland continued to decline. (It is rather unlikely that any major haunt of the species is still unknown).

The arbitrary assessment for the Outer Hebrides and the north west mainland of Scotland, which has been arrived at after discussions with Dr. J. W. Campbell and Colonel H. J. Cator, probably refers almost entirely to British native geese, rather than immigrants from Iceland. Since these breeding birds seem to be very nearly sedentary, this total is less liable to be affected by seasonal movements than the Irish figure.

The totals for November, 1957 and 1958, given in Table II are 22,330 and 20,760 respectively. Because of the variety of sources used in assembling the figures, no statistical measure of their reliability is practicable. Obviously their apparent precision is misleading: some regularly-used localities may be unknown to the Wildfowl Trust; in some places where geese were seen the counts or estimates may have been incomplete; and in some the estimates may have been too high or too low. For these reasons the " likely limits " given in the last row of Table II are to be preferred, in the writer's opinion, to any one number as indicators of the population size.

Guesses account for about one quarter and one-fifth respectively of the totals for 1957 and 1958. Figures of 15,500 in mid-November 1955 and 17,400 at the beginning of November 1956 are suggested for comparison, but in each case actual counts only provide about half the total. Records for earlier years and other months are even less reliable, so that the only way to examine changes over longer periods is to restrict attention to localities for which long series of counts are available.

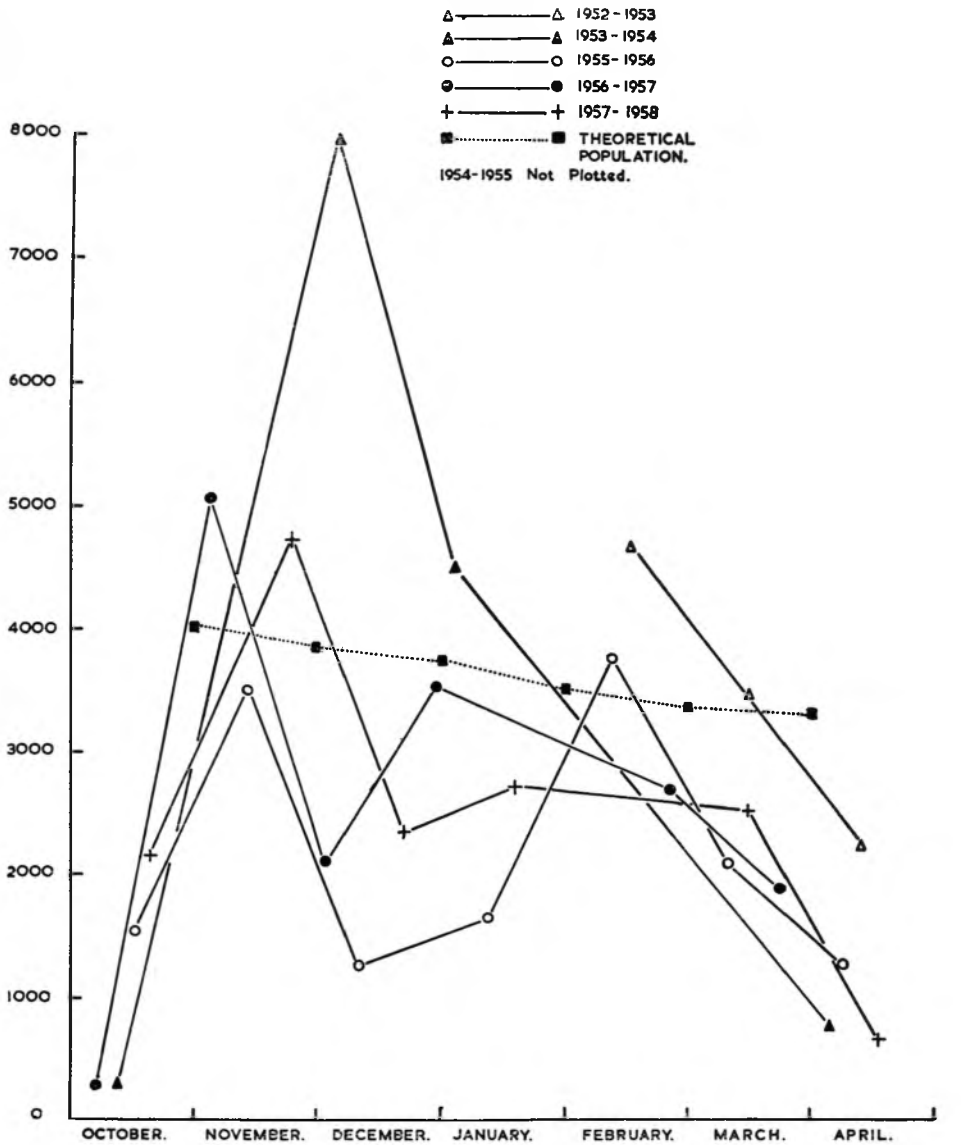
CHANGES IN OBSERVED LOCALITIES, 1952-58

Possible differences in total numbers from year to year are of considerable interest. Some relevant material is obtainable from areas where the numbers of geese have been noted at regular intervals for several years as part of the Wildfowl Count scheme. For this purpose incidental occurrences of small numbers are of little interest, so that a selection of major Greylag haunts in Scotland has been made, using only those for which long and largely complete series of counts are available. Only nine such localities have been found: in Inverness, Moray, Aberdeen, Fife, Dumbarton and Stirling, Midlothian, Bute, Dumfries and Wigtown. The sample should have included more localities in east and south-west Scotland. Unfortunately data from these areas are too fragmentary to be used.

The results of counts in the sample localities are set out in Figure 2. Observations in the months October to April, for the period October 1952 to April 1958, are included. Records prior to 1952 are too few for effective use. Even within the chosen period there are awkward gaps in the observations. These, and the considerable variations in the count dates from season to season, are sufficient to prevent straightforward comparisons between different years. For example, totals for October 1952—January 1953, November 1953, February-March 1954, the season 1954-55, January 1957 and February 1958 could not be plotted, because of gaps too large to be ignored. Interpolations have not been used, since no reliance can be placed on them in considering changes within seasons in such a series of observations.

Despite these weaknesses, Figure 2 shows several interesting features. The first point for consideration is that of abundance in the seasons 1955-58. In the previous section, from estimates of the total population in November it was suggested that 1957 : 1956 : 1955. The highest counts in the sample (all in November) indicate the order of 1956 : 1957 : 1955, despite the early date of the 1956 count. Another measure of seasonal abundance, which is potentially more reliable, is the mean of the counts in the four months November-February. The respective means are: 1955-56 2,500; 1956-57 3,300; 1957-58 3,300. Since the figures for Wigtown in January 1957 and Bute in February 1958 are omitted, because not known, these totals confirm the impression that the 1955-56 population was relatively small.

FIGURE 2: Number of Greylags in monthly counts at nine major localities, October 1952 to April 1958.



By far the most striking aspect of Figure 2 is the massive peak of December 1953. Is this evidence of a large population that autumn, or was it due to the chance occurrences of exceptional numbers in the counted localities? Inspection of the individual scores shows that well over half the total were found in the north east and in the Fife locality and that these areas were carrying unusually large numbers for December. Most unfortunately, the November total for the Aberdeen area is not known (2,000 geese were reported, but Greylags and Pinkfeet were not distinguished), and that for the Inverness locality is uncertain (350 Greylags were seen on the count date, but 2,500

on other occasions shortly before and after). Since in December there were still 1200 in the Aberdenshire area and 900 in the Inverness area, both these figures being high for that month, it is quite likely that the November sample total should have been little smaller than that for December.

If note is also taken of the relatively high totals recorded in February—April 1953, it might be argued that in the first two years of the period under review the population was importantly higher than it was later. This inference from the graphs also emerges from assemblies of November—February totals (using different groupings to allow as far as possible for gaps in the data). The most interesting set is that obtained by summing the data for all the sample localities except those in Wigtown and Dumfries, since this provides information on the season 1954-55, not plotted on the graph because data from these two areas was not obtained in that season. The successive 4-month means are: 1952-53 2,900 (without numbers from Bute, November to January), 1953-54 3,400 (without numbers from north east in November and February), 1954-55 1,300, 1955-56 1,900, 1956-57 2,800 and 1957-58 2,500. This suggests that a slump occurred in 1954 from which the sampled population had largely recovered by November 1956.

A decrease of more than half in the size of a goose population between one winter and the next, such as appears to have occurred in 1954 in the restricted sample, is quite possible, given the combination of heavy winter losses coupled with a breeding failure. However, the limitations of the sample do not permit these apparent changes to be used as quantitative indications of changes in the British population as a whole and if, as has been asserted above, the British wintering population is a closed group, it is on principle likely that a restricted sample, affected by immigration and emigration, will show more exaggerated fluctuations than the group as a whole.

MIGRATIONS AND MOVEMENTS

Figure 2 shows that winter visitors enter Scotland during October and November and leave again from mid-March to April, the speed of departure appearing to be less than the rate of arrival. It also shows, almost as obviously, that the numbers of geese frequenting the studied areas during the winter fluctuated widely, and more than would be expected to result from counting errors.

There is a general impression of a decrease through the winter, which is to be anticipated, since geese are being killed by man and dying from other causes without any replacement during this season. The " theoretical population " line on the graph shows the rate of decrease from deaths affecting a population of 4,000 at the beginning of November which would occur if data from recoveries of ringed Greylags accurately represent the mortality pattern of unmarked geese also. (Details of the calculations from which this line was drawn need not be given here).

Those fluctuations not to be explained by death, migration, or errors of observation must be due to nomadic movements, which are a commonplace of observation, though often not readily distinguishable at the time from changes in local distribution due to food-searching or disturbance. Some idea of the scale and timing of these wanderings can be obtained by further analysis of the counts from selected localities. There is a tendency for numbers to

FIGURE 3: Recoveries in winter 1952-53 of Greylags ringed in November 1952.

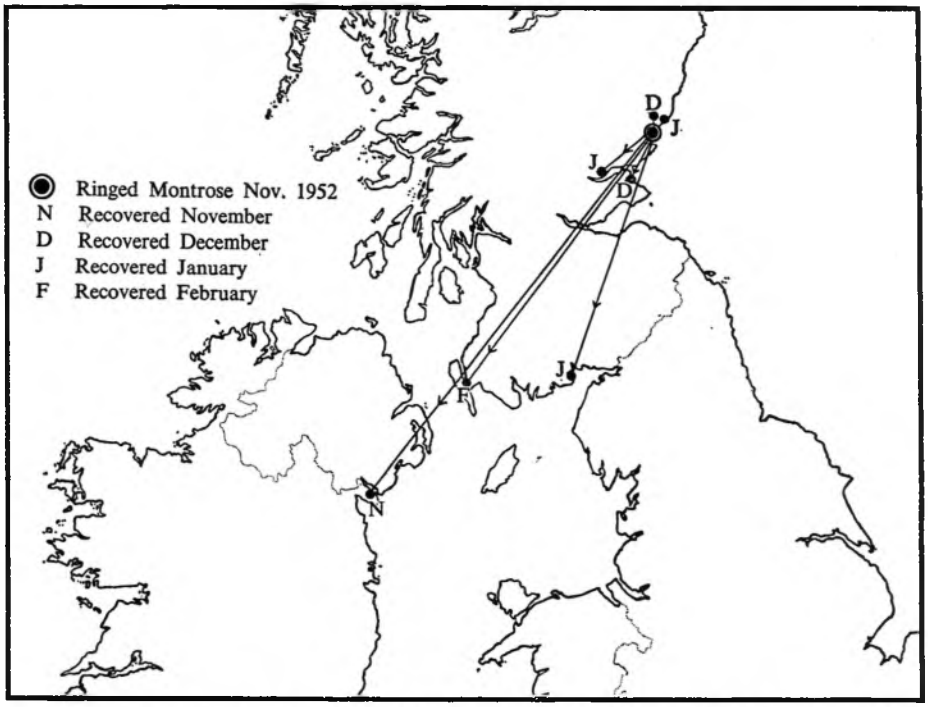
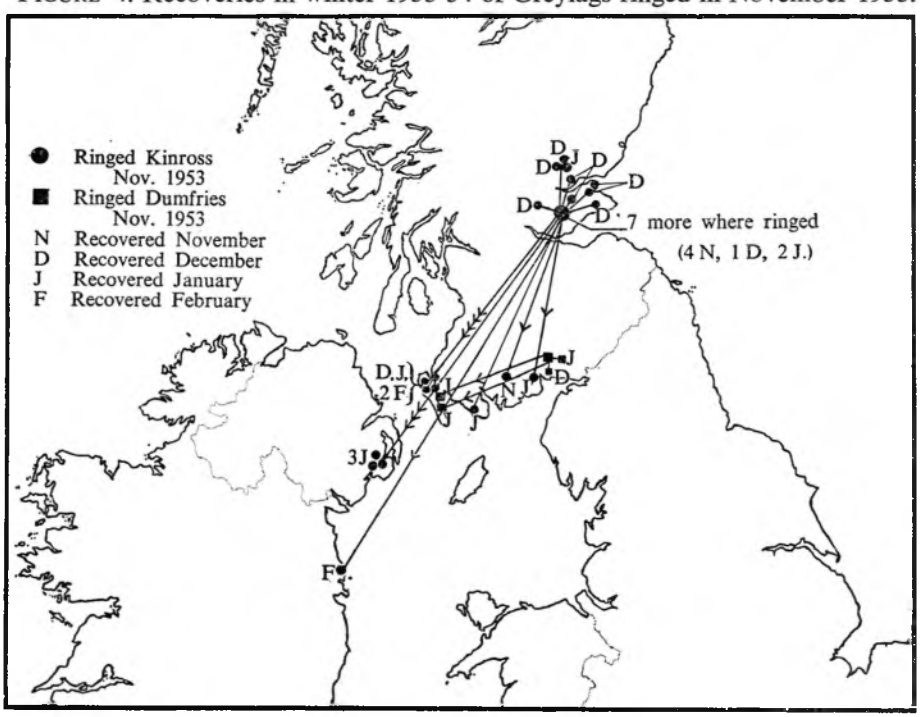


FIGURE 4. Recoveries in winter 1953-54 of Greylags ringed in November 1953.



decrease in the north and increase in the south west from November through February. More detailed comment on this pattern, and the departures from it, would need to be based on a greater wealth of material, including a variety of " background information ", to be of any value, and there are so few places for which this could be done that no general discussion is possible here.

A second, independent, source of information about winter movements is provided by recoveries of ringed geese. Some of these are mapped in Figures 3-8. Rigorous inference from recovery data is prevented by the existence of numerous sources of bias which cannot be evaluated or allowed for, especially when such a small number of recoveries is available. It is indeed somewhat remarkable that these maps provide impressions of the winter wanderings of Greylags which conform quite well with those given by observations in the sample areas and elsewhere. The pattern of distribution in March is not obtainable from recoveries, because the existence of a closed season inhibits the reporting of rings at that time, even if it does not wholly prevent continuing mortality amongst the geese.

The maps showing recoveries in the winter of marking (Figures 3 and 4) show clearly that substantial fractions of geese marked in the east of Scotland in November in both 1952 and 1953 passed on to the south-west and Ireland, later in the winter, but that geese marked in Dumfries in November apparently remained in the Solway area for the rest of the shooting season. The record for 1953-54 (Figure 4) is of especial interest because of the problems posed by the very high autumn counts in east Scotland that season. It will be noted that if the geese marked near Kinross (and so not part of the counted sample in November) behaved as typical members of an " east-central group ", the substantial decrease in the counted sample between early December and early January could have resulted from the emigration of most of the group to west Wigtownshire and Ireland, beyond the observed areas.

Since no Greylags have been ringed in recent years there have been too few recoveries to allow detailed comparisons between seasons. So far as the data go they indicate that the proportions of ringed geese recovered in the several major Greylag areas have varied very little. The maps of recoveries plotted by month of occurrence (Figures 5-8) support the inference from the sample counts that there is a shift of the main aggregations from the east of Scotland in autumn to the south-west in January and February. But, presumably because ringing has been restricted to only four areas, the recoveries fail to reflect the importance of several parts of Scotland as wintering places. From the maps no-one could guess that two islands in the Inner Hebrides harbour well over a thousand Greylags for long periods, or that parts of the north-east of Scotland, the Lothians and Northumberland are also regular haunts of many hundreds.

The maps show that much mixing of Greylags from different areas takes place during the winter, but it is not obvious that the degree of attachment shown varies. The geese ringed near Montrose and in Kinross have produced recoveries distributed about the haunts of the species in a remarkably similar way, with a pronounced tendency to be found again in east Scotland, while Solway-ringed geese have a comparable bias towards reappearance in that area, both in the course of the winter of marking and in subsequent years. More interesting is an apparent difference between two groups marked in the Solway. Comparing geese marked in Kirkcudbright in March 1950 and

FIGURE 5: Recoveries of ringed Greylags in October and November.

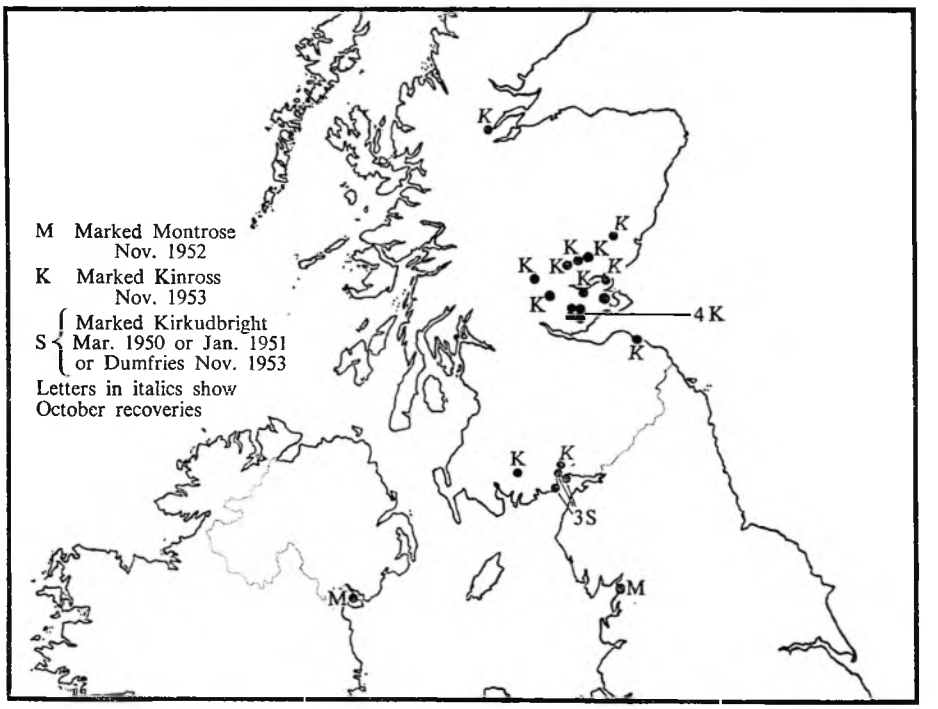


FIGURE 6: Recoveries of ringed Greylags in December.

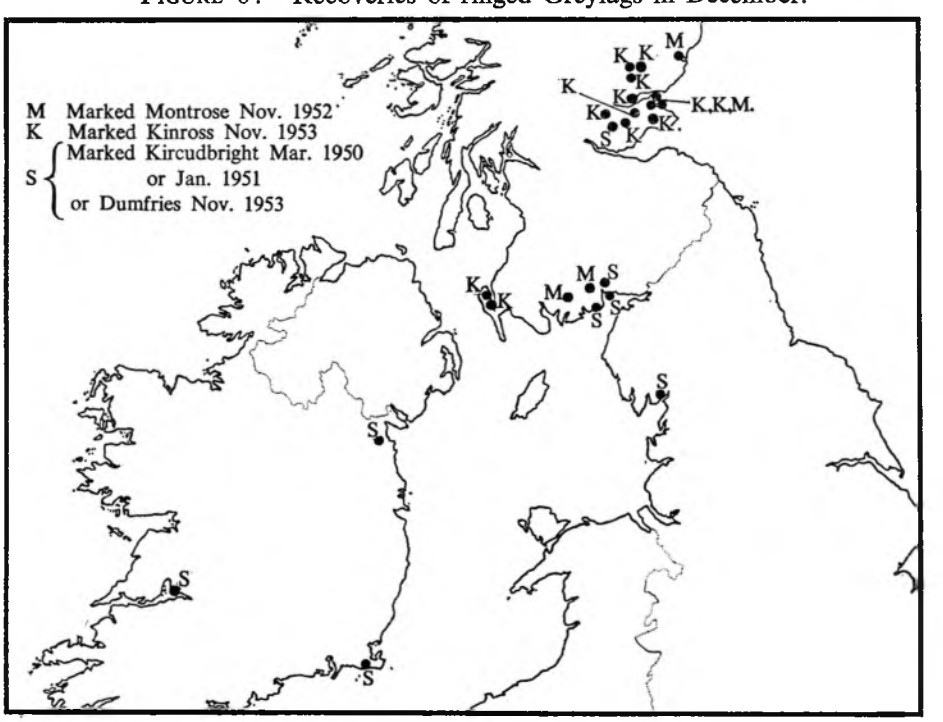


FIGURE 7: Recoveries of ringed Greylags in January.

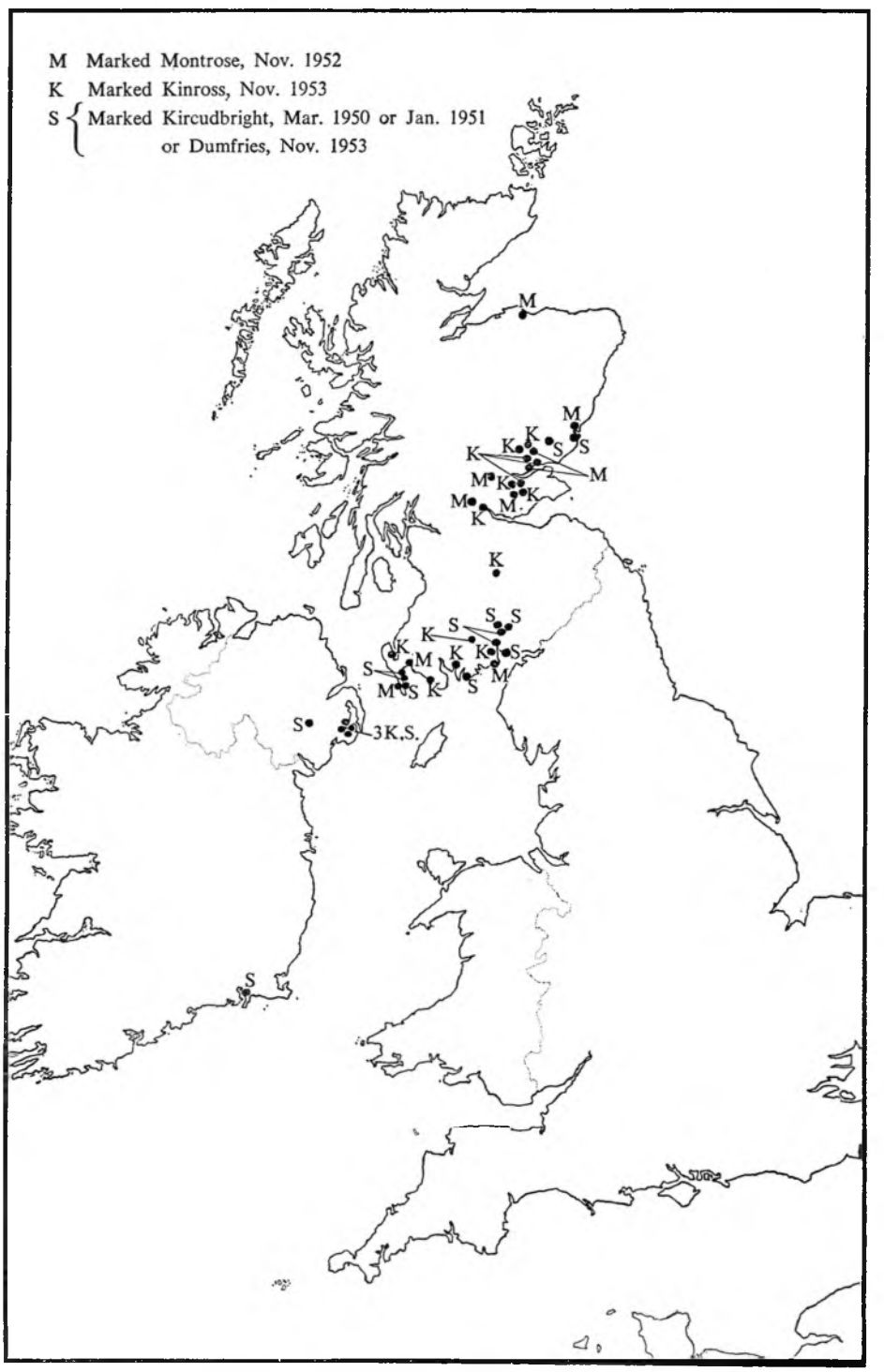
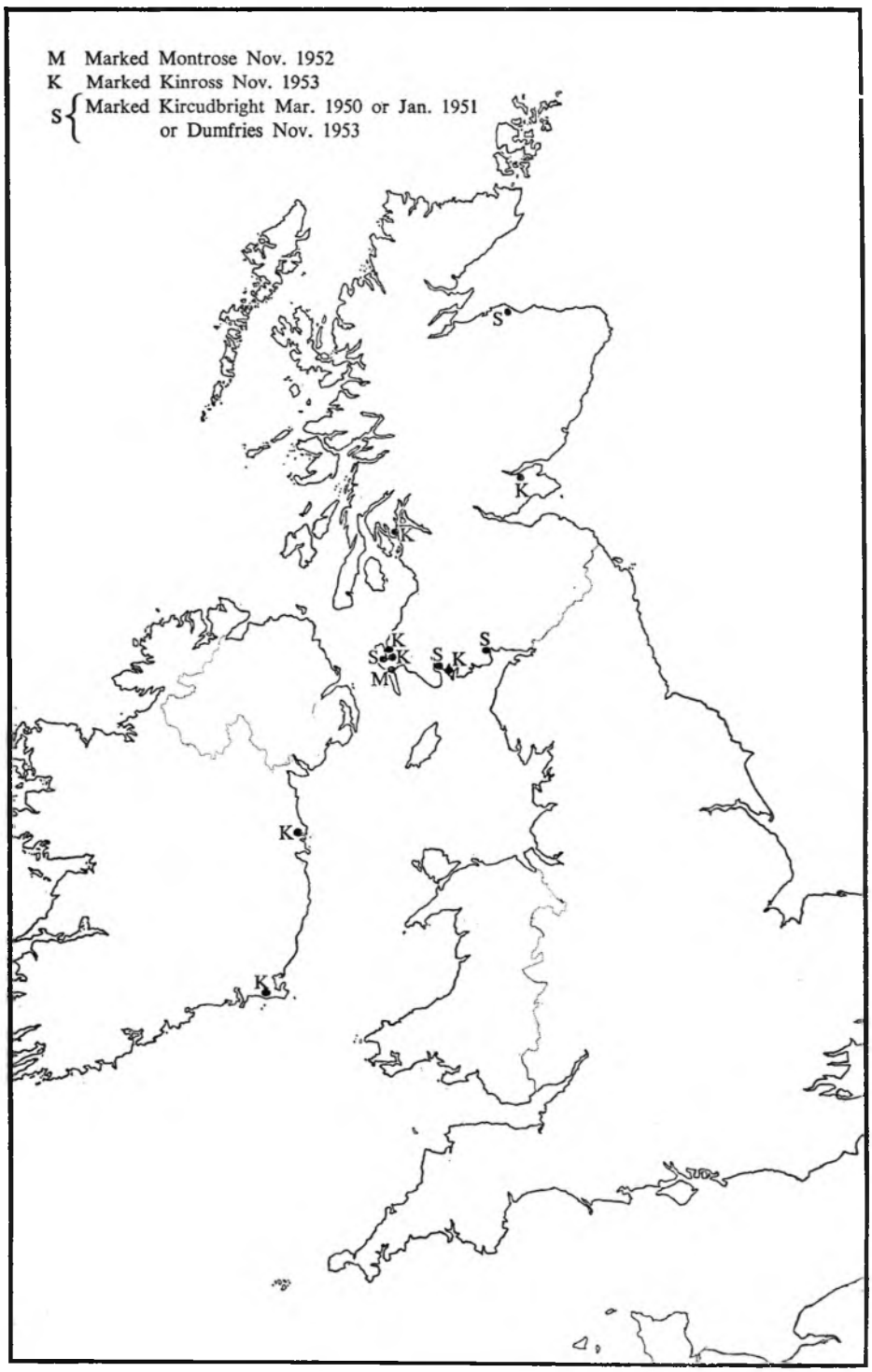


FIGURE 8: Recoveries of ringed Greylags in February.



January 1951 with those caught in Dumfries in November 1953, the Dumfries-ringed sample has produced a higher proportion of Solway recoveries. The explanation may lie not in the different catching places but in the dates of capture. Figure 4 suggests that geese arriving early on the Solway mostly remain there through the winter. But the numbers in the region increase considerably through January and February, by the return of geese from Ireland as well as by a southward shift within Scotland, and the January-for— and March-ringed samples probably included a high proportion of such late visitors.

DISCUSSION

Studies of goose numbers can be made from two points of view. One is concerned with the specific population as a reproductive unit, whose numbers are affected primarily by births and deaths. The second deals with the numbers of a particular species frequenting a particular place. The two approaches are not incompatible, but they only coincide in those cases where the whole population of a species, or an almost wholly isolated part of it, can be studied. As has been suggested in the introduction to this paper, the Iceland-breeding, British-wintering population of the Greylag seems to be a suitably distinct group.

The evidence assembled above indicates that in the last four years the population has probably numbered between 17,000 and 24,000 in the second half of November. Apparent variations between different years do not exceed the limits of error imposed by the weaknesses of the data, so that the population looks to be in a comparatively steady state. Further investigations are needed to discover why this is so. From the viewpoint of conservation it is particularly important to establish how stable a population of this size is, so that effects on the geese of changes in human activities can be predicted with some confidence, as a necessary preliminary to remedial measures.

The size of the autumn population is not by itself a sufficient basis for prediction, because it gives no indication of the size of the breeding population. In November mature geese, juveniles and pre-breeders (yearlings and most two-year-olds) are mixed in proportions which are liable to vary considerably from year to year and from place to place. The Trust has begun field observations, analogous to those already made on White-fronted Geese, which if continued over several years should provide measures of the age composition of wintering flocks. A resumption of rocket-netting of Greylags, so far carried out on only a small scale between 1950 and 1953, would provide additional information, particularly on individual survival, and on seasonal differences in losses from shooting. It might also be worth attempting a 'census' in late February with the object of determining losses during the winter by comparison with a 'census' in the previous November. But this would need exceptionally favourable weather and, since the anticipated average loss from a population of 20,000 geese during December, January and early February would be only about 2,500-3,000, both counts would have to be considerably more precise than those yet made.

The practical difficulties of organising research on the breeding grounds are formidable, so that there is little prospect of large-scale investigations being

made. It is however of great interest to learn the views of Dr. Finnur Gudmundsson, whose knowledge of the birds in Iceland is unrivalled, on the present status of the Greylag there. The writer calculates that a population of 20,000 in late November should correspond to a breeding population of 3,500 to 4,500 *pairs* of mature geese. Dr. Gudmundsson comments (*in litt.*) " 3,500-4,500 breeding pairs is in my opinion somewhat too low for the total Greylag population of Iceland, but I must confess that we have no reliable data at our disposal for making a tolerably accurate estimate of the size of the population. However, one thing is certain and that is that a spectacular increase and extension of range of Greylags in Iceland has taken place in recent years. The population seems to have started to increase soon after the turn of this century but the increase has been particularly striking in the last 25-30 years. Greylags are now becoming a nuisance in many districts and farmers are already complaining and demanding that their numbers be checked."

Most people interested in geese are more concerned with the numbers frequenting particular haunts than with the whole reproductive unit. Frequent changes in the ' popularity ' of a district amongst geese, whether of one or several species, are found wherever close investigations are made. Sometimes these changes are very striking. For British-wintering Greylags the best known recent example is the decline in numbers on the Slobs of Wexford from 5,000 or so in 1945-46 to under 250 in 1955-56 (see Ruttledge and Hall Watt, *loc. cit.*). Coupled with other examples of decrease, such as the earlier fall on the Firth of Tay and the recent ones in Ayrshire and the eastern Solway Firth, this seems to provide a basis for statements alleging a serious decrease in the numbers of Greylags. Increases in numbers over the corresponding period, such as have occurred in Wigtown and Morayshire, have attracted less attention.

In the writer's opinion, assertions about the welfare of a species must be based on studies of the reproductive unit, not on the position in fragments of its winter range. The evidence seems to show that the Icelandic-British Greylag population has not been decreasing, or increasing, markedly in the last four years, though its numbers may have fluctuated more violently before 1955.

The abandonment, or declining popularity, of a goose haunt is, of course, a proper cause of concern. But it does not seem at present either that any particular wintering place is of crucial importance to the Icelandic Greylags, or that the cumulative effects of changes in land use, shooting pressure and disturbance are too great to be offset by the adaptibility, and the reproductive potential, of the species.

It by no means follows that the Greylags *resident* in Britain are also contending successfully with their environment. There seem to be great differences between colonies in this respect. It is hoped to investigate their status in detail in the next few years. Meanwhile, it is important to see that our nesting geese benefit from the special protection afforded to them in the close season by the Protection of Birds Act, 1954.

A number of landowners in scattered parts of the country have been and are, establishing feral flocks of Greylags, some of them with considerable success. This is an attractive idea, but it would perhaps be desirable to study possible consequences of its widespread adoption, especially in relation to agriculture.

ACKNOWLEDGEMENTS

Very many people have helped in the compilation of this paper, some unwittingly. None can be held in any way responsible for errors of fact, or opinions of which they may well disapprove. I hope that the following list includes them all: S. Adams, A. F. Airey, J. A. Anderson, D. G. Andrew, R. Barker, J. Bartholomew, Miss E. P. Beattie, G. Bennett, F/Sgt. G. E. Bennett, F. M. Black, J. Blyth, H. Boase, Rev. R. A. Boyd, F. Brady, W. Brotherston, W. A. Cadman, D. Cameron, J. Campbell, Dr. J. W. Campbell, Col. H. J. Cator, G. V. Caunce, I. C. Christie, M. Clark, R. N. Constantine, P. E. D. Cooper, W. Crawford, G. Dall, W. Davidson, Dr. W. J. Eggeling, Dr. E. A. R. Ennion, J. M. Fletcher, A. Forster, F. W. Fox, A. Fraser, Miss E. A. Garden, J. Gordon, J. R. Gordon, R. Gordon, W. Greenhill, J. Grierson, Dr. F. Gudmundsson, M. Guilfoyle, Dr. J. G. Harrison, Miss M. Haydock, R. Henderson, K. J. M. Henry, L. Hewlett, L. G. Hodgkinson, N. Hopkins, W. Hughes, Comdr. G. Hughes Onslow, G. R. Humphreys, A. Hunter, A. P. Jack, K. J. M. Jackson, G. A. Johnson, R. Johnston, T. Kelly, J. M. Kennedy, G. Kerr, W. Kidd, Miss M. I. Kinnear, Dr. H. A. Lang, D. D. Lawrie, Capt. J. Lawrence, J. K. Lindsay, Col. W. M. Logan Home, D. W. McCredie, W. J. McCulloch, J. MacGeogh, G. D. McKee, Miss M. E. McKinna, Miss M. P. MacMillan, R. M. J. McMillan, T. McNaughton, F/Lt. A. R. D. Maconochie, J. McNish, A. J. Matheson, Prof. M. F. M. Meiklejohn, G. Mills, D. Moffat, C. St. J. G. Moncreiff, J. Munro, C. C. I. Murdoch, C. K. Mylne, J. F. Palmer, Dr. P. M. Peacock, G. Pilkington, J. W. Pope, J. Powell, W. Powell, G. F. Raeburn, R. Mc. A. Ramage, G. W. Reid, E. L. Roberts, R. Roberts, T. Robertson, J. C. Ross, Col. W. Ross, Major R. F. Ruttledge, C. D. W. Savage, C. D. Scotland, P. Scott, S. Shaw, R. T. Smith, R. W. J. Smith, T. Spence, Mrs. M. M. Stables, Major T. D. Stephen, J. Straiton, Lord David Stuart, J. C. Swift, A. Tewnion, Miss V. M. Thom, G. Thompson, G. L. Trafford, Mr. and Mrs. R. N. Traquair, A. F. G. Walker, R. Walls, G. Waterston, A. Watson, D. Watson, W. H. Wild, J. Williams, Mrs. F. G. Yalden Knowles.

In addition, members of the Wildfowl Count organisation who have sent in largely negative reports, and so are not listed, have nevertheless contributed much to our knowledge of distribution.

Mr. J. D. H. Radford and Dr. S. K. Eltringham flew the aircraft used in 1957 and 1958, and I am greatly indebted to them for their help.

MOVEMENTS OF MARKED SEA AND DIVING DUCKS IN EUROPE

Hugh Boyd

RINGING of dabbling ducks in Europe has helped considerably in discovering the patterns of their distribution and movement through the year. By comparison our knowledge of the behaviour of British species of the tribes Aythyini and Mergini is meagre, chiefly because they are harder to catch outside the breeding season. The numbers marked in Britain have been small, and seem unlikely to be rapidly increased, but ringers in some countries where these ducks breed more plentifully have marked considerably more. Captures of adults, mostly females taken on the nest, have been particularly informative. This paper reviews the results so far apparent. It is based on published and unpublished British records, and on the published material of foreign ringing schemes.

I am indebted to the British Trust for Ornithology for permission to use data relating to ducks not ringed at Wildfowl Trust stations. A card index of recoveries compiled by Dr. W. Rydzewski for the International Wildfowl Research Bureau provides a convenient summary of all but the most recent records published abroad, and I am grateful to Dr. Rydzewski and the officers of the Bureau for access to this index.

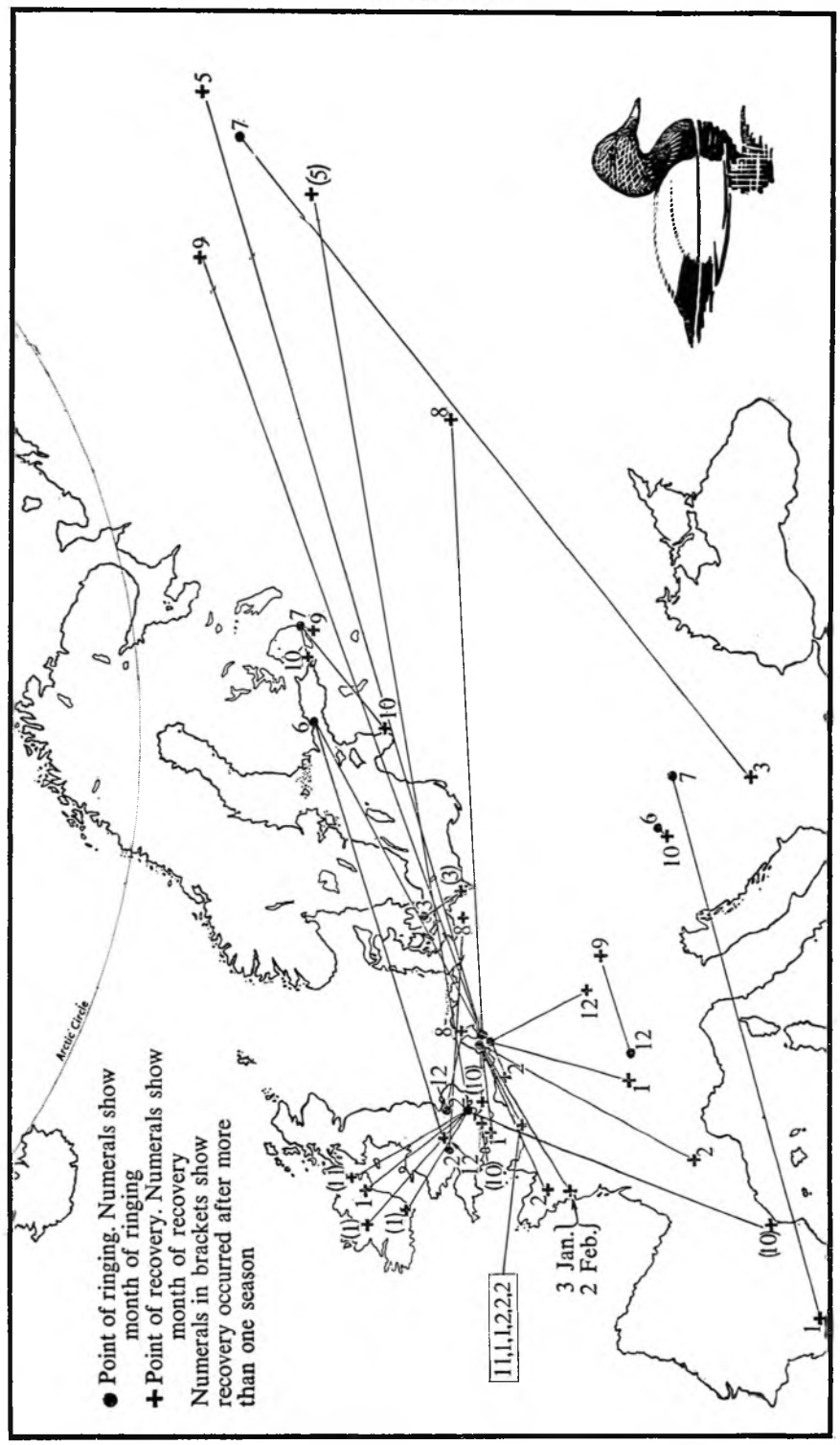
Table I summarises the amount of information obtainable from recoveries and reveals many of its inadequacies. Clearly samples as small as these cannot provide highly reliable and detailed guides to distribution, especially of species which are treated as sporting birds in some countries but not in others. However, by considering the recoveries against the background provided by published studies on the distribution of each species it is possible to form some ideas on the breeding distribution of the populations visiting Britain in winter. The differences between species which are revealed illustrate the extraordinary heterogeneity of the winter duck population of Britain.

TABLE I

Numbers of recoveries of diving- and sea-ducks ringed in Greenland, Iceland and Europe which provide evidence of movement

Where ringed	Poch-ard	Scaup	Common Scoter	Velvet Scoter	Long-tail	Golden eye	R B Merg.	Goos-ander	Total
Greenland ..	—	—	—	—	2	—	—	—	2
Iceland ..	—	80	11	—	9	—	10	—	110
U.S.S.R. ..	3	—	—	—	16	1	—	—	20
Finland ..	2	1	—	1	—	9	2	2	17
Sweden ..	—	6	—	3	—	26	6	10	51
Norway ..	—	1	—	1	—	—	1	—	3
Denmark ..	1	—	—	—	—	1	4	—	6
Germany ..	—	—	—	—	6	—	3	—	4
Holland ..	13	—	—	—	—	—	—	—	13
Switzerland	2	—	—	—	—	—	—	2	4
Hungary ..	2	—	—	—	—	—	—	—	2
Great Britain	12	—	—	—	—	—	1	5	18
Total ..	35	88	11	5	28	37	27	19	250

FIGURE 1: Recoveries of ringed Pochard showing movements of more than twenty miles.



AYTHYINI

Three species of this tribe occur regularly in the British Isles: the Pochard (*Aythya ferina*), the Tufted Duck (*A. fuligula*) and the Scaup (*A. marila marila*). An account of the summer distribution of British-ringed Tufted Ducks was published recently (Boyd, *Wildfowl Trust Eighth Annual Report*, pp. 47-51, 1957). As subsequent data have not substantially affected the picture and as the winter distribution of this species in Britain has been discussed at length by Atkinson-Willes (*Fourth Report on National Wildfowl Counts*, 20 pp., 1957) it will not be treated here.

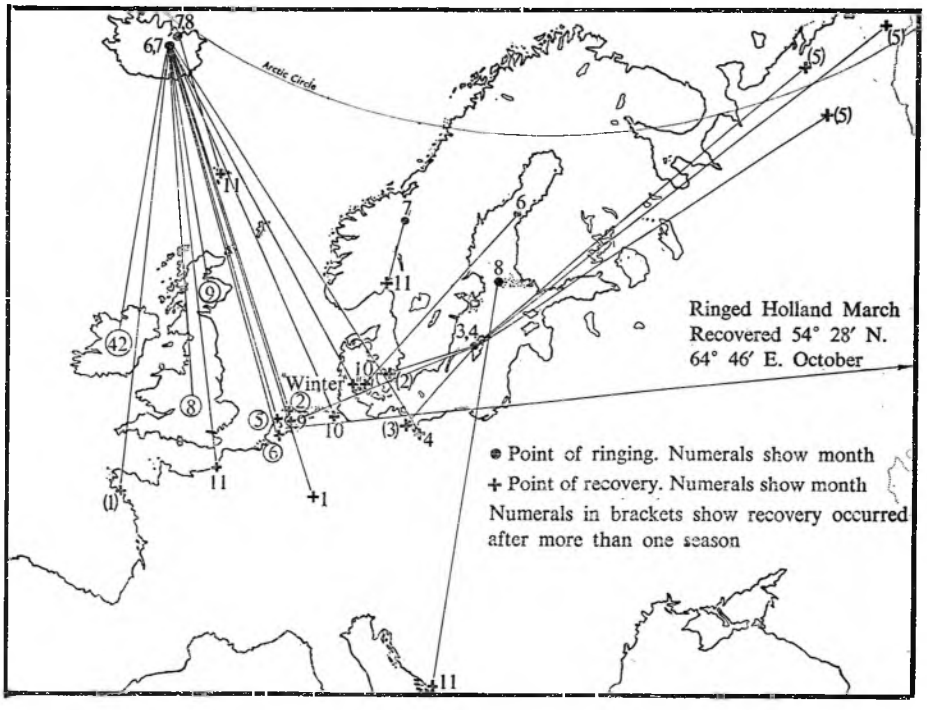
The POCHARD breeds in many parts of the British Isles, although rarely in abundance and often sporadically. Its numbers in mid-winter are very substantially greater than can be accounted for by home-breeding and home-bred individuals. The species is widespread as a breeding bird in the boreal zone of Europe and Asia, very largely within the latitudinal range 45° N. to 60° N. In recent years it has spread north and west in Scandinavia and has now even begun to colonise Iceland. This northwestern spread has been attributed both to the amelioration of the Baltic climate and to the deterioration of breeding habitat in the areas to the south and east formerly the particular stronghold of the species. This forest steppe zone has suffered from a diminution in rainfall, leading to drying up of many of the shallow reedy lakes favoured by the Pochard, a process accelerated too by agricultural drainage.

Until some Pochard have been marked in British breeding places it will not be possible to confirm, or refute, the suggestion to be found in several general works that, though they move about within the country, British birds do not emigrate. (It would be mildly surprising if this hypothesis were correct).

Recoveries of British-winter-ringed Pochard overseas and recoveries in Britain of foreign rings (Figure 1) indicate that some of our winter immigrants breed in the northern parts of the species range, at least as far as 61° E. (and probably substantially further east, since a Dutch-ringed bird has been found at 71° 30′ E.). Such birds probably arrive in Britain late (in January and February), after staying in north Germany, Holland and presumably Denmark. But the map shows that birds caught in Essex in autumn have passed through to Ireland by January. These earlier immigrants and passage migrants may subsequently be shown to breed around the Baltic, rather than further east. There is as yet no evidence that Pochard pass through England to France and the Iberian peninsula, although Dutch-ringed birds have moved into France as well as England. The only British-ringed Pochard reported from Spain was ringed in March 1956 and recovered in October 1957, dates suggesting that Iberian-wintering Pochard might return north through England in spring rather than visit it in autumn.

Two Pochard ringed in India in winter have been recovered in Siberia in summer, at 54° 42′ N, 76° 04′ E and 53° 23′ N, 83° 40′ E, indicating that the breeding population of the Siberian plain east of Omsk perform a north-south migration. In Europe, however, the migratory movements are more nearly east-west than north-south, thanks to the comparatively southern breeding-range, and to the mildness of winter weather near the Atlantic, in contrast to the severe winters of eastern Europe.

FIGURE 2: Recoveries of Scaup away from ringing place.



The breeding distribution of the SCAUP (figure 2), a subarctic species, overlaps with that of the Pochard only in the central Baltic so that the populations of the two species wintering in Britain could scarcely be expected to come from the same breeding areas. The recoveries suggest strongly, at first sight, that Iceland alone provides our winter birds. Closer scrutiny shows that the evidence may be misleading, because the only other place where any quantity of Scaup has been ringed is the Swedish island of Gotland, where the birds have been caught on passage in March and April. Some of these Swedish-visiting Scaup, breeding in Russia in the tundra of the Nenets National Okrug and the Komi A.S.S.R., evidently enter the winter-range of Iceland-breeding birds, in Denmark, Germany and Holland. This winter mingling of birds breeding in longitudes 17° W and 64° E makes it very likely that those breeding in intervening areas, from which no ringed sample is yet available, also winter in north-west Europe, including the British Isles.

Figure 3 shows in greater detail the distribution in the British Isles of Scaup ringed in Iceland. 40 of the 56 recoveries shown were in Ireland, and 41 in coastal localities, compared with 15 inland, proportions consistent with what is known or guessed about the distribution and abundance of the species in the two countries. The monthly distribution of the recoveries (Table II) shows them to be very largely concentrated in the months October to February. Few Scaup are seen in the British Isles before the end of

FIGURE 3: Recoveries in the British Isles of Scaup ringed in Iceland.

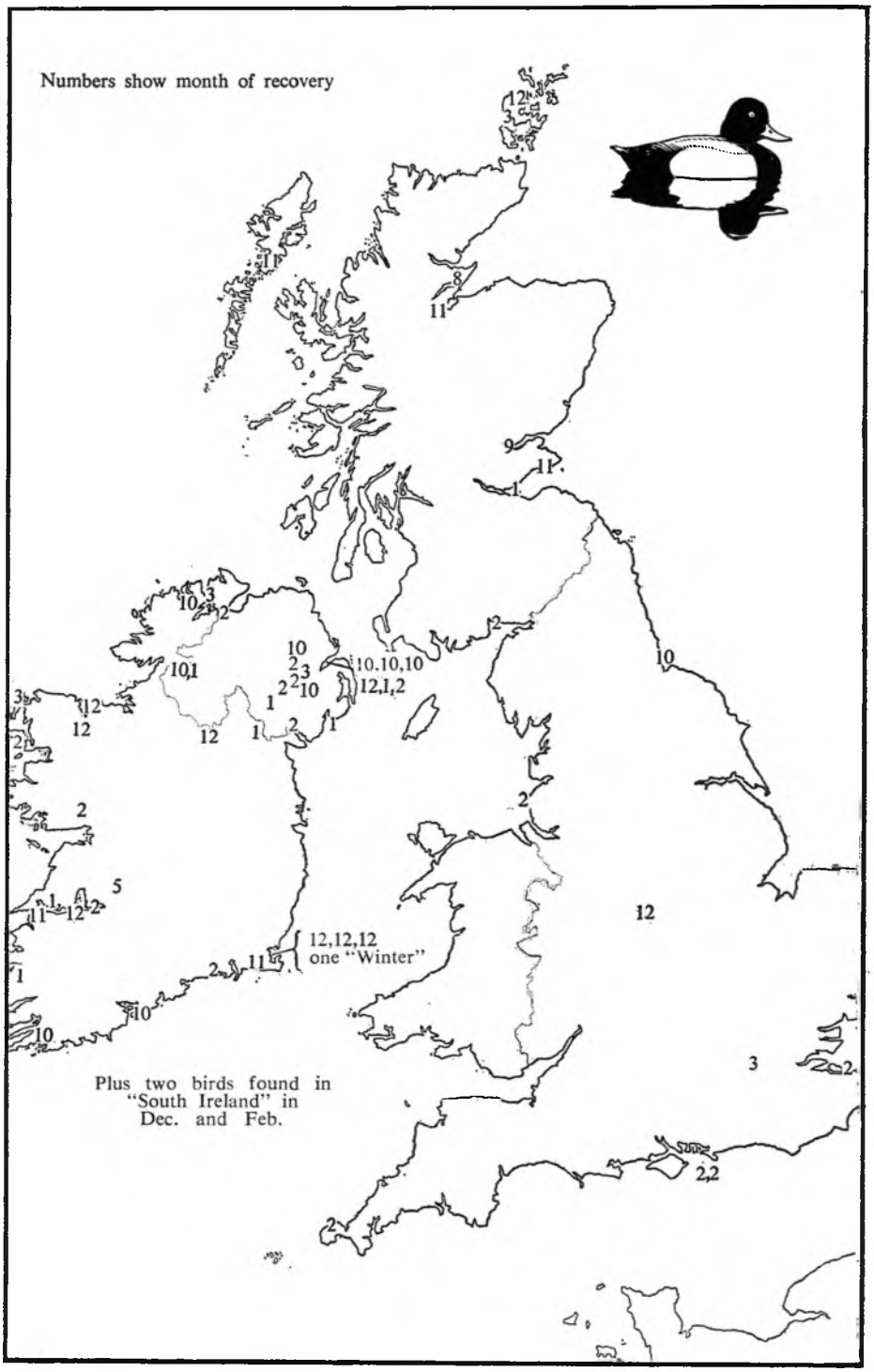


TABLE II

Monthly distribution of recoveries of Icelandic-ringed Scaup in the British Isles and North-West Europe

Recovered in	Aug.–Oct.	November	December	January	February	Mar.–Apr.	Total
British Isles ..	13	5	10	9	16	5	58
N.W. Europe ..	2	7	—	3	2	2	16
Total ..	15	12	10	12	18	7	74

September, and they are known to return to Iceland, where they do not winter, in March. When the monthly distribution of Iceland-ringed Scaup in the British Isles is compared with their distribution elsewhere in Europe an interesting discrepancy is found, recoveries in the Netherlands and France being unexpectedly numerous in November and non-existent in December. The numbers of Scaup in the Netherlands do seem to be highest in November, so that even this small sample of recoveries may reflect a real shift of the " centre of gravity " of the Iceland population from Holland in November to Ireland in December. But, as the recoveries have been accumulated over nearly thirty years and as there are known to be very marked fluctuations from year to year in the numbers of Scaup frequenting favoured localities both in Britain and in the Netherlands, no great weight can be given to this finding.

MERGINI

Seven species of the tribe occur regularly in Britain: Common Scoter (*Melanitta n. nigra*), Velvet Scoter (*Melanitta f. fusca*), Long-tailed Duck (*Clangula hyemalis*), Goldeneye (*Bucephala c. clangula*), Smew (*Mergus albellus*), Goosander (*Mergus m. merganser*) and Red-breasted Merganser (*Mergus s. serrator*).

The breeding distribution of the COMMON SCOTER is similar to that of the Scaup. No ringing data relating to birds breeding in Sandinavia or further east are available, so that their contribution, if any, to the British-visiting population is unknown. A female ringed on her nest at Myvatn, Iceland, in June 1946 and found dead near Liverpool in September 1949 provides the only record of immigration. The only recovery so far of a British-ringed Scoter shows no movement. There have been seven published recoveries of Iceland Scoters in the Bay of Biscay, six on the islands and coast of the Vendée and Charente Maritime, the seventh on the north coast of Spain near Santander. One was in September, two in November, three in December and one in February.

Further east, ringing on the Swedish islands of Gotland and Öland in June and July has yielded recoveries in Denmark in September and October, but none further west, while summer ringing in northern Sweden, Finland and the Estonian S.S.R. has produced only evidence of return in later summers.

Ringing evidence of the distribution of the VELVET SCOTER is even more meagre, perhaps chiefly because the species does not breed in Iceland, although in Scandinavia, Russia and Siberia its breeding range largely overlaps that of *M. nigra.* There is one recovery in Britain: a young bird ringed in Gudbrandsdalen in the mid-west of Norway, in July 1943, was found near Glencaple, Dumfries in October of the same year.

The only other recoveries showing movement are of birds ringed in S.W. Finland in June and on Oland and Gotland in July and found in Denmark in October and in September and October, respectively.

Since accumulated observations from many parts of the British Isles show that many puzzling changes in numbers and some quite spectacular passage movements of both species occur it would be of great interest to ring them on a large scale. Experience at Myvatn, where 540 (282 adults) Common Scoter ringed for the Reykjavik Museum to 1952 have yielded only seven overseas recoveries (though many more recaptures at the ringing place) makes plain that massive efforts would be needed to achieve much. Perhaps some inventive genius can devise a method of catching Scoters at sea in mid-winter.

No ringed LONG-TAILED DUCKS have been recovered in the British Isles, where only two had been marked to the end of 1956, so that no proof of the breeding origin of the considerable British visiting population is available. Bannerman (*Birds of the British Isles, vol. VII,* 1958) has treated the point at some length and inferred that " it is pretty certain that no members of the large Greenland population are among them " (the British population) and " if the Iceland population which leaves that island prefer to take a westerly rather than a southerly course, what more likely than that Russian tundra birds do likewise?—a migration which would eventually bring them to Scottish waters." Bannerman obtained his evidence chiefly from Salomonsen (*Birds of Greenland,* 1950), who discussed the results of ringing in Greenland and Iceland as well as observations in those countries and Scandinavia. Since Salomonsen wrote, further recoveries of Iceland- and Greenland-ringed Longtails have been obtained. Figure 4 records the movements of these marked birds, together with those of a series of birds marked in the Yamal Peninsula in northern Siberia (around 72° N, 72° E). The latter, published by Mikheev in 1947, seem to have been overlooked by Bannerman. They support his hypothesis of a westerly movement by Russian birds. As all published recoveries outside Iceland of birds ringed there are in Greenland there is still no support for the view that any of our winter visitors come from Iceland. But there is now one recovery of a Greenland bird (ringed July 1947) from Denmark in January 1951 to weaken the argument that Greenland birds which emigrate go only to America.

Two recoveries of Yamal-ringed Longtails: an adult male ringed in August 1933 found in northern Norway in July 1938, and one of unknown age marked in August 1934 and found in northern Sweden in June 1935, suggest that some redistribution of Longtails through the breeding range occurs, as would indeed be expected from the taxonomic homogeneity of the species despite its circumpolar distribution.

Presumably the main obstacle to the recovery of ringed Long-tailed Ducks in the British Isles is that few are shot or otherwise killed by man here, so that it would be helpful to catch and mark some in British waters in the expectation that they would be shot elsewhere.

FIGURE 4. Recoveries of ringed Long-tailed Ducks.

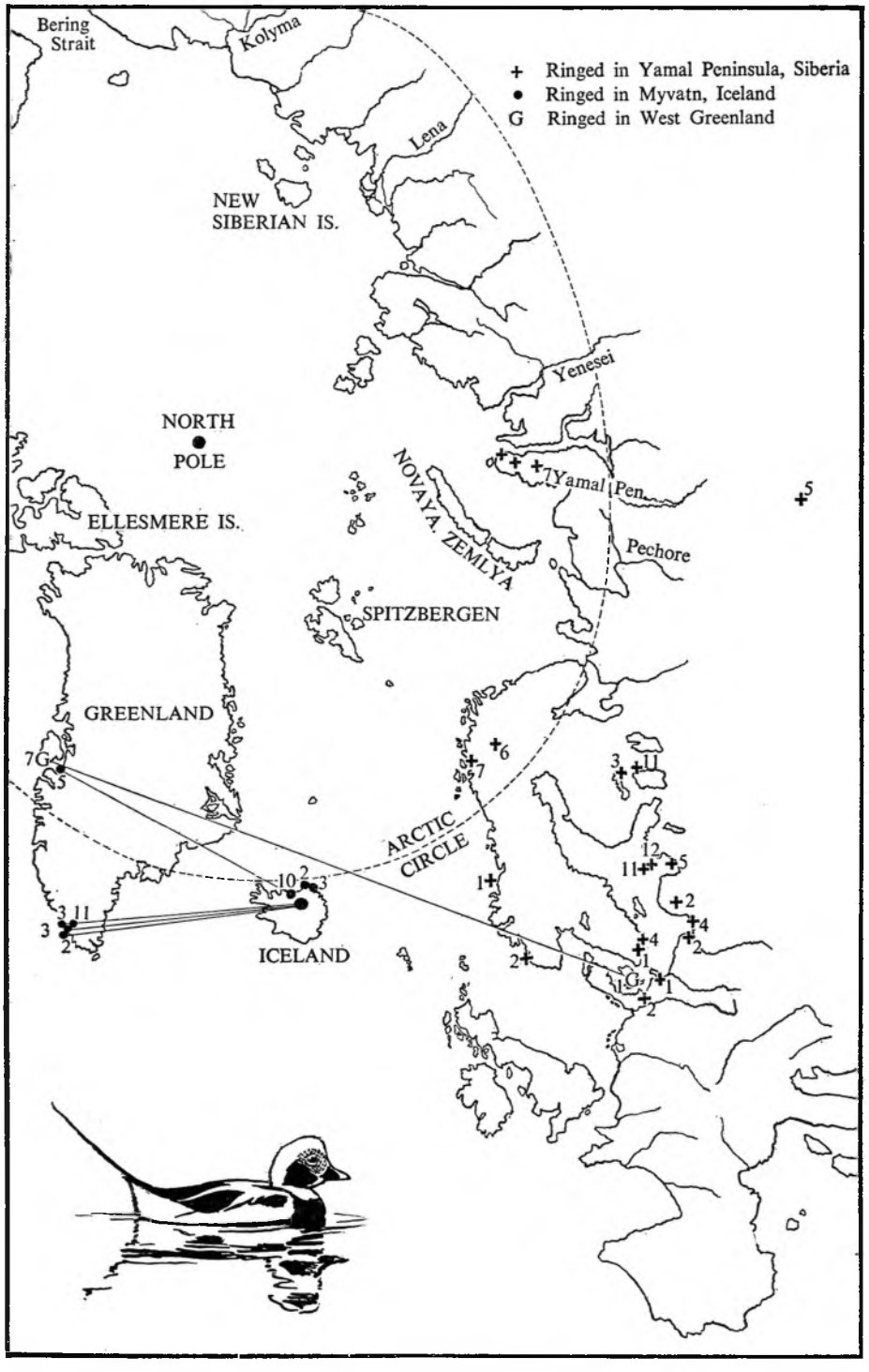
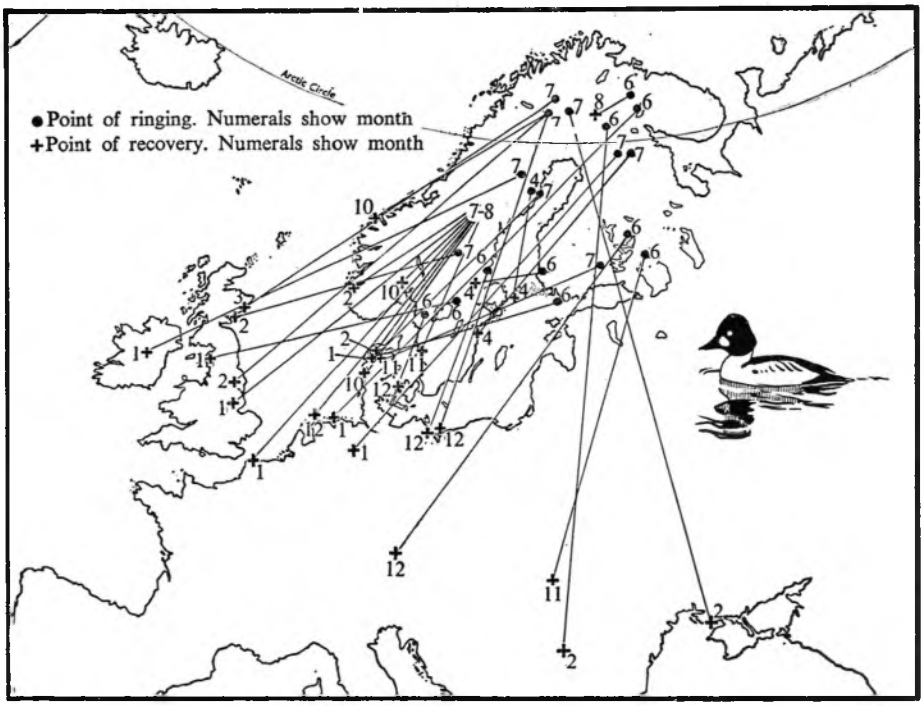


FIGURE 5: Recoveries of Goldeneye, away from ringing places.



The map of recoveries of ringed GOLDENEYE (Figure 5) provides a comparatively rich picture of the movements of the Scandinavian-breeding population. This is because the marked sample has been caught in many different localities, mostly in Sweden and during the summer. It appears that the Swedish population moves slowly south-west (see also Table 4), staying around the Baltic until December and then shifting to the countries surrounding the North Sea for January and February. The only March recovery is from Scotland. The two April ones are from Sweden.

Recoveries of Goldeneye ringed in south-west Finland show movements like those of Swedish birds, but birds marked in the north and along the Russo-Finnish border seem as likely to travel south towards the Balkans and the Black Sea as to move south-west. This tendency appears to be more pronounced than in any other species of duck nesting in Scandinavia. (Southward movements of ducks nesting further east in Russia and Siberia are, of course, known in many species).

It would be instructive to mark Goldeneye in their western wintering places, to see whether any important part of the "North Sea population" breeds east of 30°E. The absence of recoveries from Russia cannot be taken to disprove this, since ringing at breeding localities cannot provide an unbiased picture of summer distribution, because of the tendency of ducks (and especially of adults) to return to their home areas.

Ringing of Barrow's Goldeneye (*Bucephala islandica*), which replaces *B. clangula* in Iceland, has produced several recoveries and recaptures, but none outside that country. The isolation of the Iceland population from the

Goldeneyes of Europe seems all the more remarkable when other closely related species of duck occurring in Iceland are found to share wintering places with Scandinavian breeders.

The movements of ringed RED-BREASTED MERGANSERS (Figure 6) from Sweden resemble those of the Goldeneye. Mergansers marked in Denmark have been nearly sedentary, but one marked on the north German island of Fohr in August 1933 was recovered in November of the same year in northern Italy. No Scandinavian-ringed examples have yet been found in Britain, though it seems likely that some birds from Sweden, Finland and perhaps Russia should occur here. Iceland birds have been found in Shetland and off the mainland of Scotland and one is known to have reached Holland. The most pressing need is for more ringing in Britain, in both summer and winter. The only British recovery of a British-ringed bird showed only a small movement, within Co. Fermanagh, of a bird marked in June 1909 and recovered in June 1912. (It is astonishing that no further data have been obtained in forty-six years).

The British contribution to our knowledge of GOOSANDER movements (Figure 7) is less blameworthy, though this is due almost entirely to the enterprise of Mr. P. A. D. Hollom who succeeded in trapping small numbers on a reservoir at Molesey, Surrey, in several winters during the 1930's. These yielded an unusually high proportion of recoveries overseas, three in east Sweden in April, one in Arkhangelsk (also in April) and one on the west coast of Finland in September. The sketch they provide has been amplified by other small scale ringing in Sweden, Finland and Denmark, showing the Scandinavian population to remain as long as possible in and around the Baltic, but moving west if necessary in mid-winter.

Though the Goosander breeds in Iceland, few have yet been ringed there and no evidence of emigration has been obtained. Marking of members of the isolated southern breeding population in the Alps has shown that some dispersal occurs but has given no hint of Swiss birds moving northwards at any season.

Nothing has been found out about the movements of SMEW by means of ringing.

Summary

Recoveries of sea and diving-ducks ringed in northern Europe provide a sketch of the movements of eight of the ten species of these tribes which occur regularly in the British Isles.

Pochard. Some of our winter immigrants breed in the north of the species range, east to 61°E (and probably to 70°E and beyond). Pochard breeding around the Baltic may arrive ahead of those breeding in Russia. Proof that British-breeding Pochards are resident has yet to be obtained.

Scaup. All foreign-ringed Scaup yet recovered in Britain have come from Iceland, but it is very likely that some from northern Scandinavia and Russia also visit this country. The majority of the Icelandic birds have been reported from Ireland. Ringed Scaup have occurred almost entirely in the months October to February, most often in February. Surprisingly few have been found in November, the peak month for occurrences in Holland and France.

FIGURE 6 : Recoveries of Red-breasted Mergansers, away from ringing place.

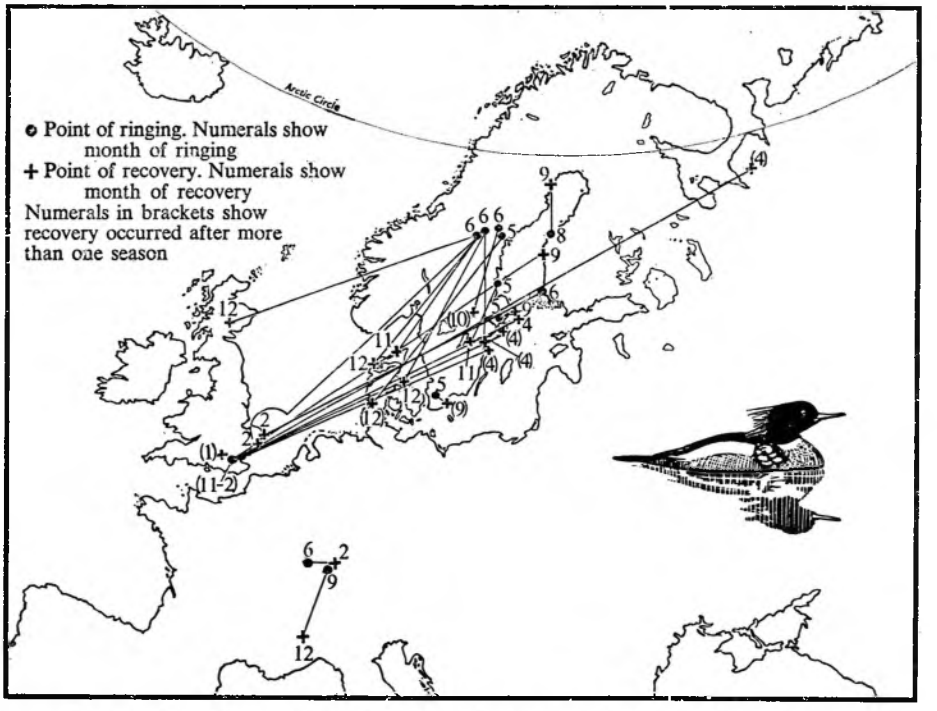
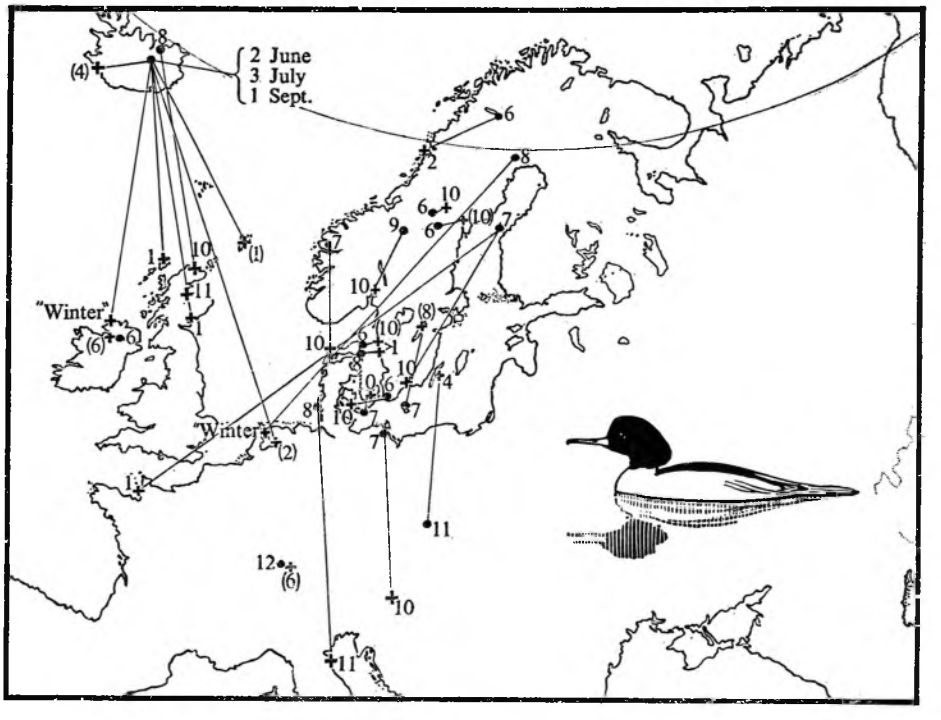


FIGURE 7: Recoveries of Goosanders, away from ringing place.



Common Scoter. Icelandic Scoters certainly visit Britain, but ringing in Scandinavia and Estonia has not yet produced recoveries in the British Isles.

Velvet Scoter. A young bird ringed in Norway in July 1943 and recovered on the Solway in October provides the only British recovery. Ringing in Finland has produced comparatively many recaptures but very few recoveries elsewhere.

Long-tailed Duck have been ringed in Iceland, West Greenland and the Yamal Peninsula in Siberia. The Icelandic birds have been found there and in Greenland. Birds from Greenland have travelled to Denmark but also to N.W. Canada. Birds from Siberia have been found around the Baltic and in west Norway. Winter visitors to Britain seem more likely to originate in the north-east than the north-west.

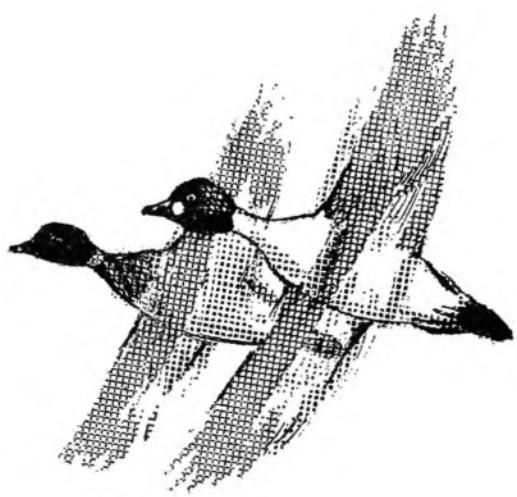
Goldeneye have been ringed more plentifully and yielded more recoveries at a distance than most diving ducks. Six ringed ducks found in Britain had all been marked in Sweden. Finnish and Russian Goldeneyes seem to move south as often as south-west.

Red-breasted Mergansers have been marked in Iceland, Scandinavia and Germany. Five recoveries in Scotland and one in Ireland have all been of Icelandic origin, but a few Scandinavian birds probably visit England, since they have been found in Holland and northern France.

Goosander. One ringed in Sweden has been found in Scotland. A Swedish and a Finnish Goosander have been recovered in Suffolk and Norfolk. Goosanders ringed near London in winter have been reported in spring from Sweden and north-west Russia and from Finland in September.

Very few Smew have been ringed and no evidence of movements has yet been obtained.

Movements of Tufted Ducks are not treated here.



WILDFOWL CONSERVATION IN DENMARK

G. V. T. Matthews

Denmark's land area (16,575 square miles) is not much greater than that of the Netherlands which we considered in the last Annual Report. It is not so densely inhabited, the human population being about four and a half millions (as against ten million Dutch), but no less than 110,000 shooting licences are issued each year (as against 20,000 in the Netherlands). Per head of population shooters in Denmark are thus more than twelve times as numerous as in the Netherlands, and some four times as plentiful as in our own country. Small wonder, then that Denmark can claim to be one of the most game-conscious countries in Europe. Land reclamation of the urgent, hungering type we see in the Netherlands is not an important factor and there are no active duck decoys. So the conservation problems are very different in the two countries.

Advisory and Educational Services

The most expensive shooting licence costs only a pound and covers all contingencies, while the cheapest is but two shillings and covers coastal shooting which is free to all " outside the coastline as near as a boat can float ". The overall income from these licences is about £75,000 a year and the extraordinary thing is that the *whole* amount is paid into a special Game Fund, administered by the Minister of Agriculture on the advice of a Special Game Council, entirely for the benefit of game and shooting interests! Such an honest use of specialist taxes provides an example which might well be followed in this country, where there is not even a suggestion in official circles (as in the case of the Road Fund) that proceeds from shooting licences be used for conservation purposes.

The first benefit that a sportsman derives from his licence fee is an insurance against hunting accidents other than those caused by very severe carelessness. But the bulk of the Game Fund is distributed towards the Game Advisory Service, the upkeep of reserves and of game breeding establishments, and game research. Some two-thirds of the licence holders join one or more of the hunters organisations, the " Dansk Jagtforening " founded in 1884 and having 30,000 members, the " Landsjagtforeningen af 1923 " a younger organisation with slightly more members (as usual in conservation circles some duplication of function appears inevitable) and the " Strandjagtforeningen " which only came into being in 1951 and has 5,000 members. This latter corresponds with our own Wildfowlers' Association of Great Britain and Ireland (W.A.G.B.I.). Nearly every parish has its own hunting community associated with one or more of the national Associations and these communities are served by a body of 13 advisory Game Wardens under a Chief Game Warden, Count Ahlefeldt Bille. Each Game Warden is a highly skilled man with at least four years specialist training behind him before he takes up the post. He has gained experience of and passed written and oral examinations in game management and breeding, shooting practices, game biology, game legislation and organisation, use of firearms and trapping methods, management of dogs, game literature and methods of teaching and propaganda. Each Game Warden is responsible for about 150 of the local

hunting communities, one Warden being concerned solely with shore-shooting interests. In the course of an average year it has been calculated that a Game Warden pays 571 visits to local organisations and individuals, gives 211 talks with and without films—half of these to schools, conducts 80 field courses, writes 511 letters, travels 15,539 miles by car, spends 288 days away from home, puts down 7,391 poisoned eggs and receives £615 plus travelling allowances.

Apart from the technical assistance that these Game Wardens give to shooters, more and more emphasis is being laid on their function in making the mass of people nature-conscious. The part to be played by well constructed and beautiful films is fully realised and many fine ones have been made. In the words of the Chief Warden " It is not our wish to create more sportsmen but we are eager to educate and extend the outlook of those who already have the sportsman's blood in their veins, and—above all—we wish to create a nation of Nature lovers. And we commence our activity in children's schools ".

The Game Fund maintains a very fine Hunting and Forestry Museum at Horsholm, 15 miles north of Copenhagen. It is housed in three large buildings, originally stables and barns of a Royal Palace, and beautifully set out. The collections of antlers perhaps weigh a little heavily on the non-specialist especially in one vast room which is ' papered ' with several thousand roe deer heads, but there are many excellent demonstration exhibits. These include a collection of specimens of game species with the opening and closing dates of the seasons clearly marked in each case, an interesting section devoted to wildfowling, showing punts, decoys, guns and a monitory case of burst guns. The results of research work on food, diseases and parasites are set out in a demonstration of charts and specimens. A particularly horrifying section is devoted to poachers' weapons and devices, illustrating to the full the fiendish ingenuity of which man is capable. Including as it does buildings devoted to forestry, the wood industry and life in Greenland and the Faroes, the Museum cannot fail to interest and instruct the general public as well as the shooting man.

Protection and restoration

Education, in the broadest sense, is rightly one of the main underpins of an enlightened programme of conservation. Protection and restoration of stocks and habitat form the second, with research an equally important third. Denmark's bird preservation legislation is based on the Game Act of 1931. As in our own much later instrument of 1954, all species of birds are protected with stated exceptions. The open season in general begins on 15 August and extends to the end of December, that is for geese and dabbling duck. For diving duck and sawbills the season extends into January and February, there being variations according to species. The Barnacle Goose and Canada Goose are protected throughout the year. Eider Duck can only be shot from October to December. The Minister of Agriculture has powers in an emergency situation to reduce open seasons or prescribe total protection for a period of three years (after which an Act is required). He can also prohibit shooting during periods of hard frost.

Birds may not be shot between sunset and sunrise except in the case of flighting ducks when the period is extended 1½ hours at either end, calibres

must not exceed 12 bore and automatic guns are prohibited. The use of nets is forbidden, likewise artificial lights and decoy ducks. Mechanically propelled boats can only be used to pursue birds from October to May.

There are some fifty reserves in Denmark, most of which are of value to wildfowl. They come under the Ministry of Agriculture and are governed by a committee representing the ministry, the game organisations, agricultural interests and Denmarks Naturfredningsforening (Nature Protection Society founded in 1911). Of major importance is the reserve in Ringköbing Fjord on the west coast of Jutland. Comprising the peninsula of Tipperne and the island of Klaegbanken this reserve extends over some two thousand acres. In the autumn Greylag and Pinkfooted Geese spend some time in the reserve, the latter outnumbering the former by two to one, and the grand total being about three thousand birds. Whitefronts occur only in small numbers, their main migration passing to the south. In spring only the Pinkfeet return in any numbers, and these may pile up to a total exceeding that for both species in the autumn. In spring Brent Geese also come in numbers up to a thousand and feed inland. Swans, ducks and waders are present during migration and many breed here. For some years now the position and fates of nests have been noted meticulously and are displayed on large charts in the observatory buildings at the tip of the peninsula. At the time of my visit in October 1957, these quarters had recently been finished and were more than adequate, indeed luxurious, both as regards living accommodation and laboratory work rooms. There is a substantial observation tower adjacent to the buildings, from which a first-class view of the whole area is obtained. The precision with which the geese respected the boundaries of the reserve was particularly obvious from this viewpoint.

The Danes are very keen on restocking programmes for game. Pheasant propagation has in particular been highly successful and has changed the whole shooting picture in the course of this century, and, incidentally taken some pressure off wildfowl. Propagation of the latter takes place at something like a hundred ' duck-farms ' throughout the country, generally based on small, specially created marshes. The largest, experimental, unit at Kalø maintains 125 ducks and, a pleasing economy, 25 drakes. Eggs are collected and reared under hens, but the last clutches of the season are left with the ducks. It is recognised that the product of these ' duck farms ' replenish local stock (91% were recovered within 10 miles of the release point) but do not increase the migratory population except by reducing shooting pressure on it.

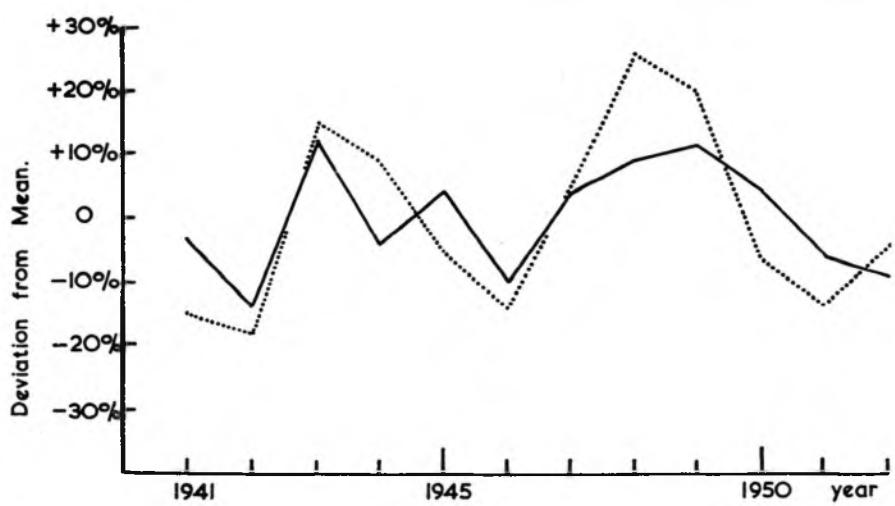
Most of the active habitat improvement measures that we saw were aimed at deer, hares, pheasants and partridges. Little was done for wildfowl. Indeed the nature of the terrain over much of the country precluded such activities even supposing they could be reconciled with the requirements of a very intensive agriculture. However one measure seen deserves to be copied on a wide scale wherever numerous, small lime-pits or marl-pits occur and have filled with water. These were fenced round except on one side where access to the water is left for the benefit of cattle. Cover is planted between the fence and water and these little horse-shoes of vegetation round a pond make ideal breeding places for Mallard as well as other species of birds, especially pheasants. Indeed one that was being demonstrated disgorged a large roe-deer in our faces.

Research

Research on game species is centred on the Game Biology Station at Kalø (founded in 1948), twenty miles north of Aarhus. Here 2,500 acres of woods and arable land is available for experiment, and rearing of Mallard, pheasants and partridges is carried out. The Game Advisor's School is attached and every year four pupils are trained. The scientific staff of four is concerned with many aspects of game research and their work is by no means restricted to wildfowl. The scientists are attached to the Zoological Department of the fine new University of Aarhus and also collaborate with with workers in the Veterinary Serum Laboratory in Copenhagen where research into diseases of game is carried out. Several scientists in the Zoological Museum at Copenhagen are concerned with work on the parasites and food of game species.

Research is largely financed from the Game Fund and expenditure is of the order of £12,500 a year. The National Committee for Nature Protection carries out research on various nature reserves. There is a flourishing Ornithological Society (Dansk Ornithologisk Forening, founded 1906) and much first class work is carried out by amateurs, as in this country, and published in the Dansk Ornithologisk Forenings Tidsskrift. There are two specialist journals for publishing the results of game research. Dansk Vildundersøgelser, containing detailed but popular research reports, has a free circulation of 10,000. Complete scientific reports are published in the occasional Danish Review of Game Biology.

One of the basic problems of conservation is to determine how many head of game are killed by sportsmen each year, how big a harvest is taken of the seasonal crop. For only if the demand be known can it and the supply be matched up, by appropriate measures, to ensure a stable wildfowl population. In this country we have not yet been able to do anything beyond make some 'educated guesses'. In America, where bag-limits are enforced, some progress has been made with sample questionnaires and by direct bag checks. In Denmark the problem was approached with simplicity by requiring



Fluctuations in the annual bag of Hares taken on 22 large estates (broken line) compared with fluctuations in the reported national bag (solid line).

that shooters should fill in a form attached to the shooting licence, stating the exact number of game birds and mammals and 'vermin' that they killed. The apparent naivity of this scheme is rather breathtaking since one feels that the mendacity, conscious or unconscious, that Dr. Kinsey encountered in his studies would be more than matched in accounts of shooting exploits. Moreover the Danish sense of humour is well-known, and is at its best when officialdom is the target. The extraordinary thing is that these game statistics do, taken as a whole, seem to give a realistic picture of the varying toll taken by shooters. The Hare is the most popular game animal in Denmark (rabbits are confined to a small area in the south) and has been the subject of a special investigation. The actual annual bag taken on 22 large estates was known in reliable detail. The fluctuations in this sample (about 1%) bag were plotted as deviations from the average value over a period of years, and compared with the fluctuations of the national bag as shown in the Figure. The two curves are remarkably similar in broad outline and certainly give one more confidence in placing reliance on the national figures. Like Dr. Kinsey we would be well advised not to place much reliance on individual claims. But, given a large enough sample, it does seem that under-estimates and over-estimates tend to cancel out.

The number of birds and animals reported to have been killed has averaged nearly two and a half million *per annum* since the statistics were started in 1941. The main contributions to this total were provided (to the nearest thousand) by the following:

Hares	389,000
Dabbling Ducks ...	350,000
Pheasants	312,000
Partridges	305,000
Crows	198,000
Pigeons	140,000
Magpies	137,000
Diving Ducks	132,000
Gulls	121,000
Rooks	72,000
Snipe	43,000
Curlew	28,000
Waders	28,000
Foxes	23,000
Seabirds	21,000
Woodcock	18,000
Birds of prey	16,000
Roe deer	16,000
Geese	9,000
Polecats	7,000

Smaller numbers of Red-deer, Fallow deer, Sika Deer, Badgers, Pine Martins, Otters, Seals, Black Grouse and Herons are also accounted for each year.

These figures certainly are food for thought, even if they do no more than indicate the approximate level of the toll taken by a hundred thousand sportsmen under European conditions—half a million wildfowl, for instance. In Finland it is strongly felt that the Danes are chiefly responsible for the undoubted diminution in the Finnish Mallard breeding stock (which ringing

studies show as migrating through Denmark). But before stones are thrown it should be remembered that there are three times as many shooters in Britain. True, we do not know whether the proportion of those shooting wildfowl are the same in both countries. This information could be determined, presumably, from the Danish statistics and certainly is much greater than the 5000 members of the Strandjagtforeningen (who would otherwise have to be credited with a bag of a hundred wildfowl apiece). Our own W.A.G.B.I. has not published total membership but it probably represents an even smaller proportion of our 300,000 licensed shooters. So until further information is available the latter figure is as good as any we have for determining relative shooting pressure. The need for better data from our own shooters is paramount and obvious.

The variations in the annual national game bag provide information on the fluctuation in the numbers actually present, although man is not a strictly " density-dependent predator " i.e. he does not necessarily turn from one prey to another when the first becomes scarce. The Danes have also, since 1951, been endeavouring to assess fluctuations and longer-term trends in wildfowl populations by monthly wildfowl counts on the same days as in this country. They have concentrated efforts on three main areas, rather than attempt a network of count points. An analysis of the result to date is expected soon.

As in this country the Mute Swan has increased rapidly in the last few years and in Denmark also there has been pressure brought to put this bird on the shooting list. A full investigation of the bird's population, its food and its relation to other species was made using both direct observation and questionnaire methods. An unusual part of this study was concerned with investigating the damage caused by swans to the bottom vegetation in shallow water. It was concluded that while Mute Swans can interfere with ducks on small restricted sites, in no circumstances can the swans be of importance to the Danish duck population as a whole. It was felt that, with only just over two thousand young swans being produced each year it would be inadvisable to turn 110,000 sportsmen loose on them.

Important work has been carried out on the food of wildfowl, particularly of diving ducks and the fish-eaters, using the technique of stomach analysis. The internal parasites have also been studied in some detail. Both these researches have given valuable leads to the work now being done in this country.

Work is in progress on investigating the habitat requirements of Mallard, with a view to improving available areas and in conjunction with the Mallard rearing schemes. The breeding biology of the Eider has received attention and more recently that of the Greylag Geese breeding in the north of the country. The question of damage done by geese to crops is also being investigated. After some difficulty it has been found possible to round up numbers of Greylags during their flightless period for ringing. Eider Duck have been ringed in hundreds, and the reared Mallard are also ringed. At Amager, near Copenhagen, extensive trapping of shore birds is done and many ingenious variations of the basic cage trap evolved. Very large numbers of waders are trapped, but ducks are less frequently ringed. The trapping area is on an artillery range which complicates operations and unfortunately prevented my visiting the site.

Conclusions

There is no doubt that shooting pressure is high in Denmark, relative to both the area and the human population. Nevertheless, in the absence of duck decoys, the absolute toll taken of wildfowl is of the same order as in the Netherlands. The fact that a much greater number of people are concerned in a way makes more probable a thorough-going conservation in policy and practice. Certainly the complete devotion of licence income to conservation interests is an example to other countries, as is the emphasis now being laid on education and the excellent research work being carried out.

Acknowledgements

The information in the article was gathered during a Congress of the International Union of Game Biologists in Aarhus during October 1957, and in the course of a three day tour of the main centres of conservation interest afterwards. I have leaned very heavily on the information provided by Danish conservationists themselves and I am particularly grateful to Count G. Ahlefeldt Bille, Professor R. Spärck, Dr. H. M. Thamdrup and Dr. K. Paludan. The following publications have relevant information:

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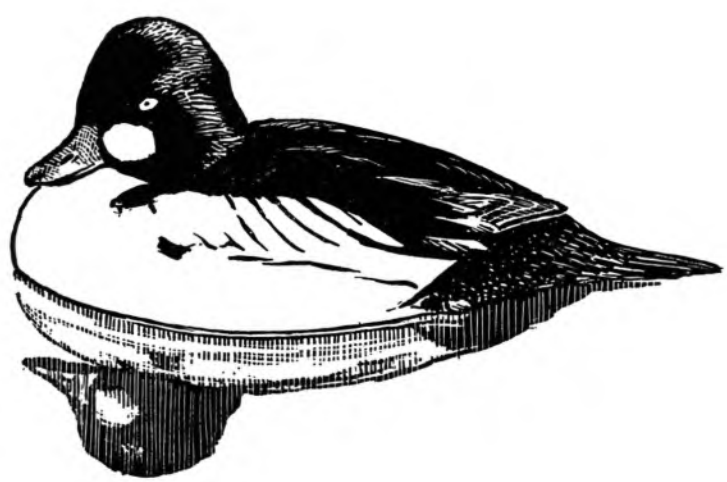

THE CONSERVATION OF WATERBIRDS AND THEIR HABITAT IN NEW ZEALAND

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(This paper originally appeared as Wildlife Publication No. 52 of the Dept. of Internal Affairs. The Trust is indebted to the author and to the Controller of the Wildlife Branch for permission to reprint it).

Author's Foreword

THIS brief account of one of New Zealand's big wildlife problems was prepared in 1957 as a submission to the Soil Conservation and Rivers Control Council by the Department of Internal Affairs. Its purpose was to introduce a subject fraught with vital consequences for waterbirds, particularly waterfowl, and the sport of game shooting in New Zealand.

After being received by the Council, it was suggested that an outline of this conservation problem be prepared as a pamphlet for distribution to a wider audience.

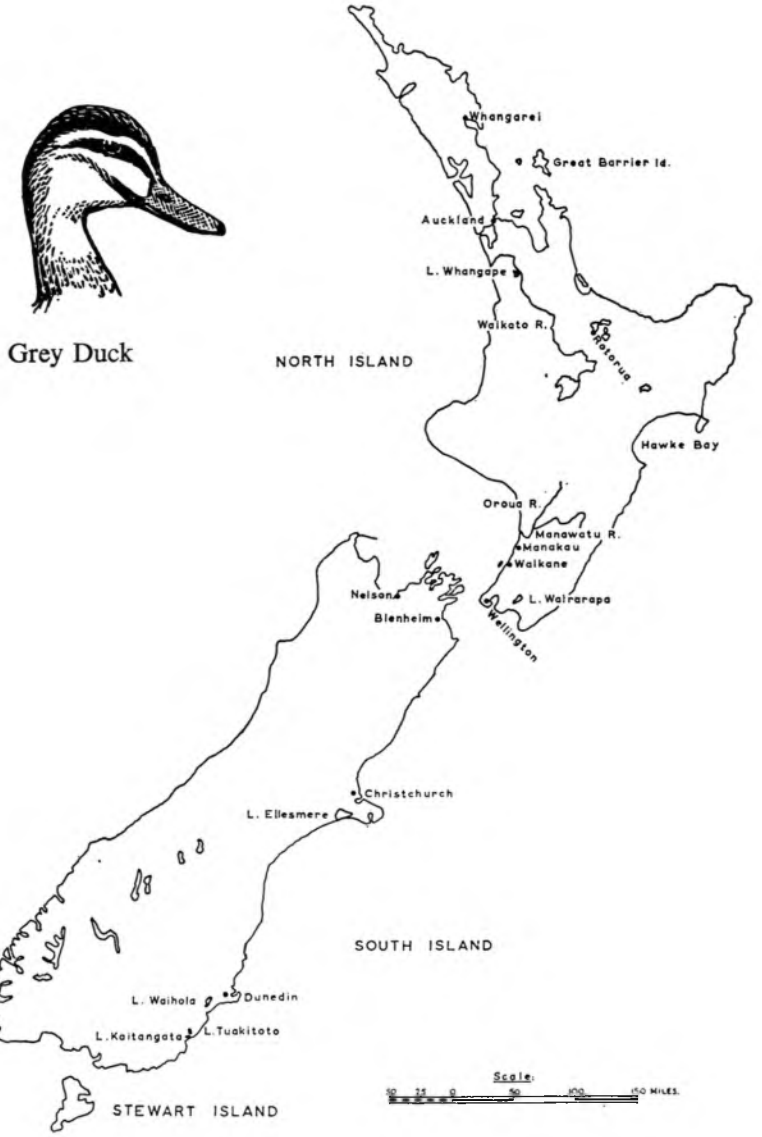
My thanks for helpful discussions are due to the Controller of the Wildlife Branch, Mr. H. D. Kelly, Mr. T. H. F. Nevins of the Soil Conservation and Rivers Control Council, and to my colleague, Mr. K. H. Miers.

Introduction

With the variety of habitats utilised by some species of birds at varying times of the year the term " waterbird " needs to be treated with elasticity. " Waterbird " here is meant to cover those species which are entirely or to a great degree dependent on areas of still fresh water whether large or small, e.g., lakes, lagoons or ponds, or whether there be free water merely interspersed amongst vegetation, e.g., swamps, or whether the ground surface is merely damp or wet.

Commonly, people think of these areas as being the haunt of only a few ducks, but let us exclude the classes of birds known as sea and shore birds, those species known only as stragglers to New Zealand, and those generally regarded as extinct. Having made these deletions in the North and South Islands, the waterbirds found in this particular habitat form nearly one-third of the number of remaining species. They therefore constitute an important segment of the country's avifauna and consist of the following:—

Two grebes, two herons, Royal Spoonbill (*Platalea leucorodia regia*), Bittern (*Botaurus stellaris poiciloptilus*), four shags, Canada Goose (*Branta c. canadensis*), two swans, seven ducks, a rail, two crakes, Pukeko (*Porphyris porphyris melanotus*), two stilts, two fern birds, with the possible addition of the Cape Barren Goose (*Cereopsis novaehollandiae*). One further species, the White-eyed Duck (*Aythya a. australis*), vanished from the fauna, probably through injudicious shooting, before 1900.



From Past to Present Times

Primitive New Zealand was well supplied with this type of habitat and early reports indicate a widespread abundance of waterbirds. As was to be expected, and indeed was inevitable as a necessary step in settlement, swamp drainage was one of the earliest forms of land development. Balham in "Grey and Mallard Ducks in the Manawatu 1952" graphically portrays the ecological changes in this rich farming district. Sixty-thousand acres of swamp in the lower reaches of the Manawatu and Oroua Rivers in 1890 was reduced to one thousand acres of undeveloped swamp by 1949. Commenting

on Grey Duck (*Anas s. superciliosa*), he said that while it had adapted itself to the changed environment it had suffered to an unknown extent through loss of the indigenous vegetation. The district's carrying capacity for waterfowl had been reduced, firstly through loss of water by drainage; secondly through replacement of swamp vegetation by the close green turf typical of stock grazing areas. While much of the original food supply had been destroyed another in the form of grasses, grain and weed seeds had appeared.

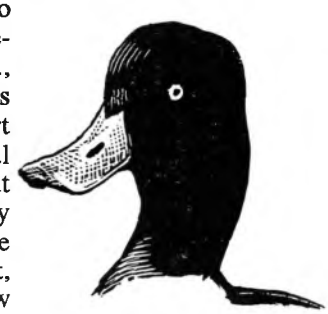
The relative numbers of the duck species present in 1949 was held to be mainly determined by the suitability of each species for the new environment. The formerly common Brown Duck (*Anas aucklandica chlorotis*) had disappeared entirely. The New Zealand Shoveler (*Anas rhynchotis variegata*) never plentiful, remained in small numbers but had not been able to utilise new foods due to its specialised feeding habits. The Grey Duck, undoubtedly affected by change, had survived by reason of some ability to adapt itself to new feeding and nesting conditions. During this development, the Mallard (*Anas p. platyrhynchos*) had been established.

While this relates to the Manawatu area, by and large it depicts a story not uncommon over many parts of the country. It is of course absurd to suggest that swamp drainage should not be undertaken. What is of concern is the preservation, as widely distributed as possible, of limited areas of waterfowl habitat, especially shallow open waters. The heyday of waterfowl has inevitably departed; can we not stop before elimination?

Black Swan (*Cygnus atratus*) and Canada Geese on being introduced found suitable niches in the environment. They have become established where conditions are favourable, the former species in both Islands, and the latter in the South Island. Paradise Duck (*Tadorna variegata*) in the North Island has extended its range, apparently owing to favourable changes in the habitat, e.g., from bush lands to grass lands. Other species of waterbirds similarly show a varying reaction to changed conditions. Some have been able to adapt themselves to the changing environment, while others only persist where the habitat basically has been little altered.

Present Status of Protected and Game Species of Waterfowl

One of the eight species of duck in New Zealand, the Blue or Mountain Duck (*Hymenolaimus malacorhynchos*), was not included in waterbirds as here used because it has always been restricted to fast flowing water. The Brown Duck, once widespread, now survives in a very few areas only, e.g., Great Barrier Island, perhaps half a dozen places in the North Auckland Peninsula, and Stewart Island. The New Zealand Scaup or Black Teal (*Aythya novae-seelandiae*) is more widespread but its range and numbers have both been drastically reduced. It has recently shown signs of increase and spread in a few areas where conditions suit it, e.g., on the habitat provided by some of the new Waikato hydro lakes. The Grey Teal (*Anas gibberifrons gracilis*) never widespread, and always few in numbers still has a very limited distribution. In a few suitable small



New Zealand Scaup

areas there are remnants of primitive swamp, it does show signs of increase. These four species have been absolutely protected for many years, New Zealand Scaup being the last species to receive protection in 1934. The introduced Mute or White Swan (*Cygnus olor*) is also protected.

Apart from Pheasants (*Phasianus colchicus*), quail and Chukar (*Alectrios graeca chukar*), which are absent from large parts of the country, there are seven species left for sportsmen. These are Grey Duck, Mallard, Paradise Duck, Shoveler, Pukeko, Black Swan and Canada Goose. As a contrast to New Zealand conditions the Waterfowl Hunters' Guide issued by the Canadian Wildlife Service lists forty-three species of swan, goose, duck, gallinule, coot and rail. Of these only two swans and one goose are entirely protected. The Pukeko, as with rails in other countries, is not highly prized by sportsmen. Paradise Duck, despite an extension of range in parts of the North Island, is still not generally available to sportsmen. The Shoveler, always restricted in distribution remains so, and only in a few restricted areas does it form any significant portion of the game bag.

Black Swan, in general, are restricted to large shallow water areas, whether fresh or brackish, carrying extensive beds of aquatic plants. For many years they were not utilised greatly but in some districts now they are much more widely utilised than formerly as ducks available become more scarce. Canada Geese, found in large numbers between Otago and North Canterbury, have not been utilised to any extent owing to the difficulty in stalking the birds, with the result that they have had to be regarded as pests. Recently appropriate aids and hunting methods have been imported. These include decoys, the use of goose calls and records on which to train hunters in their use. These introductions indicate that this species, with a greatly increased kill by sportsmen, eventually could become an important game species here as it is in North America.

The two remaining species, the native Grey Duck and the introduced Mallard, have a wide distribution between them and form New Zealand's two main game species. It is upon their survival in worthwhile numbers that the average sportsman depends for his shooting. Broadly speaking, in the eastern part of the South Island from Southland to North Canterbury, the Mallard now predominates over the Grey, as it does in the Wellington and Hawkes Bay districts. Elsewhere, the Grey Duck still provides the bulk of sportsmen's bags.

While it is a moot point as to whether or not it was a wise thing to establish the Mallard, this species is here to stay. Banding records have shown that there is a differential rate of kill between the two species which favours the Mallard's survival. Policy now is to discourage further establishment of the Mallard while research seeks out what is essential for the management of each species. While the Mallard appears to flourish more in improved farming districts than under conditions of primitive vegetation and the Grey Duck the reverse, it is not as easy as this. There are too many cases where this easy distinction does not wholly apply. The Grey Duck and its allied sub-species spread over much of the Pacific largely takes the place there of the Mallard in the Northern Hemisphere. They are closely allied species with similar habits. As far as we know, basic habitat requirements are similar but certainly not identical. At least, they both require shallow water areas for survival.

Decreasing Habitats versus Increasing Sportsmen—a History of Increasing Restrictions and their Limitations

While duck habitat has drastically decreased in extent, numbers of shooters have increased. Decrease in habitat results in an increasing concentration of birds and shooters on remaining areas, thus accentuating kill. This decrease in general habitat is paralleled by similar effects on wildlife refuges. In a review of wildlife refuges under way over the last three years, over half of the areas which have had to be revoked or substantially altered in area are those which have been affected by drainage or land reclamation. Of 116 refuges classified as water areas 16 have been thus affected over the last 25 years.

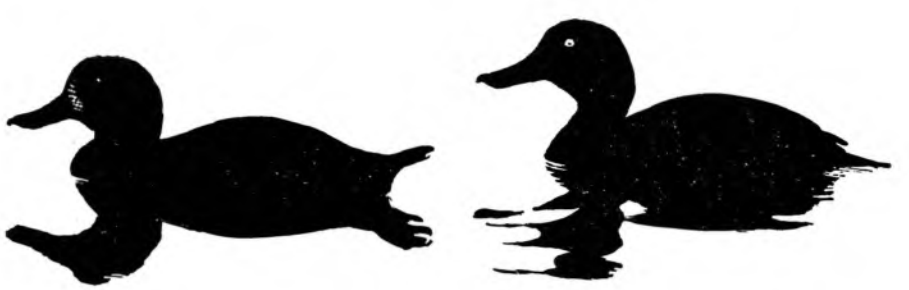
As property owners may shoot without licences we cannot establish the true number of shooters, but those shooting under licence have grown from less than 9,000 in 1932 to 21,000 in 1948, and to just on 25,500 in 1956. To this number must be added the large number of property owners who shoot on their properties without a licence. At present there appear to be some 30,000 game shooters in the country.

The rise in the number of licences follows the general increase in population but such matters as the long weekend, more availability of motor cars, better road access and a more general prosperity of the community all play their part. In common with other countries, having the ills as well as the benefits of Western technical civilization, shooting provides some relaxation from the ties and stresses of that civilization and its material progress. We can, therefore, expect an increase in demand on a decreasing resource seriously threatened by a still further lessened area of habitat already greatly reduced in extent.

This problem of an increasing number of sportsmen against a background of shrinking habitat and decreasing numbers of birds, has in New Zealand, as in America, been tackled first of all on a basis of restriction. Restrictions applying in New Zealand for the 1932 open game season contrasted with those pertaining in 1956 are illuminating:—

	1932	1956
Bag Limits Grey or Shoveler	5 } 25	5-10
Mallard	6 }	6-15
Length of Season	60-90 days	16-31 days
No. of decoys allowed	15-25	0-10

Limits vary in different districts.



In 1932 shooting on the water was permitted, feeding allowed, and the restriction of two shots only per automatic gun was easily evaded.

In 1956 shooting on the water was prohibited, feeding was not allowed, except by a Minister's special consent in six out of twenty-seven districts, and the restriction to two shots per automatic gun more easily enforced.

These restrictions are the ones in which there has been marked change. Other restrictions in general remained the same. Research work (commenced in 1948) has, from the return of bands, indicated that there is some widespread movement of Grey Duck. This has supported the decision of a New Zealand wide bag limit of ten as a maximum for Grey and Shoveler. An analysis of the banding carried out over seven years, which is now in progress, shows a big kill of Grey Duck, almost the largest proportional kill known anywhere in the world where this kind of research has been carried out. Owing to the difficulty when shooting of distinguishing between Mallard and Grey, and the development of hybrids between the two species, a bigger differential bag limit between Grey and Mallard, which might be considered as a further conservation measure, may not be fully effective. The analysis also indicates such a large proportion of the season's kill being taken on the opening weekend that any further decrease in the length of the shooting season is unlikely to be of any great value.

The restrictions generally have served conservation purposes, although not entirely. Indeed, it could be held that prohibition of shooting on the water may have a reverse effect owing to an increase in wounded birds which are not recovered for the bag as compared with birds killed on the water and recovered. One manner in which the loss may be reduced is by the use of a gun dog to retrieve downed birds. Desirable as this is, restrictions imposed to date are so drastic that many shooters naturally hesitate to keep a gun dog forty-eight weeks of the year for work during four weeks.

Enforcement of Restrictions will always be Difficult

At present restrictions are reasonably enforced in some districts with laxity in others. In these latter districts there are rumours of over-the-limit bags being common on the opening weekend. Efforts are steadily being made to bring about an improvement in law enforcement, both as regards stipendiary and honorary officers, but enforcement of the law can never be anywhere near 100 per cent effective. At present, there are only approximately thirty stipendary officers available to cover the whole country. Even envisaging an increase in this number the total likely to be able to be employed from existing sources of revenue will still not make 100 per cent law enforcement possible. It is doubtful if any further restrictions would be more effective without a much greater increase in facilities for enforcement, which is unlikely.

Other Efforts at Management

Besides restrictions, other devices in the past have been considered in an effort to preserve a head of waterfowl for sport. These include the attempted control of predators, such as stoats and hawks; the breeding of Mallard and their liberation, and the introduction of new species. In brief, each of these devices comes up against the limitations of habitat. Provided

habitat is in good heart predators are held to be unlikely to adversely affect the stocks. If it is not, such control is likely to be both costly and ineffective. The further breeding and liberation of Mallard is being discouraged. It is considered inadvisable where they are not already established because it tends to replace a Grey population with a Mallard population, the habitat remaining the same, and as being unnecessary where Mallard are already established. The introduction of further new species is held to be unwise, owing to possible effects on existing species, especially as a habitat by its limitations will control duck carrying capacity.

The Modern Approach to Management

Modern ideas of game management, as evolved in North America, point to the habitat as the key factor on which waterbird numbers depend, and envisage, as far as game species are concerned, the taking of a yearly maximum crop. Research work in New Zealand has provided some information on which to base game management and continuation of banding is planned. Other aspects will be opened up as work proceeds, but it will be many years before we know the detailed habitat requirements of our game ducks, let alone other waterbirds, dependent as these requirements are on the life histories of the various species, their food and other habits. In the meantime results of work done overseas, especially in North America, can be utilized by trial and experimentation under New Zealand conditions. We can also utilise in suitable cases the end result of New Zealand experience where results have been successful, although we may not be able to isolate the individual factors responsible for that success. As with soil conservation, a new approach, a new class of work is now evolving—game management by management of habitat.

A professional Game Management Officer (Mr. K. H. Miers) has recently been appointed to the staff of the Wildlife Branch. He will be given the assistance of two other professional officers as the work develops. Important aspects of their work will include advisory services on the construction of artificial duck waters and the regeneration of old waters gone out of use through the natural succession of vegetation, including here such aids as swamp blasting and manipulation of water levels. Liaison with technical officers in other government departments and organisations will be equally important, especially with those organisations having responsibilities for development and utilisation of land, vegetation and water resources.

Further Action Taken

In addition to the above activities, the Wildlife Branch has made a pilot survey and inventory of wet lands in the Marlborough, Nelson, West Coast and Westland Acclimatisation districts; this is still proceeding in the Southern Lakes and Rotorua Acclimatisation districts. A biologist (Dr. R. W. Balham) was assisted in a four year's post graduate course in wildlife managament in America, and has since returned to New Zealand. Representations some years ago were made by the Minister of Internal Affairs to the Minister of Works requesting consideration for wildlife interests when planning drainage projects. Although the reply given was favourable, we have had no evidence in any case of this having been done.

The dangers of the Grey-Mallard differential kill have been pointed out to acclimatisation societies, and a recommendation made to discourage liberations of Mallards in fresh areas. An article has been published, " Farm Ponds to Increase Wild Ducks," in the June, 1957, issue of " The New Zealand Journal of Agriculture." The North Canterbury Acclimatisation Society recently issued a pamphlet entitled " Grey Duck Rehabilitation " which stresses the habitat needs of this species for distribution to farmers and others. To assist in the preservation of protected waterbirds a booklet on the identification of this class of bird is in production, while a further booklet on techniques of making artificial duck waters is expected to be published within twelve months. Resulting from suggestions made by officers of the Wildlife Branch, a preliminary trial of swamp blasting has been carried out.

Under the Town and Country Planning Act, all local authorities have to prepare planning schemes for their areas. Advantage has been taken of notifications sent out by the district officers of the Ministry of Works, regarding the various planning schemes. By this means, local bodies are being informed as to the value of shallow water areas, the need to preserve them and for reference to be made in their plans to this end. In addition, more specific attention is being drawn to the need for preservation of wildlife refuges and closed game areas of this type.

Negotiations have commenced with the Lands and Survey Department for the control and development of a swamp reserve on the shores of Lake Ellesmere; also, for another area at Tuamarina, near Blenheim. In the latter case, the Catchment Board has been informed of the Department's interests in the area. Enquiries have been made from the Lands and Survey Department, both direct, and through the Minister of Internal Affairs, regarding the Lake Ellesmere reclamation scheme, to enable a submission on behalf of wildlife conservation interests to be put forward. Representations were made to the Soil Conservation Council and the Manawatu Catchment Board relative to the proposed drainage of a useful lagoon at Waikanae.

Not Only For Sportsmen

Shallow water areas provide sport for some 30,000 sportsmen, while members of specialised organisations such as the Ornithological Society, the Forest and Bird Protection Society and scientific organisations find recreation, special interest and study value in such areas. The membership of these groups runs into several thousands. For example, the Ornithological Society alone has 750 members. Apart from these people with a special interest, there is the citizen who finds pleasure in seeing such birds about, or enjoys recreation in places enlivened by their presence. It was not for nothing that Crosbie Morrison's wildlife broadcasts continued for such a very long time. There is widespread public interest in such matters, even if it is not very vocal, active or well informed. Judging from more highly developed countries overseas, as the population grows and habitat shrinks, remaining areas will become yet more highly prized and interest quickened.

Limitations to the Value of Existing Water Areas and Reserves

While New Zealand has numerous lakes, many of these are in the mountains, and especially with the ones which fill glaciated troughs, they

provide very restricted areas of shallow water. It is fertile, shallow water that supports high populations of waterbirds, especially the bulk of the waterfowl. Frequently where lakes have been specially protected by reservation, it is the main body of water only which has been reserved. The wet lands adjoining, which are valuable for feeding and nesting, have been allowed to deteriorate or have been actively destroyed. Many lakes, by reason of the nature of the soil beneath, or of the lands adjoining, or for other reasons, are not fertile waters. To this class belong many of the lakes and lagoons of the Waikato area where waterfowl usage of acid waters may vary from no use at all to moderate use only. Such relatively unfertile lakes serve some purpose, perhaps for flocking, refuge and shooting purposes, but are of little avail for food and nesting. These areas contrast strikingly with the use by perhaps 30,000 head of waterfowl of the fertile Lake Whangape of that district.

While we have many scenic reserves, forest reserves and national parks, there has been little conscious effort to preserve reasonable areas of wet lands. As in the days when forest covered much of the country and it was considered a useless hindrance to the use of the soil beneath, so, too, today there is a similar attitude to wet lands and shallow waters in the low country. The few limited areas being used for flax plantations are perhaps an exception. While this attitude still remains, it is a fact that in many districts such areas have now almost entirely vanished. This type of area is in effect a natural resource, a part of our national heritage, which should be conserved to, at least, some small degree, not just subjected to unlimited exploitation until the stage is reached when there is nothing left to exploit.

The Effects of All Out Drainage

Is it wise to drain all wet areas in a district, together with shallow lagoons and ponds? The value of the community of these areas has been mentioned. There are surely also farming values in times of drought, and rarely in any year is there some part of New Zealand which is not adversely affected by summer dryness. One has only to visit a property on which there is a good duck water, whether natural or artificial, to realise the big part it plays in the lives of the occupier and his family. Is it going to be a good thing to have a richly pastured countryside literally drained of much of the natural interest which helps to make life in the country more satisfying than life in the city; one of the big sporting, recreational and aesthetic assets eliminated? Again, drainage does not always result in good pastoral farmlands. Admittedly, slow moving drainage canals on the sites of drained lagoons or swamps provide free water of value to two or three species of ducks, if some aquatic and marginal growth of vegetation is permitted, but the overall effect on waterbirds is drastic.

Artificial Pond Making Is Not Enough

At the time when local interests are often urging drainage of shallow water areas and wet lands and this is being accelerated by the dragline programmes of catchment boards, the Department of Internal Affairs and acclimatisation societies are about to commence a programme for the making of artificial waters and the rejuvenation of old swamps. Already, apart from some individual farmers, at least four acclimatisation societies have expended

or are expending sums of money from their limited funds, derived from licence revenues, in either building or encouraging the building of artificial waters. In addition, the North Island and South Island Councils of Acclimatisation Societies have been able to build up funds from licence holders to subsidise this class of work. While this is all to the good, it is still necessary for this to be backed by some provision for the preservation of a reasonable number of limited areas of fertile, shallow waters and wet land. Otherwise, this work will be largely of no avail.

The artificial waters planned want to be something better than normal stock ponds, and need to have gently shelving banks and provide the greatest amount of shallow water under three feet. As far as maximum value to waterfowl is concerned, this sets them apart to some extent from fish ponds which actually require deeper water. So, too, with farm water storage ponds aiming at depths of five feet or more, or those being built to take the crest off flash floods. Nevertheless, in the former two classes some suitable modification should be possible in favour of waterfowl without unduly detracting from the efficiency of the main objective.

A Suggested Modification of Policy

The remnants of a natural resource, a part of the country's heritage, is rapidly being liquidated with no thought as to its wildlife value in its many facets, as compared with the economic values of the land beneath the water and its possible production in pounds of butterfat and wool. There is need for some modification of existing policy if something worthwhile is to be preserved for future generations. It is, therefore, suggested that the Soil Conservation and Rivers Control Council should declare that reasonably fertile shallow waters and wet lands generally have some wildlife values. These values are apart from the land beneath and lie in preserving a large section of the country avifauna, which provides sport, recreational, educational, scientific and aesthetic interest to many thousands of the country's population.

In the preparation and approval of schemes for the drainage or reclamation of such areas, full and careful consideration should be given to those values, as well as to the economic value of the resultant land beneath. Again such areas should not be destroyed except for very good reasons. If, after full enquiry, a scheme has to proceed, every endeavour should be made in conjunction with the Wildlife Branch to retain small areas in water or as wet lands so that a district is not denuded entirely of its shallow water and wet land assets.

Conclusion

Such instances as the lagoon at Waikanae already mentioned, proposals affecting Lake Wairarapa and adjacent lagoons, Lake Ellesmere, Waihola and Waipori; the recent almost complete drainage of Lakes Tuakitoto and Kaitangata; the formation of the Waikato Valley Authority and the proposed formation of a North Auckland Catchment Board all stress the feeling of urgency which has impelled the preparation of this statement. Acclimatisation societies are ill equipped with resources or staff to act in a liaison capacity with drainage and development authorities. This is one of the main reasons for the setting up of a specialised section of the Wildlife Branch to assist in bridging this gap.

From the viewpoint of wildlife conservation, it is highly desirable that suitable arrangements be developed whereby government departments and catchment boards, in the early planning stages of development schemes affecting shallow waters or wet lands, consult with the Wildlife Branch of the Department of Internal Affairs on behalf of wildlife conservation interests. The Department of Internal Affairs welcomes any suggestions aimed at setting up suitable liaison on a practical and effective basis between the Wildlife Branch and the Soil Conservation and Rivers Control Council, departments engaged on land and power development, and catchment and land drainage boards, in order to give a satisfactory degree of protection to the wildlife interests for which the Wildlife Branch is responsible under the Wildlife Act, 1953.

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New Zealand Scaup

ESTABLISHING CANADA GEESE IN WEST KENT AND THEIR USE OF NESTING RAFTS

Dr. James M. Harrison and Dr. Jeffrey G. Harrison

In June 1956 the first 19 Canada Geese were collected from the Wildfowl Trust and placed on two industrial ballast waters, one of 10 acres, the other of 40 acres, about a mile apart in the Darenth valley near Sevenoaks. Both waters are wildfowl reserves controlled by the Kent Wildfowlers' Association through the kindness of their owners, Mr. Basil Jones of the Sevenoaks Brickworks and Mr. George Wallis of the Kent Sand and Ballast Company. All the geese settled down at once and of the 12 placed on the larger water, four which were half-grown goslings were cared for by the adults, which appeared to make excellent foster-parents. Nine were feather pinioned to prevent wandering and by the end of the winter only one bird had left, although by early February a few were flying between the two waters and one pair moved to a third ballast water just to the west near Chipstead.

One of the disadvantages of these particular ballast waters is their complete lack of islands and the two companies concerned very kindly each constructed and presented us with a raft composed of railway sleepers, lashed together with wire and floating on tanks. These were then covered with soil and vegetation and anchored well out. Each measured 14 x 8 feet and was extremely substantial, but the cost worked out at about £12 each.

In view of this it was fortunate that a pair quickly adopted and defended each raft, on which courtship took place. A clutch of 5 eggs had been laid on the Kent Sand and Ballast raft by May 1st but the other pair never laid. The pair on the Chipstead water had completed a clutch of 5 a few days earlier on the bank among spike-grass. Two of these eggs proved infertile, a third was knocked into the water by the goose and two hatched, but both goslings died a fortnight later after walking into a small patch of melted tar.

The gander of the pair on the raft was in close attention for four days prior to hatching. All five young were successfully reared and the parents from strategic positions fore and aft were able to defend their young from the attentions of Carrion Crows, which wrought havoc among Mallard ducklings on the same water.

In June 1957, a further 24 adults were obtained from the Wildfowl Trust and were put onto the Kent Sand and Ballast Water. Like most of those released in 1956 these geese had been caught in Derbyshire. They were rather slow to mix with the original birds and even now in August 1958, the two groups still occasionally separate out. The parents and five goslings kept completely away from the newcomers until the young were almost full-grown. One of these was eventually killed by a Fox on Christmas Eve, our only casualty of the year.

By mid-February some of the birds became restless and a party of five were often to be seen circling over Sevenoaks, their circuit taking them low over the hospital, where they acted as a fine tonic to a seriously ill gamekeeper. These five eventually disappeared. Four new rafts were constructed, this time of wood an inch thick, in an attempt to cut cost. Each was 5 foot 6 inches

square and floated on four oil drums. They were covered with soil and vegetation and weighed down with rocks to a suitable height and placed on the Kent Sand and Ballast Water. Two in sheltered water proved satisfactory, but the others in more exposed water were unable to withstand the waves and had to be lashed into one. Courtship and pair formation was well under way by the end of February and last year's successful pair were back on their raft by March 2nd, but the onset of a cold spell a week later stopped all this activity.

By mid-April both of last year's pairs were nesting in the same places; a third was on one of the small rafts at the Kent Sand and Ballast Water with a fourth on the bank about 100 yards away. The same pair returned to the railway sleeper raft on the Brickworks and nested, while single pairs which we had placed on the Chipstead water and on Bradbourne ponds brought the total of nesting pairs in the district to seven.

On the Kent Sand and Ballast Water we now had four rafts anchored roughly in two pairs about a quarter of a mile apart, but the distance between each raft of a pair was only about 30 yards. This proved to be too close and the geese occupying one raft of each pair drove others from the unoccupied ones. These were moved to about 80 yards apart in mid-April and one raft was quickly adopted and defended in its new position, but no eggs were laid. Two other pairs separated out from the main flock without laying. It would seem that a nesting colony of Canada Geese commences at the perifery of the nesting terrain and fills up nesting sites centrally.

Of the seven nesting pairs, the following table shows the breeding successes:—

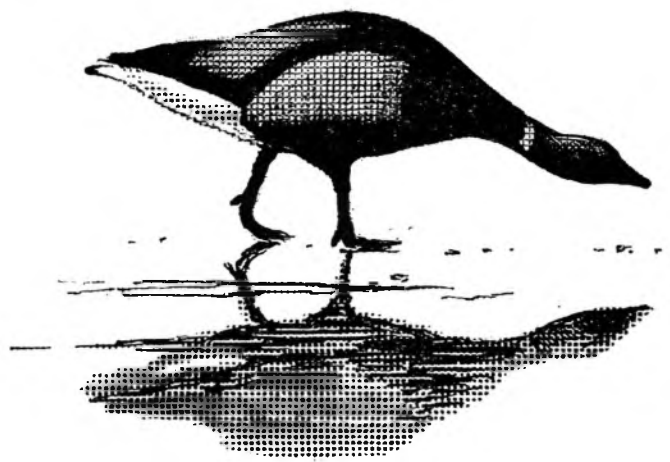
Place	Clutch	Hatch	Maturity
Kent Sand and Ballast	c.7 (Raft)	7	7
	c.5 (Raft)	5	5
	c.5	0 (Robbed)	0
Chipstead ..	c.6	4 (1 late hatch)	3
	c.5	3	3
Brickworks ..	c.5 (Raft)	4	4
Bradbourne Lakes	c.5	0 (infertile)	0

It is gratifying that of all the goslings which hatched, only the late one was lost, owing to the fact that the parents had already left the nest with their three young. The raft nesting families frequently returned to their rafts at night for several weeks after hatching.

In July one of the non-breeding females was found dead, the cause for which could not be demonstrated. This together with the five which flew off in the spring means that our local flock has increased by 16 this year. Those on Bradbourne Lakes were seen to kill several young Mallard, which they pecked at in an inquisitive manner when they were swimming close together in a confined pool. No such trouble has occurred on the larger ballast waters. Food appears to consist almost entirely of grass at present, of which there is an abundance in the low-lying fields surrounding the waters and so far no flighting has taken place.

This summer the Kent Sand and Ballast Water was visited by Mr. Cooley, the President of the Colorado Sand and Gravel Producers, from Denver, Colorado. Mr. Wallis reports that he was far more interested in his native geese than in the equipment he had come to see and used up some 50 colour photographs on them! He returned to America enthusiastic about industrial ballast waters being used as wildfowl reserves.

This concludes our account of an experiment which has shown how the Wildfowl Trust, wildfowlers and industrialists can all combine together. We believe that industrial ballast waters can play a big part in the British wildfowl scene and the enthusiasm shown by all the workers on those in west Kent has been most encouraging. We look forward now to watching these Canada Geese as they establish their new traditions and hope to continue our experiments with other suitable species of wildfowl.



BRENT GEESE IN ESSEX, 1957—1958

P. J. K. Burton

IN the 9th Annual Report (pp.175-179), an account was given of work on the proportion of first-winter birds in flocks of Brent Geese in Essex. Similar observations have been made during the winter of 1957-58, and these are dealt with below.

Results

The method of estimation, using the numbers of first-winter birds in samples of 50, has been continued. A greater number of samples than in previous years have been obtained, and these came from several localities as follows:

Foulness	22 samples
Stansgate (S. Blackwater)	5 samples
Osea I. (N. Blackwater)	4 samples
Holbrook Bay, Suffolk (Stour estuary) ...	2 samples
Dengie	1 sample
Total	34

The counts cover the period 9 November 1957 to 15 March 1958. The mean number of first-winter birds per sample of 50 for 1957-58 was 26.32, with a standard deviation of 5.53, and standard error of the mean 0.95. There were no significant differences between the counts for different areas, or on different dates.

These figures indicate a proportion of first-winter birds in the population of about 53%. A few brood sizes only were counted, and do not give a significant figure for the winter.

Discussion

The results of the counts for the winters 1954-55 to 1957-58 are set out in Table I.

TABLE I

Season	Total count	Number of 1st winter birds	Mean Number	S.D.	S.E. of mean	Number of samples
1954–55	776	314 (40%)	—	—	—	—
1955–56	2020	522 (26%)	13.26	6.40	1.19	29
1956–57	1484	97 (7%)	3.52	3.90	0.78	25
1957–58	1810	955 (53%)	26.32	5.53	0.95	34

It will be seen that the proportion of first-winter birds in 1957-58 is the highest yet recorded. This figure differs significantly from those in the two preceding winters, but may represent a similar state of affairs to that in 1954-55, when the method of estimation by samples was not yet in use.

Two principal reasons for this high percentage may be advanced. In the first place, the summer of 1957 was undoubtedly a good breeding year for the Brent wintering in Essex. In support of this, the wildfowl counts for the county reach a maximum total of 5070 Brent on 19 January, 1955.

Secondly, the year preceding (1956) was a very bad one for Brent, as shown both by wildfowl counts, and counts of first-winter birds. This would have the effect in 1957-58 of reducing the proportion of sexually immature birds in adult plumage, with a corresponding increase in proportion of first year birds.

The high proportion (40%) in 1954-55, when the wildfowl count reached a maximum of 6089 on January 23rd must also indicate a good breeding year in the preceding summer (1954). Again, though, it may have been partly due to a poor season two years before (1953). This possibility is suggested by low wildfowl count totals in the winter of 1953-54, and by three small adult/first winter counts (not mentioned in the previous Report), which total 192, with 28 first-winter birds (14.6%).

The general picture so far then is tending to suggest that there has been a slight increase in numbers over the last 5 years. This is probably at least in part due to protection. However, present information does not seem to justify resumption of shooting for some years yet.

RECENT RESEARCH ON BRENT GEESE

Hugh Boyd

FOR many years the status of the Brent Goose (*Branta bernicla* (*L.*)) has caused concern because of a marked decline in numbers in most parts of its range. Strenuous efforts by bird protection organizations in most countries of north-western Europe intended to obtain or increase legal protection for the species have achieved some success and have been accompanied by detailed investigations into the present and past distribution of the bird. The first part of this review consists of an abstract of a lengthy report on the status of Brent in Europe by Dr. Finn Salomonsen, published late in 1958.

Alarming changes in numbers have occurred in the American populations of Brent too. They have provoked vigorous investigations and the second part of this review deals with a major paper on the Pacific coast population by Henry A. Hansen and Urban C. Nelson. The final section is an attempt to synthesise results from the two papers already mentioned and from work by P. J. K. Burton and Russell Marris, in order to assess the prospects in Europe during the next few years and to suggest lines for research.

I. The Present Status of the Brent Goose (Branta bernicla (L.) in Western Europe.

This report, by Dr. Finn Salomonsen of the Zoological Museum, Copenhagen, was published in *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening*, vol. 120, pp. 43-80, in November 1958 and has been issued as a separate reprint as Publication No. 4 of the International Wildfowl Research Bureau[1]. It summarises investigations made since 1954 by collaborators in many countries working with the International Committee for Bird Preservation through the agency of the I.W.R.B. The evidence for Great Britain was in the form of: a) a historical survey of the literature concerning abundance and distribution from the early 19th century to 1953 by G. L. Atkinson-Willes; b) results of the Wildfowl Counts scheme since 1948; c) results of aerial surveys of south-east England in 1955, 1957, and 1958. Other British evidence was supplied by P. J. K. Burton (detailed counts on the east coast, including age class ratios), Dr. D. S. Ranwell, of the Nature Conservancy (studies of *Zostera* distribution and the effects of grazing by Brent Geese), and Russell Marris.

The abstract which follows here is somewhat selective, reporting most fully those findings of particular interest to British readers, but tries to present only the facts used by Dr. Salomonsen and the inferences and opinions he bases on them. The status of the Brent in Britain was the subject of heated arguments prior to the passage of the 1954 Bird Protection Act, and it would be foolish to reanimate those sterile historical disputes by quibbling about the interpretation of some data of merely subsidiary interest.

The Brent Goose is a circumpolar breeding bird restricted to the Arctic zone in summer and wintering in coastal waters of the temperate regions of Europe, Asia and America. The species is divided into three (or possibly four) sub-species. The Light-bellied[2] Brent (*B. bernicla hrota* (O.F. Müll.)) is a

[1]Obtainable from the headquarters of the Bureau, c/o British Museum (Natural History), Cromwell Road, London S.W.7, price three shillings.

[2]Dr. Salomonsen uses the English forms " Pale-breasted " and " Dark-breasted," but in this paper " Light-bellied " and " Dark-bellied " are substituted, in accordance with Trust practice.

high-arctic form breeding in the Arctic Archipelago of Canada, Ellesmere Island, North Greenland and east to Spitzbergen and Franz Josef Land. It is replaced by the Dark-bellied Brent (*B. b. bernicla* (L.)) in north Russia and west Siberia to the Taimyr peninsula. Further east the Brent becomes darker, reaching an extreme in the Bering Strait population, the Black Brent (or Black Brant in American usage), *B.b.nigricans* Lawrence. *Nigricans* and *hrota* overlap in western Canada, the two forms breeding side by side over an etxensive area, without mixing. Brents wintering in Europe come from three widely-separated breeding populations: 1) light-bellied from Canada and Greenland, 2) light-bellied from Spitzbergen and Franz Josef Land, and 3) the whole dark-bellied population.

Dr. Salomonsen finds that Ireland is the only important European wintering-place of Brent from Canada and Greenland. On passage these geese may stay for some time in West or S.E. Greenland or S. Iceland, some arriving in Ireland in the middle of September but the majority in October. During the winter there is a partial shift from localities in the west to others in the east of Ireland, with a very few birds moving on to the Hebrides, the Firth of Clyde and the coasts of Wales. This population stays in Ireland till the latter part of April, or sometimes May, and visits Iceland and S.E. Greenland on the northward migration, the breeding places not being re-occupied until the first half of June.

Light-bellied Brent from Spitzbergen and Franz Josef Land migrate south in September, to Denmark. Some may rest off the south of Norway but most do not stay long, and very few winter, though in icy winters numbers in Norwegian waters may be increased by an influx from Denmark. Most of this population remains in Denmark, mainly in the north, at least until January-February. In hard weather some may then move to the east coast of Britain, especially Northumberland. Some indication of the mid-winter movements has been obtained from recoveries of geese ringed in Spitzbergen in 1954 (see Goodhart, Webbe and Wright, *Wildfowl Trust Seventh Annual Report,* pp. 17-176 (1955)), as well as from observations. These visitors to Britain usually leave again before the middle of March, returning to Denmark, where the population remains until late May. Formerly Light-bellied Brent were plentiful in eastern Scotland and Salomonsen supposes that these were 'European' rather than from Greenland. At present Brent are few and transitory in Scotland.

Professor S. M. Uspenskij has provided a valuable statement on the present breeding range of the Dark-bellied Brent: "It breeds and moults particularly in the north-eastern part of West Taimyr and in smaller numbers on Kolguiev Island, North Yamal above 70°N. lat., (but is missing from Belij Island), in the north-easternmost part of the Gydan Peninsula, in the southern part of Severnaya Zemlya and on some small islands in the Kara Sea. In Novaya Zemlya only moulting, not breeding birds, occur, according to the most recent investigations. Likewise, on the Kanin and Kola Peninsulas only moulting birds are found. The total population of this subspecies amounts to at least 10,000 birds, according to various censuses carried out in recent years during spring migration on the Kanin Peninsula. This subspecies is replaced by the Black Brent from eastern Taimyr (from about Lake Taimyr) eastwards. All Black Brents migrate to the East and do not visit Europe."

The Dark-bellied Brent leave their breeding grounds in September and migrate along the North Russian coast, cross overland from the White Sea to the Finnish Bay, and move by way of S.W. Sweden to southern Denmark. Though the ranges of pale and dark birds overlap in Denmark there is no considerable mixing. Some dark-bellied birds remain in Denmark but the bulk cross Jutland to the Wadden-See and then move west along the coasts of Germany, Holland and Belgium to S.E. England and France. The visitors to England begin to arrive in quantity in mid-November. Their numbers increase in December and sometimes again in January or even February. Some dark-bellied birds move slowly northward, meeting light-bellied birds. A few have been shot on the north-west coasts of England, implying that flocks sometimes fly overland. The greater part of the British population has gone by mid-April, the dark-bellied birds moving to Holland, Germany and Denmark, where they stay until the end of May.

Dr. Salomonsen draws attention to several important features of the migratory movements of Brent in Europe: 1) the birds are constantly on the move, even in February, when they have reached their final destination, searching for new feeding places; 2) their movements are strongly dependent on the weather, in cold winters their more easterly quarters (Denmark, Germany and Holland) being largely deserted in favour of England and France; 3) the three populations " wintering in European waters occur in distant areas, as if trying to avoid each other. Having identical food requirements they strongly compete for the available resources, and the spatial segregation in the winter grounds is an important factor in avoiding competition."

He emphasises that the midwinter shifts make it difficult to estimate the size of the wintering population and continues " It is necessary, therefore, to limit the counts strictly to the severe winter months (January, February) and, if possible to use average values for a number of consecutive years." With these working assumptions he proceeds to assemble, in the course of seven pages, estimates of the midwinter population which are summed up in Table I (Salomonsen's Table III, for the Dark-bellied form, together with his figures for the two Light-bellied groups).

" In order not to be accused of painting the situation too black, I have everywhere tried to estimate the decrease conservatively and used the maximum figures." " Paying attention to all sources of error we suggest that the European wintering population of Dark-bellied Brent is **not** lower than 15,000 and certainly not higher than 16,500."

Perhaps the most controversial of Dr. Salomonsen's inferences is that at the end of the nineteenth century, the total population of Brent wintering in Europe must have been 350,000 birds, about 216,000 of them Dark-bellied. These figures were arrived at by supposing that the decreases recorded from localities that have been reported on in some detail during the last eighty years are representative of the whole range. His data further suggest that the decline has continued over a long period, so that by the early 1930's the numbers were only about half of what they had been fifty years earlier, and that " since about 1935, the decline has accelerated alarmingly."

Enquiring into the probable causes of the decrease Dr. Salomonsen considers six factors that might be supposed to militate against the Brent:

TABLE I

Present wintering populations of Brent Geese in Europe, **in January/February,** according to data assembled by Salomonsen.

	Dark-bellied (from Siberia)	Pale-bellied (from America and N. Greenland)	Pale-bellied (from Spitzbergen & Franz Josef Land)
Denmark	1700	—	1300
Germany	2200	—	—
Holland	1500	—	—
France	3700	—	—
England	7400	—	2700
Scotland	—	(200)	—
Ireland	—	6000	—
Total	16,500	6000	4000

disturbance of breeding haunts, land reclamation in wintering places, industrialization, the effects of aircraft, over-shooting, and a widespread disappearance of eel-grass (one of the Brent's food plants). The latter is probably not, though the others certainly are, due to man.

Disturbance of the breeding haunts, though it may have had serious local effects in Spitzbergen, is thought not to be a primary cause of the decrease. The Light-bellied birds wintering in Ireland breed in countries almost wholly uninhabited by man, yet this population has decreased with the others; and in other areas disturbance has tended to diminish.

Land reclamation has certainly deprived Brent of some feeding places in Denmark, Germany and Holland, but probably not in France and England (where reclamation was largely accomplished prior to the decrease).

Though industrialization may have caused Brent to leave some areas (e.g. Teesmouth) and bombing ranges and low flying aircraft have apparently made others untenable, Salomonsen notes that there is little positive proof of their ill effects and does not attribute to them a major share of the damage.

It was until recently usual to maintain that the drastic alterations in the distribution and abundance of eel-grass (*Zostera marina*) which occurred in the early 1930's, and from which its recovery is far from complete, were of great importance to Brent. But studies of the feeding habits of the geese made in several countries have shown that they can do without this food and Salomonsen concludes that " the disappearance of the eel-grass did effect the life of the Brent, but has not essentially contributed to its decrease apart from the first years following the disappearance, in which period the number of Brents drastically declined in many places."

On the role of shooting Salomonsen says: " During my work with the Brent problem I could not avoid the impression that shooting in the winter quarters was one of the principle causes of destruction. Many instances could

be cited of species which, being easy victims for hunters, have been completely wiped out, such as the Labrador Duck and the Eskimo Curlew. The Brent might have had the same fate, but has been saved until now, because of its extensive breeding range and its extreme mobility in winter. Shooting pressure became too heavy as early as in the middle of the 19th century, when the decline commenced. All North European nations contributed to the development, but the greatest number of Brents were shot in the British Isles."

Salomonsen makes a number of suggestions concerning protective measures. He notes that attempts to oppose development plans of great economic importance will be fruitless, but that fights against the erection of military establishments may not always be futile, citing the recent success of the I.C.B.P. in securing the abandonment of the R.A.F. bombing range on the Knechtsand in N.W. Germany, the moulting place of most European Shelducks. He continues " Establishment of bird sanctuaries and reserves in suitable places along coasts will render good service for the preservation of the Brent. Most European countries possess a number of such coastal preserves which have strongly contributed to assure the present existence of the Brent in our continent. What really matters, however, is more extensive protection against shooting. This has restored the stock of other large and highly vulnerable wildfowl, like swans and the Shelduck, and in the case of the Brent protective measures form the most urgent demand. It must be required as a minimum that in all countries shooting ceases at 1 January, giving the Brent a chance for survival in the hardest winter and offering it a necessary resting period without disturbance before the final spring migration. It would be only a half measure, however, and would require a very long period before the species was restored. Full protection, therefore, is needed, and should be granted for at least 10 years in all countries in which the Brent spends parts of the year. A more prolonged period than 10 years would, naturally, be better, but for political reasons would be difficult to accomplish. It is also a question of international justice; some nations ought not to reap the fruits which are the results of sacrifices made by other nations."

TABLE II

Close Time for Brent in those European countries frequented by considerable numbers of the species. (Abridged from Salomonsen's Table IV).

Country	Close Time
Belgium	All year round (since 1956)
Denmark	1 January-31 July (for ten years, since 1954)
Iceland	1 November-19 August
Eire	1 March-11 August
Finland	1 March-19 August
France	31 March-14 July
W. Germany	1 April-31 July
Great Britain	All year round (since 1954)
Northern Ireland ..	All year round (since 1954; for 3-year periods)
Holland	All year round (since 1950)
Norway	1 March-31 August, and 24-31 December
Spitzbergen	All year round (since 1955)
Sweden	All year round (since 1957)
U.S.S.R.	Varying, open season in autumn only

Table II adapted from one provided by Salomonsen shows the present extent of legislative protection afforded to the Brent in those countries which harbour considerable numbers in winter, or on migration. It shows that though considerable increases in protection have been achieved in recent years, loopholes remain in four important countries—Denmark, West Germany, France and Eire. " In both Denmark and Germany proposals for full protection have been submitted to the Government recently, but as yet without result."

Dr. Salomonsen has dealt admirably with a mass of data, full of gaps and inconsistencies, to produce a clear and plausible account of the status and movements of Brent in Europe. He is convinced that continued pressure towards increasing protection on the winter quarters is the best way to " check the decline and let the population grow to a reasonable height." This raises two important questions: Would further restrictions on shooting bring about the necessary change? And what is a " reasonable height "? If firm answers, fully supported by incontestable evidence, to these questions were available, much controversy could be avoided. They are not. But a good deal of relevant evidence, not considered by Dr. Salomonsen, does now exist and will be assembled at the end of this review.

II. **Brant of the Bering Sea—Migration and Mortality,** by Henry A. Hansen and Urban C. Nelson, of U.S. Fish and Wildlife Service, Juneau, Alaska

Transactions of the Twenty-second North American Wildlife Conference, pp. 237-256 (1957).

Since the Pacific coast population of the Black Brant has been affected by massive changes in numbers in much the same way as the Brent of Europe, the U.S. Fish and Wildlife Service has devoted considerable effort to nesting studies in Alaska and to inventories of the population in its winter quarters. This research programme has continued since 1949 and the paper by Hansen and Nelson is the first report on its progress to be made generally available, except for a preliminary account of nesting-ground studies by Spencer, Nelson and Elkins in 1951 (America's greatest Goose-Brant nesting area, *Trans. 16th N.A. Wildlife Conference,* pp. 290-295).

Breeding studies. The nesting area studied comprises a strip of about 800 square miles along the coast from Igiak Bay to the south of Nelson Island (between the deltas of the Yukon and Kuskokwim Rivers, from about 62°N, 166°W to 60°N, 163°W). Here Brant nesting densities reach as high as 144 nests per square mile in parts of the zone three to five miles from the coast. A study by S. T. Olson in 1951 showed that nesting commenced in the last week in May and the peak of the hatch occurred from 25 June to 7 July. 97 (79%) of 123 nests studied hatched successfully. The average clutch size, in 116 nests, was 3.5 eggs. In 1951 average brood size decreased from 3.8 (sic.) during 17-24 June to 3.2 young during 2-11 July. In 1954 the average size of 34 Class I (recently hatched) broods was only 2.26 young, that of 159 Class II (half-grown) broods 2.01, and of 31 Class III (newly-fledged) broods 1.71. Individual brood identity is often obscured by the mixing and grouping of broods.

Migration. Between 1949 and 1954 3,440 adult and 5,364 ' local ' (gosling) Brant were ringed in the study area. Recoveries of these birds, numbering 767 (10.2%) up to the time the data were assembled in 1956, have provided

a great deal of information on migratory movements, and also on mortality. On migration the Brant move south to Bristol Bay and the tip of the Alaska Peninsula in the latter part of August and early September. There they stay until about 1 October, when they fly off to the southeast across the open ocean. " The mass arrival and exodus is sometimes great enough to permit radar tracking of the flock." " Where this flight later makes landfall on the coast is not known, but it is probable that it stays well off the coast at least as far south as Puget Sound. Possibly most of the flocks do not stop on land until they arrive in California." (Puget Sound, in north-west Washington, near the Canadian border, is at least 1700 miles from the Alaska Peninsula, and Humboldt Bay, the most northerly of the Californian wintering places, at least 1950 miles). Some Brant follow the coastline of Alaska and British Columbia but they are only a small minority, perhaps the birds which regularly winter off Vancouver Island and in Puget Sound. James Moffitt pointed out nearly twenty years ago that the earliest arrivals move right on through to the southern wintering grounds in Baja California (Mexico), the winter residents of California not arriving until 10-20 November, a month later.

The spring migration is much more leisurely and there are few ring recoveries to chart its course, but there is no mass arrival in Alaska, so that " it is unlikely that a major flight proceeds north across the open ocean, and more probable that the Brant follow closer to the shoreline in smaller flocks."

There is strong evidence from recoveries that geese in adult plumage are shot more often in the north of the winter range than would be expected from the numbers wintering there. This seems to result from pre-breeders performing shorter migrations than members of families. (Dr. Arthur S. Einarsen, Leader of the Oregon Co-operative Wildlife Research Unit, who is at present conducting an intensive study of Black Brant, has collected additional evidence of differential migration, which he hopes to publish soon).

A more puzzling example of differential movements is provided by 28 recoveries from the north coast of Alaska and the MacKenzie Delta (North West Territory of Canada), most in June or July, because " at least nine of the 28 were taken during full maturity while wandering far north of their natal grounds." Such movements are common amongst pre-breeders of various species, but that they should be indulged in by sexually mature geese raises important questions about " non-breeding."

Population size. A part of the Brant investigations of especial interest for comparison with work on the European population is the annual winter inventory, carried out in January. " Of the waterfowl wintering in the Pacific Flyway, many technicians consider that the Black Brant is the easiest species for which complete and reasonably accurate winter inventories can be made by aerial count because of its social behaviour and reaction to low flying aircraft." Since 1951, counts have been made for the entire wintering grounds, excepting the Aleutian Islands (almost certainly of little importance as a wintering place). Complete counts are not available for Baja California, nor for British Columbia before 1951, but British Columbia normally winters relatively few Brant. The annual January inventories have produced the following totals: 168,000 in 1951; 167,000 in 1952; 155,000 in 1953; 132,000 in 1954; 135,000 in 1955; and 110,000 in 1956. (Figures from Table 3 of

Hansen and Nelson, rounded to nearest thousand, and omitting totals for 1949 and 1950 which included estimates, rather than counts, for Baja California). It is important to note that according to the 1957 Status Report for Waterfowl (U.S. Fish and Wildlife Service Special Scientific Report—Wildlife No. 37) the decline of the Black Brant population was abruptly reversed, raising the population to the order of 140,000 in January 1957 (reviewer's calculation from index figures).

Hansen and Nelson also refer to the Black Brant censuses in California organised by James Moffitt in the years 1932 to 1942. These censuses (nearly complete for the state, but probably including only 20 to 40% of the total Pacific coast population) showed wide variations, from a low of 13,800 in 1933 to a peak of 125,150 in 1935, with an eleven-year average of 57,400. The authors remark that " It does not appear likely that the low count in 1933 was due to a major part of the normal California population wintering beyond the boundaries of the state . . . " because in their view the numbers in California and Baja California move synchronously. They suggest " Rather, in light of the recent production study on the Yukon-Kuskokwin Delta, it would seem that the entire annual production for one or more years had been wiped out." It is interesting to note, however, that the 11-year high in Moffitt's California censuses followed by only two years the drastic low of 1933, indicating the potential revival of the species on one or two good production years."

The Fish and Wildlife Service has also made winter inventories of the Atlantic coast population of the Pale-bellied Brent. Hansen and Nelson illustrate the results obtained from 1950 to 1956: in January 1950 about 78,000; in 1951, 110,000; in 1952, 104,000; in 1953, 150,000; in 1954 235,000; in 1955, 180,000 and in 1956 168,000. Thus during most of the time that the Black Brent was decreasing rapidly the Atlantic coast Brent was increasing even more rapidly.

Mortality. The analysis of mortality and kill by man presented by Hansen and Nelson is cautious and provisional, since they are well aware of the many difficulties in interpreting recovery data. For this reason only a brief report of their principal findings, without a discussion of such topics as regional distribution of kill, need be given here. Using the Bellrose and Chase method for calculating total mortality they arrive at a first-year mortality rate of Brant marked as goslings of 45.4% with an average mortality in later years of about 32%. From two different approaches it appears that mortality due to shooting, including allowances for crippling losses, is about 27%, or more than four-fifths of the total losses. Because of the method of calculation used, the calculated total mortality is almost certainly too high, but the general conclusions drawn from the pattern of recoveries are worth quoting. " It is apparent from the rate of band (i.e. ring) returns that brant hunting in 1954 was relatively poor throughout the flyway. It is equally evident that hunting during 1955 was proportionately better with a holdover of banded, unharvested Brant from the previous year . . . The important implication . . . is that adult Brant (yearlings and older) may not be subject to as great a natural mortality as most of the other waterfowl species. A more likely possibility is that mortality from hunting is so great in the Black Brant that there is little or no margin left for natural mortality, and those Brant which survived the 1954 hunting season were not subjected to as severe

environmental pressures during the ensuing year as birds in an under-harvested population. Thus, they survived in proportionately greater numbers."

Management Implications and Needs. " Is the steady decline in the Black Brant population since 1949, as deduced from the winter inventory, a result of over-shooting, a gradual deterioration of habitat, or merely normal population dynamics which have occurred coincidental to the period of study?" Hansen and Nelson firmly reject the latter. " The last of the three possibilities seems to be quite remote from the evidence at hand. Observed population changes in both American (i.e. Light-bellied) and Black Brant in the past have been more abrupt and of greater annual magnitude. There is no recorded historical basis for such consistent, though moderate, attrition to a flyway population of brant." The reviewer accepts these statements, but does not see in them any reason for excluding the possibility that the recently observed changes could be due to " normal population dynamics." The earlier records, notably Moffitt's Californian census, dealt with segments of the population, instead of the whole, and given the existence of wide variations in annual breeding success and the occurrence of differential migration, such as have been demonstrated, it seems very probable that numbers in part of the winter range should show changes " more abrupt and of greater annual magnitude " than are apparent in the total population.

Hansen and Nelson can find no evidence of a gradual deterioration of habitat. There were signs of an eel-grass shortage in three Californian wintering places in 1950-51 and 1951-52 but no report that it adversely affected the Brant population. They are thus driven to seek an explanation in over-shooting, but their evidence is incomplete and unconvincing. Indeed, they concede as much: " Nevertheless, logic is sometimes subservient to expediency when data are insufficient, and in the case of Black Brant, comparisons with other studies are necessary."

So the problem remains unsolved. But this paper remains important, first, because it presents much new information and, second, because its authors are able to point to weaknesses in existing research and to suggest how these may be overcome, by additional ringing, by the collection of age-ratio data, and by better measurements of losses due to shooting.

III. The prospects for the Dark-bellied Brent

Salomonsen puts the numbers of this population in January at " not lower than 15,000 and certainly not higher than 16,500." This is a misleading way of summarising the data available to him, since it suggests a census of high precision, whereas the national totals he uses are " average values for a number of consecutive years " of estimates differing considerably in reliability, so that counting errors alone must produce greater variability than the quoted figures allow. An even more important reason for modifying Salomonsen's conclusion is the likelihood of important differences between one year and another in the numbers of Brent alive in January.

The midwinter population is determined by the size of the breeding population in the preceding summer, the number of young geese reared, and the losses inflicted on both adults and young between August and January. None of these quantities is known, but there are strong reasons for supposing that they all vary considerably from year to year. Bruton (see pp. 91-92 of

this Report) has shown that the proportion of first-winter geese in the Essex flocks in midwinter was 40%, 26%, 7% and 53% in successive winters from 1954-55 to 1957-58. If these proportions are in any way representative of the population as a whole (and there is increasing evidence from counts abroad that this is so) then the total numbers must have altered considerably from winter to winter, unless losses of adults have exactly offset the changes in production. Burton has not been able to detect significant differences in the first-winter/adult ratio during the course of any winter (November-March), implying that shooting losses amongst the geese after their arrival in Essex are slight—as is to be hoped, since the species is legally protected there—but their losses in Denmark in autumn are considerable. Kill figures for years after 1954, when spring shooting ceased to be legal in Denmark, have not yet been published, but earlier totals for the fiscal years 1941-1951 showed that the claimed kill in Denmark in those years varied between 2,500 (in 1951) and 7,000 (in 1943). Recent evidence from recoveries of Spitzbergen-ringed Brent shows a striking concentration of reported losses in the months September-December, 25 of a total of 27 having been in those four months and in Denmark. While reported losses are not wholly representative of all losses, since geese dying from natural causes are unlikely to be reported and only some of the rings from shot geese were notified, it does seem likely that the bulk of casualties suffered by European Brent Geese after they have fledged occur nowadays in the autumn and early winter.

The observed changes in the annual survival of young geese up to their arrival in Britain seem to be due mainly to differences in the numbers of successful parents, since from counts of broods the average number reared by a successful pair shows little variation. This implies either that the numbers of sexually mature geese change considerably, or that varying proportions of mature geese fail to breed or to raise young, or that all these possibilities occur together. The Black Brant research has shown it to be probable that, in some years at least, a substantial fraction of the mature geese do not raise young, as seems also to be true of Arctic-breeding grey geese.

Large differences in the numbers of young geese reared in different years must subsequently result in changes in the size of the breeding population as successive year-classes become sexually mature. The age at which maturity is reached is of great importance in determining the reproductive potential of a population. Unfortunately it is very difficult to determine in the field, since the ideal procedure requires the identification or collection of birds of known age while they are actually nesting. It seems likely, from the behaviour of the Brent in captivity at Slimbridge, and by analogy with other Arctic geese, that most Dark-bellied Brent will be mature at 34 months. It is quite certain that they are immature in the year after hatching, and unlikely that many are mature at 22 months.

If the population at the start of the breeding season includes two year-classes which are immature, two conclusions must follow: first, the breeding population is much smaller than the total surviving population and, second, the proportion of immature pre-breeders depends on the numbers of young geese reared in the two previous summers. The reviewer has calculated that, if the Dark-bellied Brent numbered 16,000 in late May in each of the years 1956 to 1958, the proportion of mature geese would have been about 44%

in 1956 and 1958 and 69% in 1957[1]. Using more realistic models, with a total population varying between 11,600 in 1957 and 22,600 in 1958 as extremes, the potential breeding population was found to be in the range of 4,200-5,300 breeding pairs. If it must be assumed that in some years one-third or more of this potential breeding population will fail to rear young, the reproductive capacity of the Dark-bellied Brent appears to be very much smaller than might be expected. Yet the example of the Light-bellied Brent of the American Atlantic coast has shown that in favourable circumstances the species is capable of increasing at a very rapid rate (by 125% in two years).

It seems to be characteristic of natural populations of birds that they fluctuate within comparatively narrow limits, due to compensatory interactions between the forces affecting reproduction and mortality. For the continued existence of a population it is essential that net fertility should not fall below mortality for any long time. The implication of Salomonsen's historical survey is that during the last eighty years mortality has exceeded recruitment, and his argument appears to be that the most practical aim for conservationists is to try to reduce adult mortality, and mortality of young geese between fledging and sexual maturity, by reducing "shooting pressure," so that net fertility may come to exceed mortality and the population increase in consequence.

This course of action appears sensible. Yet, since it has encountered, and will continue to encounter, strong opposition from some shooting interests, and since it could prove wholly ineffective, it is highly desirable that it should be accompanied by research, to find out not only what changes in numbers and age-structure occur during the next ten years or so but also whether alteration in losses due to shooting have any marked effect on the total annual losses or on productivity. It is by no means certain that the kill by man and losses from other causes are related in any simple way.

Studies of the breeding population must be left to Russian ornithologists, since the Taimyr National Okrug is apparently closed to foreigners ('The Times,' 10 November 1958). From the correspondence Dr. Salomonsen has had, it is clear that the Russians are interested in the welfare of the Brent, and ornithologists in western Europe must attempt to sustain that interest by carrying out intensive investigations during the autumn, winter and spring.

In such inquiries Denmark must play the key role. Censuses in autumn and spring, when the Dark-bellied Brent is for considerable periods largely concentrated in Danish waters, could provide direct measures of population size and, if they can be made precise enough, of losses during the winter. Midwinter surveys, such as have been made in England, are less useful and seemingly more difficult to make complete, since they require simultaneous searches in at least five countries. Censuses of the English population without comparative material from elsewhere may prove more dangerous than helpful since, like the Black Brant censuses in California in the 1930s, they cannot be assumed to reflect changes in the total population, because of differences from year to year in the dates and rate of immigration and emigration. However they should be carried on since it may be possible to combine them

[1]These and subsequent calculations are not worth giving in full, since in the absence of adequate data they must be merely illustrative, but they include allowances for varying mortality based on analogies with Black Brant and Light-bellied Brent survival, as well as using Burton's age-ratio data.

with age-ratio information and occasional data from overseas into a passable substitute for autumn and spring censuses should the latter prove impossible to achieve. Age-ratios and brood-size checks in Britain must certainly be made each year.

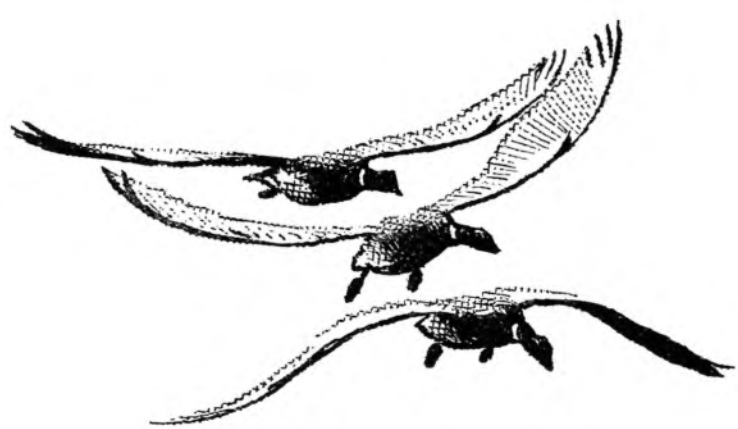
The collection of kill statistics in Denmark is apparently being continued. Estimation of the kill in other countries, which may not be negligible even where full protection is ostensibly afforded, presents great difficulties, but should be explored. Wildfowlers' organisations are probably more likely to succeed in this task than people suspected of ' protectionist ' leanings.

In Britain there is need for further investigation of the distribution and numbers of the Pale-bellied as well as the Dark-bellied Brent, especially in areas where both forms occur. The recent work of Dr. D. S. Ranwell and his assistants has clarified the question of what Brent eat, where and when, so that it may be possible to assess with comparatively little further effort whether food in Britain is important as a limiting resource.

Any ringing of any Brent, whether in this country or elsewhere within the range of the European-wintering groups, must be helpful at this stage.

For the welfare of Brent populations it is essential to consider the various groups as complete units and to act " conservatively " at least until it is clear that the populations have reached levels as high as can be maintained in the face of persistent natural hazards*. It is possible that the existing populations are already near the upper limit set by to-day's environment, but it seems worthwhile to assume that this is not so. There have been some signs of increase in the numbers of Brent in England since 1954. These have already led to agitation for the removal of protection in some of the localities where increase has been most marked (notably in the north of Norfolk). If shooting were to be allowed wherever local flocks show signs of flourishing, the chances of a substantial improvement in numbers of the whole population would be sadly reduced, It is important to do everything possible to set parochial and insular claims in their proper, continental, context.

*From age-ratio counts (Burton *in litt*) it is now apparent that 1958 was a very bad breeding year. 1956 was nearly as bad and probably 1953 too, so that it is necessary to assume that only one summer in two will add substantially to the future breeding stock.



WHAT MAKES PLUMAGE WATERPROOF?

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(*This paper is a translation by the author of his original paper "Vad gör fåglarnas kroppsbeklädnad vattenavvisande" which appeared in* Zoologisk Revy 18: 71-83. 1956).

WHEN a biological system is disturbed, this often gives a clue to the normal functioning of that system. This is the case with the ability of the plumage of birds to repel water. Under certain circumstances this vital ability is easily lost in birds kept in captivity. This is particularly true in the case of diving species, and the downy young are more sensitive in this respect than adult birds. Such disturbances, which make the downy plumage wet and lead to death with symptoms resembling pneumonia, cause severe losses in the rearing of poultry and waterfowl. In the Berlin Zoo Heinroth (1924) observed that such disturbances were rare in ducklings which had been hatched under their mother and were conducted by her, while they very commonly occurred in ducklings hatched in incubators or under hens. He assumed that the reason for this was that the ducklings hatched under their natural mother got preen gland secretion from contact with her feathers.

It has been a common belief that the plumage of birds is water-repellent because the feathers are anointed with the secretion from the oil gland. A comprehensive survey of the literature in this field has been given by Elder (1954). When I observed that some changes in the diet caused a loss of the waterproofing of the plumage of young Tufted Ducks, I supposed that these diet changes in some way interfered with the functioning of the oil gland (Fabricius 1945). The disturbances easily occurred when the ducklings were fed on fish, but disappeared if they were fed on insects. The oil gland, preen gland or uropygial gland is the only skin gland in the birds, and it is known that the skin glands of mammals are dependent for their proper functioning on some vitamins of the B-group.

Absolute or relative lack of some vitamins causes severe disturbances when the animals are given food containing the enzyme thiaminase, which is particularly abundant in raw fish (Suomalainen and Pihlgren 1955). One must therefore be very careful in using raw fish as food for furred animals, such as foxes and minks.

It would thus not be unimaginable that a diet consisting exclusively of raw fish would cause disturbances in the functioning of the oil gland. But if so, one wonders why several species of diving birds, such as the mergansers, are capable of living exclusively on fish, and why the young mergansers particularly easily lose the waterproofing of their plumage if they are fed on fish in captivity. The food of the ducklings of these species is, however, different from that of the adults, and one could imagine that the young birds would be more dependent on certain vitamins.

In the summers 1945 and 1946 I had an opportunity of making some observations and experiments on these problems in ducklings which were reared for behaviour studies. In all 66 Tufted Ducks (*Aythya fuligula*), 10 Eiders (*Somateria mollissima*) and 5 Shovelers (*Anas clypeata*) were reared for these purposes. The ducklings were hatched in an incubator, and the

rearing technique has been described in a paper dealing with experiments on the following response and imprinting (Fabricius 1951).

The newly hatched ducklings were taken from the incubator and allowed to swim as soon as they looked dry, i.e. when their downy feathers had thrown off their horny sheaths. Their plumage was always waterproof at this first swimming test, and this overthrows the theory that the plumage of newly hatched ducklings is repellent to water because they get preen gland secretion from contact with the feathers of their mother.

In the beginning of my experiments I was mainly interested in the influence of the diet. To get an idea of the composition of the natural food of the ducklings in the archipelago off Hangö, where the studies were made, I had to shoot some ducklings of the Eider, the Velvet Scoter (*Melanitta fusca*), the Goosander (*Mergus merganser*) and the Tufted Duck, in all 15 specimens. It turned out that the young Goosanders had eaten mainly small crustaceans of the species *Neomysis vulgaris,* but also some adults of aquatic insects such as *Trichoptera.*

The young Goosanders thus showed a preference for free-swimming prey. The young Tufted Ducks and Scoters had, on the contrary, mainly been feeding on molluses of the genera *Theodoxus, Bythinia* and *Lymnea* which are abundant in the Fucus-vegetation of the shallow coastal waters in the Baltic Sea, and in addition they had consumed some adult midges of the genus *Chironomus.* The food of the young Tufted Ducks also contained much vegetable matter, mainly seeds of water plants of the genus *Potamogeton.* The young Eiders had eaten the aquatic snails mentioned above, but the bulk of their food consisted of three species of crustaceans which are abundant in the Fucus-vegetation, i.e. *Idotea baltica, viridis* and *granulosa.* The perference of the Eider for hard and comparatively large food objects thus appeared early. The food of the young Eiders had this composition up to an age of two weeks. In Eider ducklings three or four weeks old the bulk of the food consisted of mussels of the genus *Mytilus.*

The experimental birds were fed on fish (bleaks, herring), small crustaceans (*Neomysis, Praunus*) and grasshoppers (*Corthippus, Stauroderus, Mecostethus*) all in raw condition. In addition they were given dry oat flakes. At every feeding they were allowed to eat until they were quite satisfied, and it proved necessary to feed them at least 6 times daily, with intervals of 2-3 hours. To obtain the weight of the food consumed each bird was weighed immediately after every feed. Their daily consumption was considerable. It was 115% of their own body weight on a diet of crustaceans, 85% on fish, 38% on insects and 75% on oat flakes. The differences probably express mainly the differences in the specific weight of these substances, since the birds always fed until the crop was full, an almost constant volume. It should be noted that the birds always soaked the oat flakes in water before they swallowed them.

In addition to weighing at feeding, some observations were also made on the growth of the young. It turned out that the young Tufted Ducks, which newly hatched had a weight of about 38 grams, regularly lost weight during their first five days of life, and that the loss, about 5 grams, approximately equalled the weight of the internal yolk sack, about 5.4 grams, which remained in the body cavity at hatching. At an age of five or six days the yolk sack was completely absorbed, and it was not until then that the weight of the young

began to increase. The weight increase was largest during sunny days, and during overcast and cold days it was small. At this early stage, before the insulating adult plumage is developed, the metabolic balance of the young seems to be very labile. In cold weather all the food seems to be needed for maintaining the body temperature, so that nothing is left for growth. It should be mentioned that no suitable artificial brooders were available for my birds.

The crustaceans of the genus *Neomysis* turned out to be the most favoured food. Young Eiders which for some days had been fed on these crustaceans became strongly conditioned to this kind of food. When they were offered a mixture of animals from the Fucus-fauna on a plate, they quickly selected and swallowed all the *Neomysis,* rejecting the crutaceans of the genus *Idotea* as well as the molluscs though these two groups of animals constitute the main food of Eider ducklings of this age in nature. The birds were fed on land. The fish was crushed, and the *Neomysis* were obtainable in such a quantity that they formed a ' porridge ' on the food plate.

At first the experiments confirmed my earlier observations. When the birds were fed on fish, the waterproofing of their plumage was very soon lost. But this also happened when they were fed on the *Neomysis,* and the young of the diving ducks turned out to be more sensitive in this respect that those of the dabbling ducks. As in my earlier experiments, the normal condition of the plumage could be restored if the birds were fed exclusively on insects, but this was also the case if they were put on a diet exclusively of dry oat flakes.

In addition, some new observations were made. For controlling the condition of the plumage, a number of swimming tests were made with the birds every day, and the degree of soaking was recorded. As mentioned in an earlier paper (Fabricius 1951, p.98), the birds after each swimming excursion came up on the shore and performed intense preening movements. This preening was continued until the plumage was completely dry, which could take more than an hour in the case of severe soaking.

The preening behaviour contains a number of fixed motor patterns which are repeated again and again. First the bird touches the nipple of the preen gland with the tip of its bill. Then the chin and the sides of the head are rubbed at the nipple, and after this the bird usually wipes the under side of the bill over the crop and the breast, by a pendulating movement from side to side. This is followed, in an irregular order, by a number of other movements. The sides of the head are rubbed over the back, the scapulars and the flanks. The neck and the under side of the head are scratched by the feet, and the bill is inserted into various parts of the plumage, and nibbling movements made. In this nibbling the bird, by cautious chewing movements, lets a small portion of the plumage glide through the bill. Then it performs swallowing movements and shakes the head to get rid of the water which has adhered to the bill, and finally it inserts the bill at a new place in the plumage and repeats the procedure. The largest portion of the time is spent in preening the plumage of the breast and belly in this nibbling manner.

The preening movements seem to be fixed motor patterns, but their orientation is apparently governed by local stimulation of the skin. This was shown by the fact that if the backs of the birds were experimentally soaked by water, the breast and belly being left dry, the birds spent most of their

time preening the back in the nibbling manner. Now and then the preening was interspaced by shaking. The birds shook their body like wet dogs and fluttered their wings. This shaking is also performed immediately after the bird has emerged from the water, as an introduction to the preening behaviour.

In most cases the preening movements considerably improved the ability of the plumage to repel water. Even on a diet of raw crushed fish it was possible to make the plumage of the ducklings almost waterproof by repeatedly allowing them to preen, swim, preen again, and so on, without feeding them between these performances. It is apparent that the secretion of the oil gland is distributed over the plumage by the preening behaviour, particularly by the rubbing and wiping movements of the head and bill. When the feathers were dyed in Sudan III, the droplets of the oil gland secretion could be distinctly seen on microscopic examination, even on feathers from those ducklings which had lost the waterproofing of their plumage. The oil gland is a tubular gland, and each of the numerous tubules consists of an epthelium built up by several layers of cells surrounding a central lumen. In microscopic preparations dyed in Sudan III considerably amounts of secretion could be seen as dark masses in the lumen of the tubules irrespective of whether the plumage of the bird from which the gland had been taken had been waterproof or not.

My observations here differ from those of Madsen (1941, 1943) and Veselovsky (1951), who claim that the oil gland is not functional in newly hatched diving ducks, which swim and dive without wetting their plumage. Madsen was not able to squeeze secretion out of the oil glands of Eider ducklings by manual manipulation, and he could not detect any secretion droplets on feathers of waterbirds by microscopic examination. In my ducklings one could not press out secretion of the gland either, as long as they were living, but immediately after death it was quite easy to squeeze out considerable amounts of the secretion by gentle manual maniplulation. Apparently the powerful sphincter musculature around the external openings of the ducts of the gland makes it impossible to squeeze secretion out of the gland of a living bird, unless one uses such force that the bird is damaged.

As mentioned already the secretion was distinctly visible on microscopic preparations of feathers from ducklings of the species used in my experiments, and one could also watch how it was spread over the plumage by the preening movements. But when feathers from adult ducks were examined, it was found that the secretion was present in such small quantities that it could be seen only with great difficulty. This probably explains the difference between Madsen's and my own observations, since Madsen made his Sudan III tests on feathers from specimens of Black-headed Gulls and Goosanders which were probably adult. Elder (1954) has also confirmed that the oil gland is functional in newly hatched ducklings.

Irrespective of weather the plumage of the ducklings was wettable or water-repellent, their oil glands were thus functioning and the secretion was present in their feathers. This undoubtedly speaks against the theory that changes in the condition of the plumage obtained by altering the experimental diet was due to changes in the functioning of the oil gland. Several authors, for example Paris (1913), have denied that the oil gland has anything to do with the water-repellent quality of the feathers, because this quality has not always been lost when the oil gland has been removed. In such removal

experiments, which have also been made by Kossmann (1871), Hou (1928) and Madsen (1941, 1943) adult birds have generally been used. Thus, one cannot exclude the possibility that secretion from the oil gland might have been present on the feathers at the time of operation, and might have remained there for a considerable period, affecting the condition of the plumage*. Madsen and Elder have, however, found that after completion of the moult the water-repellent quality of the plumage was restored in glandless birds. To be absolutely sure that the ability of the plumage to repel water is not primarily dependent on the secretion of the oil gland, one would have to remove the gland from birds which definitely have no oil gland secretion on their feathers. In newly hatched ducklings the downy feathers are enclosed in totally isolating horny sheaths. Not until about six hours after hatching are these sheaths thrown off and the downy feathers unfolded, making the duckling look dry.

In 14 young Tufted Ducks I removed the oil gland immediately after hatching, the downy feathers still being enclosed in their horny sheaths. The operation was made under ether anaesthetic. The skin was opened by a T-shaped incision and the gland and its nipple was carefully excised. Treatment by alum solution made the loss of blood very small, and the wound was closed by adhesive plaster. In all cases the wound healed quickly, and the operated birds behaved quite normally. It was observed that they performed all the normal preening movements, including touching the bill to the area where the nipple of the oil gland had been situated, and all the rubbing and wiping movements of the head over different parts of the body.

In order to avoid all possibilities of contact with oil gland secretion, the glandless birds were kept isolated in a separate cage, while a control group of unoperated young Tufted Ducks of the same age was kept in another cage. All the birds were allowed to swim as soon as they had thrown off the horny sheaths of their feathers. It turned out that the plumage of the glandless birds was just as waterproof as that of the unoperated ones. All the ducklings swam and dived without wetting their plumage, which indicates that the water-repellent quality of the plumage is not primarily dependent on the oil gland secretion. One could, of course, object that the horny sheaths of the feathers in the newly hatched ducklings might perhaps contain some substance similar to the oil gland secretion, but no droplets of secretion were found on the feathers of the glandless birds on careful microscopic examination.

In a series of experiments no differences between the glandless birds and those of the unoperated group could be found in the following respects:

1. When the birds were fed on raw crushed fish or raw *Neomysis* the water-repellent quality of their plumage was lost if the food was offered on a plate on land.

2. The water-repellent quality could be restored by a change to a diet of insects or dry oat flakes.

3. Even when the birds were fed on raw crushed fish, the water-repellent quality of their plumage persisted if they were never fed on land, but only when swimming in clean water. The pieces of fish had to be thrown in the water one by one allowing the birds to dive for them.

*Elder (op. cit.) removed the oil gland from young Redheads, but he did not test the water-repellent quality of their plumage while they were still in the downy stage.

4. The ability of the plumage to repel water was improved by the preening movements, in spite of the fact that in the glandless birds no secretion could be applied to the feathers by such movements.

5. The ability of the plumage to repel water was always poorest in the morning, at the first swimming test which was made immediately after the birds had been released from the narrow brooder where they had been crowded during the night. It was, however, much improved during the course of the day if they were allowed to preen repeatedly outdoors.

6. When the birds were offered dry oat flakes, they repeatedly took some flakes in the bill and ran to the water, where they soaked them before they were swallowed, returning then to the plate for more flakes. When this occurred on a rock at the edge of the water, a wet track was formed between the water and the food plate. The bellies of the running birds touched the wet rock, and if a swimming test was made immediately after this, it was observed that the birds became wet on the under side.

7. If a bird was rubbed during handling, this could destroy the water-repellent quality of its plumage, so that it became wet to the skin if placed in the water immediately afterwards.

8. The ability of the plumage to repel water was gradually lost if a bird was prevented from preening. This could be done either by force or by leaving the bird alone in a cage. The birds were imprinted to their keeper, and if left alone they continuously searched for him and for their group companions, and this apparently blocked their preening behaviour.

In connection with these experiments, a careful microscopic examination was made of feathers of ducklings in which the plumage was perfectly waterproof, as well as of feathers of ducklings which had lost the water-repellent quality of their plumage. A feather consists of a quill from which the barbs branch out. At the portion closest to the quill, each barb carries numerous fine barbules. These are lacking in the terminal portion of the quills, the barbules are equipped with rows of small hooks which keep the vane together and maintain the barbules at a constant and very small distance from each other. In feathers of downy ducklings these hooks are poorly developed, but the barbules bear small protrusions of an irregular shape, which probably have a similar function.

It was observed that the barbules were disarranged in feathers of ducklings which had lost the water-repellent quality of their plumage. Several barbules would stick together in groups, or cross each other, so that broad gaps formed between them. On the other hand, the barbules were in perfect order and at an even distance from each other in feathers from ducklings in which the plumage was repellent to water. When a duckling in this normal condition emerges from diving, one can only see some narrow wet stripes at the surface of the plumage, formed by the naked bristle-like terminal parts of the quills, but the deeper layers of the plumage, where the barbules occur, are perfectly dry.

According to the previously mentioned papers by Madsen, which were not available to me in Finland during the war, the water-repellent quality of the plumage of birds is due to the presence of air among the finest ramifications of the feathers. The barbules are maintained at constant distances from each other, and the spaces between them, as well as between

the individual feathers, are so narrow that water with a normal surface tension is not able to penetrate them. But as soon as gaps are formed, water penetrates into the feathers, replacing the air and wetting the plumage. Contact with fluids, such as oils, which have a smaller surface tension than water, has the same disastrous consequences. The feathers of water birds are, in contrast to those of most passerine birds, densely and evenly distributed over the skin, and special muscles maintain them tightly together. When these muscles cease to function in a dead bird, gaps are formed between the feathers and water can penetrate the plumage. This explains the experience of duck shooters, that dead ducks soon become wet to the skin if they fall into water. Madsen also assumed that the barbules were maintained in their correct order by the preening movements.

My experiments seem to confirm the results of Madsen. The water-repellent quality of the plumage is lost if the fine barbules of the feathers become disarranged by contact with smearing substances, or by mechanical action. The first condition arises, for instance, when the birds lie in a plate of crushed fish or wet crustaceans when feeding, or when they become smeared by faeces while enclosed in a narrow brooder during the night. Probably a mechanical action is also concerned in these cases, but particularly must this be so when the water-repellent quality of the plumage is lost after manual manipulation, or after the bird has rubbed its under side to a wet rock when running to and fro between the water and the food plate to soak oat flakes. A case described by Elder (1954), where Redhead ducklings became wet when jumping at the edges of a wash tub, might be explained in a similar way.

The waterproof condition of the plumage can be restored by the preening behaviour, and probably the nibbling movements of the bill in particular are effective in bringing the barbules back into their normal positions. It has been assumed by several authors, among others Sick (1937) and Madsen (1941), that electricity produced in the plumage by friction caused by the preening movements may contribute to the maintenance of the correct distances between the barbules.

The reason why the water-repellent quality of the plumage could be restored and maintained by feeding on insects and oat flakes was simply that this kind of food was dry and did not smear the feathers. Even when the birds were fed exclusively on crushed fish, the ability of their plumage to repel water could be maintained, provided that the food was given in such a way that it never got in contact with the feathers, i.e. if they were allowed to dive for the food in clean water. The water-repellent quality is more easily lost in downy young than in adult birds apparently because the feathers of the young in the downy stage are not so stiff and capable of resisting mechanical action as those of older birds, and in addition the hooks are poorly developed in the downy feathers. The consequence of wetting are also most severe at the downy stage, and particularly during the first week of life it very easily causes death, probably because of the labile condition of the metabolic balance at this early age. Downy young at this stage have a very great need for warmth, and apparently they are not capable of maintaining their body temperature for any length of time, for they can only be kept alive if allowed to rest under their mother or in an artificial brooder several times a day.

It is not difficult to understand why diving ducks in captivity lose the water-repellent quality of their plumage more easily than dabbling ducks. The tarsi of diving ducks are shorter than those of dabbling ducks, and the

position and posture of the legs is such that, when moving on land, the diving ducks much more easily touch the ground with the under side of their body. This easily causes disarrangement of the plumage or smearing, particularly at feeding or when the birds are kept under crowded conditions. All these circumstances show that in rearing waterfowl of diving species one should avoid all conditions which could cause smearing of the plumage. Food of a smeary nature should not be given, the birds should only be fed when swimming in clean water, not when moving on land, and crowding in too narrow enclosures or brooders should be avoided. Finally, such birds should not be handled, and particularly not when they are wet, or by wet hands.

Thus, the ability of the plumage of birds to repel water is apparently not primarily dependent on the secretion of the oil gland, but on the delicate structure of the feathers, which is maintained by the preening behaviour. It is evident, however, that the preening behaviour also includes movements which apparently serve to distribute the oil gland secretion over the plumage, and one wonders what the function of this secretion might be. It has been shown by the Chinese physiologist Hou (1928) that the secretion of the oil gland contains ergosterol which changes into vitamin D when subjected to sunlight on the feathers, and that birds obtain this vitamin by the swallowing movements they perform during the nibbling type of preening. Hou also found that birds developed rickets when kept in darkness on a diet free of vitamin D, and that this could be cured by ultraviolet light in normal birds, but not in specimens from which the oil gland had been removed. Because of the thick, insulating plumage, vitamin D cannot be produced in the skin of birds by sun radiation as in many other animals, and therefore nature has apparently relied on the indirect method of letting the provitamin be irradiated at the surface of the plumage and then subsequently be swallowed.

In domestic ducks from which the oil gland had been removed Hou also observed that all droplets of secretion had disappeared from the feathers about one month after the operation. At this time the birds began biting their plumage so frantically that the barbs and barbules were broken and disarranged, which caused a deterioration of the water-repellent quality of the plumage. A similar degeneration of the plumage in birds from which the oil gland had been removed has been observed by Madsen (1941, 1943) and Elder (op. cit.) . I could not keep my operated Tufted ducklings alive long enough to study this phenomenon. All, as well as those of the control group, died when about a week old, after having become wet to the skin during a torrent of rain.

Even if the secretion of the oil gland is not primarily necessary for the plumage to repel water, it apparently indirectly affects this ability in the course of time, by maintaining the feather structure and preventing degenerative changes of the plumage. It seems also possible that the secretion could affect the conditions of surface tension at the areas where the feathers are in contact with the water, in a way which would reinforce the effect of the delicate structure of the feathers. To solve these problems team work would be necessary, involving at least a physiologist, a biochemist specialising in methods of analysing microscopic quantities of organic substances and a physicist specializing in problems of surface tension and capillary action. In addition, a thorough study would be needed of the very complicated structure of the feathers, including careful measurements of the distances between the different structures under various conditions.

Summary

Ducklings of several species lost their water-proofing on a diet consisting of raw-crushed fish, and regained it on a diet of insects.

Even in specimens that had lost their water-proofing there were indications that the gland was functioning.

The oil gland was removed from 14 young Tufted Ducks just after hatching, while their down feathers were still enclosed in their isolating horny sheaths. After the bursting of these sheaths and the full development of the down the plumage was as repellent to water as that of normal control birds, indicating that it is not the secretion of the oil gland which makes the plumage waterproof.

Operated and normal control birds alike lost their water-proofing when subjected to contact with smearing substances. In this condition the barbules of the down feathers were disarranged, sticking together in groups, between which there were irregular spaces. The normal waterproofing was gradually restored if the bird was allowed to preen. Plumage remains water-repellent when the birds feed on insects because insects are dry and clean. Plumage even remains water-repellent on a diet of fish, provided that the pieces of fish are only given to the birds while these are swimming in clean water. In rearing waterfowl, smearing food and crowding should be avoided.

The preening consists of a number of stereotyped movements which are described. The nibbling type of preening movements in particular aid in maintaining the barbules in a state which makes the plumage repellent to water.

These findings confirm the view of Madsen (1941), that the large amount of finely distributed air among the ramifications of the fethers is the principal factor in the water-repellency of plumage.

There is a discussion of a paper by Hou (1928), who showed that the secretion of the oil gland contains ergosterol, which changes into vitamin D when subjected to sunlight on the feathers, and is then swallowed by the birds during preening.

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A GOOSE-WATCHING VISIT TO NORTHERN ICELAND

Robert Gillmor and N. G. Blurton Jones

(Illustrated by Robert Gillmor)

UNDUE optimism is not wise where bird watching is concerned and perhaps we should have been less disappointed had we treated the assurances that Skagafjordur swarmed with Barnacle Geese in autumn with greater caution. However, 3 September 1956 found us in this broad valley, running south from the northern coast of Iceland, eagerly awaiting the migrant Barnacle Geese fleeing the onset of Greenland's winter. The farmer in whose hay barn we camped some 20 miles from the coast, daily told us that the geese would come as they did annually, although eventually he was forced to admit that 1956 was an exceptional year.

We stayed at Silfrastadir in Skagafjordur (about forty miles south west of the second largest town in Iceland, Akureyri) from 3 to 24 September. We covered the surrounding countryside on foot for an area of about 5 miles in each direction. The weather was severe, with some very cold, sleepless nights which made us feel more like sitting down to sleep in what sun and shelter there was, than exploring further afield. The fact that we found no sizeable flocks of Barnacle Geese staying in the valley until 13 September was also discouraging. We dared not move camp lest while we were away the geese suddenly arrived en masse as we believed they would. However, we are most grateful to Jóhann Jóhannesson of Silfrastadir for his almost overwhelming hospitality, which did much to make up for our discomfort and too liberal spare time, and for his advice and information.

During our stay there were always up to 150 of the local Greylags in the area and these were quite interesting to watch when conditions were suitable. They nest in the area, mostly near the river Heradsvötn and, we were told, largely on the more rocky western side of the river. We saw many family

parties, the goslings well able to fly. On 7th we saw an adult with white primaries flying about, looking like a very athletic domestic goose. The bird seemed to be paired with a normal mate and leading two normal goslings. The Greylag flocks seemed to roost on gravel banks in the river and fed on any grazing land in the area though not near the houses. We were told that in spring they were much tamer, even tamer than the Barnacles which come into the hayfields near the farms to feed. We were also told that none were seen further up the valley during the sheep round-up between 13 and 16 September.

We were fortunate in seeing three flocks of Pinkfooted Geese flying up the valley from the north. The first were on 8 September, a flock of about 20 flying south in the morning, and in the early afternoon 29 flying south about 1000 ft. above the valley and away out of sight at hill top level towards the long valley Goddalir. The next day we saw 15 flying south late in the afternoon. On 10th we saw a family party of 6 on the ground near the river. They flew away from us, northwards down the valley and landed with a large flock of Greylags. This must be one of the only records of Pinkfeet in the lowlands of northern Iceland. Jóhann had never seen any here, nor on his sheep-fetching journeys far up the valley, although he knew they had been seen up there.

These birds could only have come from Greenland and were evidently mostly continuing into the interior where they would veer eastwards round the Kerlingarfjöll or Hofsjökull as we had seen flocks doing at the same time of year in 1954. Most likely they would stop in the Pjorsa valley before continuing to Britain.

In the first days of our stay we saw several flocks of Barnacles but they did not stay long, some flying straight over and on into the interior. Those that stopped included no young of the year. On 13th a large flock arrived from the north-west early in the afternoon, coming down from a great height. The flock turned out to be 68 strong and to include several families. They stayed through the 14th but had gone by the 15th. On 16th a flock of 11 appeared and stayed until 22nd. This flock also included some goslings and we were able to watch the behaviour of the families for some time. In 1954 in the interior we had noticed that all but the very latest flocks to arrive had no goslings in them. It looks as if the non-breeding birds leave Greenland earlier than the breeding birds. The total number of Barnacle Geese passing Silfrastadir between 3 and 23 September was about 200, a fraction of the number we had expected and certainly many fewer than the local people expected. There are various ways one could account for these " missing millions." The simplest explanation would be that the main passage was unusually late and came after we had left. The local people said that every year the first Barnacles arrive at the coast on 29 August and are soon seen in large numbers all over the valley. About half way through our stay Johann admitted that the geese were unusually late at Silfrastadir although some had been seen on the coast on 31 August. But he predicted that the north-east winds forecast for 12 September would bring cold weather and geese. It brought snow but only the one flock of geese. By the time we left Skagafjordur the Barnacles were nearly a month late if it was true that the majority had not already left Greenland. This explanation seems unlikely. Another, equally unlikely but impossible to disprove, is that numbers of Barnacles were stopping

Silfrastadir—stormy evening.

further north in the valley between us and the sea and did not come down to Silfrastadir. On 7th two small flocks appeared near Silfrastadir just after we heard shooting further north. This suggests that some were present down the valley but it seems unlikely that large numbers were there. We saw none when we came through the valley on the way to Silfrastadir and on the way back on 24 September we only saw one, with a flock of Greylags.

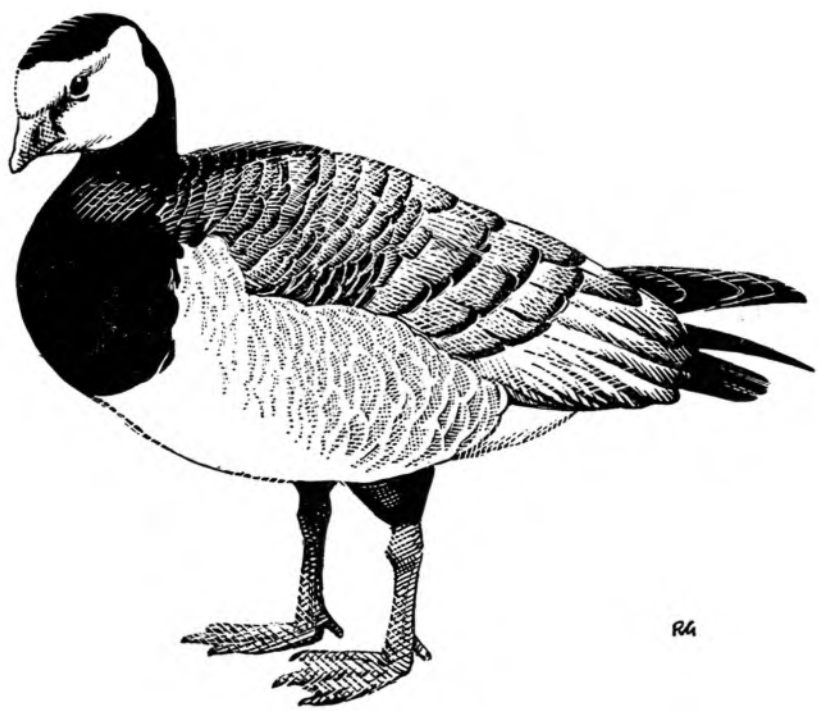
The most probable explanation seems to be as follows. Skagafjordur has gained its reputation as a Barnacle resort from the large numbers which stay there in the spring and crowd the hay fields of the lowland farmers while snow still covers the interior and the uplands. But in autumn all the uplands are snow-free and available for Barnacles to stop on passage. Thus there is none of the bottleneck effect that there must be in spring. Consequently the numbers of geese are spread over a huge area, and any slight variation in wind which takes them away from Skagafjordur does not matter, they may stop anywhere and need not bother to find their way into the northern valleys.

Forgetting the scientific aspects of the trip, the lack of Barnacle Geese to study made it possible for us to watch, enjoy and take part in the main September activity of the Icelandic farmers. This was the annual gathering and sorting of the sheep, and in Skagafjordur the ponies, which had been spending the summer in the highlands and interior. We saw the farmers setting off on horseback and their return a few days later driving many hundreds of ponies and thousands of sheep. The ponies, many with foals, were strung out along three miles and were slowly brought along the road running against the side of the valley. Off the road and lower down was the concrete gathering pen, surrounded by smaller pens, each allotted to a particular farm. The animals, ponies one day and sheep the next, were herded into the central pen—and then it was chaos as the farmers looked for their animals and then tried to drive

them into their own pens. When it was all over everyone gathered in a shed to celebrate the successful completion of the autumn round up.

Our most exciting occasion was on the day that brought the largest party of Barnacles. We stalked to within 150 yards and then lay behind an abrupt bank. There were 68, mostly families, separated from us by a river. Having watched for some time we moved further out of sight to eat our " lunch." Hearing the Barnacles fly up, but evidently not away, we again crawled to our vantage point and were thrilled to see that they had crossed the river and were feeding in a broad line towards us. We watched excitedly as they came nearer and nearer, quite unaware that we lay only 50 yards away. Eventually our over-exuberant attempts at photography caused some to become suspicious and the flock went off, not far and not in panic but it finished that day's watching. We had watched them for some hours and had quite forgotten the frustrations of the previous ten days of searching in poor weather for just such a flock.

Once, attracted by the sudden clamour of frightened geese, we watched a large white gyr falcon hurtling after a flock of Greylags. The terrified geese split up in wild confusion, flinging themselves low over the valley floor. The gyr, looking almost as large as a goose, did not make a kill and we know of no such record but it certainly did not give the impression of a playful stoop. In 1954 we had seen one stooping at Barnacles. They reacted even more violently, several flying straight downwards, diving headlong into the river. This was a most forcible demonstration of the use of " whiffling " so familiar in a mild form to those who have watched geese at the New Grounds or elsewhere in this country.



SOME OBSERVATIONS ON WILD GEESE IN SPITSBERGEN

N. G. Blurton Jones and Robert Gillmor

(Illustrated by Robert Gillmor)

Summary

The authors spent two weeks at a nesting colony of Pink-footed Geese at De Geerdalen in Icefjord. Eighteen nests were found containing an estimated 67 eggs and producing about 30 goslings, mostly hatching unusually early, from 27 June onwards, the peak hatching date being 29 June. Females brooded eggs and goslings in the nest for very long spells. They varied in their readiness to leave the nest when disturbed. Males stayed on guard near the nest, sometimes going away to drink and bathe. They also spent much time on the alert when the family had left the nest. Goslings spent approximately one day in the nest, eventually making excursions from under the female to feed and then being led away by the female. One female deserted her goslings which were adopted by another pair. In the wild Pinkfoot goslings follow their parents poorly at first but soon improve. At first families were single and scattered, some form flocks of families and eventually they join broodless adults. Goslings can fly only a short time before the probable date of departure. Observations on relations between geese and foxes are conflicting.

Pinkfeet seem to have survived disturbance in Icefjord better than Brents and Barnacles. Forty Barnacles, including 9 goslings, were watched in Sassendalen. Twenty-eight Brent Geese, including 7 goslings, were seen in Austfjord. Surprisingly few Pinkfeet were seen in Sassendalen.

Introduction

ONE of the aims of the Reading University Zoological Expedition, Spitsbergen, 1957, was to study some aspects of the population and behaviour of Pink-footed Geese and Barnacle Geese in their breeding areas. Although Spitsbergen Pinkfeet winter on the continent and seldom reach Britain (Holgersen 1958) information on their breeding biology must shed some light on the problems facing British Pinkfeet in their Greenland and Icelandic breeding grounds.

The authors travelled to Spitsbergen ahead of the other members of the expedition in the last half of June, arriving at Longyearbyen in Icefjord early on 27 June. In the evening we were taken to De Geerdalen some 20 miles east in a hired motor boat and left there with our stores. We almost immediately found the nesting colony of Pinkfeet reported by Pennie & Andrew (1956). The first clutches had already hatched. We established ourselves in a tiny trapper's hut about 1½ miles from what we came to call "the goose gorge."

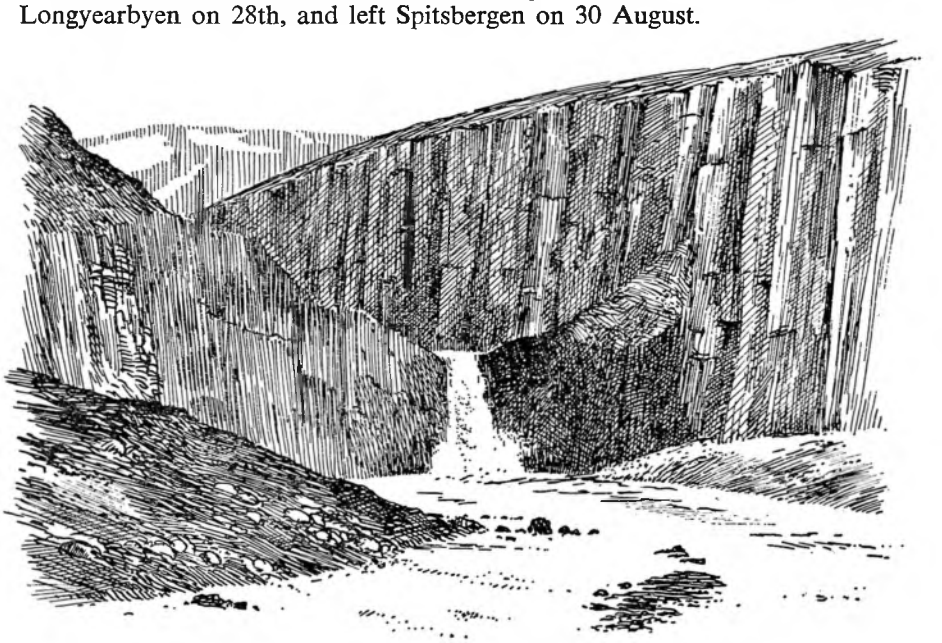
From the time of our arrival at De Geerdalen at about midnight 27-28 June until our departure on 7 July we made daily visits to the colony, either checking on nest contents or, from a distance, watching the undisturbed birds,

either at their nests or with goslings on the wide marsh between the gorge and the sea. Not only were geese and goslings extremly hard to see on the marsh but most seemed to move far away along the shore quite soon after leaving the nest, perhaps partly because of our presence in the area.

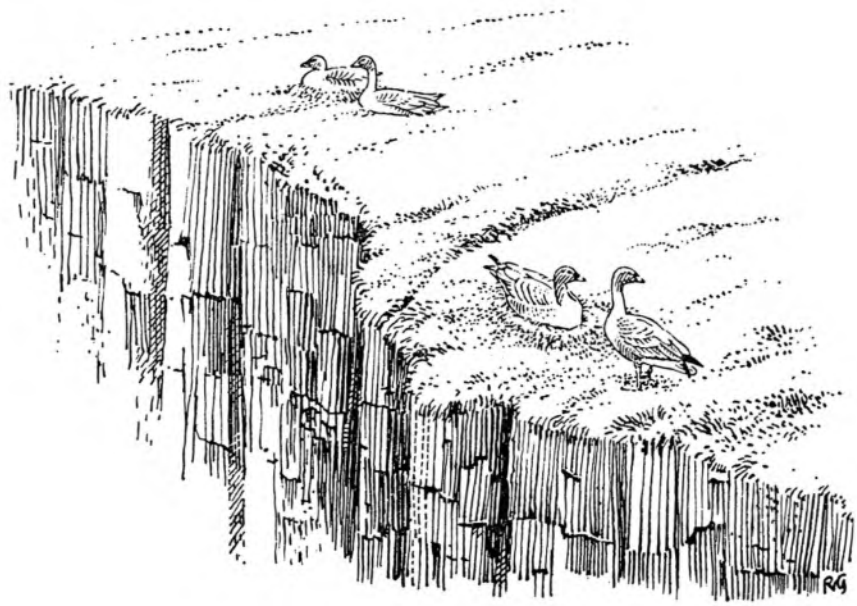
On 7 July we walked back to Longyearbyen overland to meet the other two members of the expedition, M. M. R. Freeman, the leader, and Ronald Passey. We then travelled together by boat to Sassendalen some 10 miles east of De Geerdalen where we hoped to watch Barnacles and Pinkfeet and later to catch some geese for examination for ectoparasites. R.G. returned to De Geerdalen for a week to complete a film of Arctic Skuas and other birds. He saw no geese at all after 12 July. At Sassendalen N.G.B.J. found a small flock of Barnacle Geese and watched these every day. Surprisingly we saw hardly any Pinkfeet here and none were caught.

On 29 July we left Sassendalen for Ebbadalen, 35 miles away in "Petunia Bay" at the head of Billefjorden. We travelled on the catamaran we had constructed by connecting our two 18 foot Kayak-type canoes, about three feet apart, with a Dexion angle-iron frame. The journey took some 17 hours and en route we stopped for a couple of hours at Gåsoyane (Goose Islands) before making our base camp at Ebbadalen where we had ample opportunities for finding what birds and other animals were in the area.

The purpose of the journey was twofold. Firstly, we wanted to test the catamaran and its suitability for this kind of expedition and, secondly, to cross the Mittag Glacier to explore the fauna of the southern end of Widjefjord. To do this properly a boat was almost essential and the feasibility of carrying a collapsible canoe over the ice on one of the sledges was another aspect of the technical programme that was running parallel to the scientific work. We stayed in Widjefjord between 10 and 16 August, returning from Ebbadalen to Longyearbyen on 28th, and left Spitsbergen on 30 August.



De Geerdalen—Pinkfeet nest along top edge of cliff



Along the edge of the gorge at De Geerdalen

Acknowledgements

Space does not permit mention of all the many people who helped the expedition but we must especially thank the Sysselman of Svalbard and his assistant for invaluable help in Spitsbergen, the Senate and Council of Reading University for approving the expedition, the Research Board of Reading University, the Everest Foundation and the C. H. Foyle Trust for financial assistance and numerous commercial firms for help in kind.

Distribution

In De Geerdalen 18 pairs of Pinkfeet had nests and when we arrived there were an additional 16 geese on the marsh. These left the area very soon. On 1 July five flew down the valley and away eastwards along the shore, supporting our expectation that broodless geese from such colonies would go to Sassendalen to moult. After hatching pairs with goslings scattered over a wide area around the colony in the first few days but all except two families seemed to leave the area after that. These two families stayed on the marsh and by the sea for twelve days but then disappeared. There is no reason to suppose they were any more likely to have been preyed on than that they moved away to another place. One family was observed to travel to Vindodden when the single gosling was still very small. They swam far out to sea and then eastwards, eventually swimming in towards Vindodden. This was on 6 July. On 13th a pair with one gosling was seen here by M.M.R.F. and R.G. as they passed in a canoe.

On our journey up De Geerdalen to Adventdalen and west to Longyearbyen we saw geese only in De Geerdalen up to one mile beyond the gorge where we saw 5 Pinkfeet on 7 July. There were goose droppings everywhere, especially all along De Geerdalen, but as decay is extremely slow so far north, these tell one little more than that geese have been there sometime

in the past few years. At one time Adventdalen was known as a breeding area for Pinkfeet and Barnacles but the mining and other activity there seems to have stopped this.

In passing it is interesting to note that the De Geerdalen colony was not mentioned by Conway (1897) though he visited and photographed the gorge, whereas he does describe the still-existing colony at Eskerfossan near Sassendalen. Members of the Sherborne-Cambridge expedition found nests at De Geerdalen in 1954. In 1955 Pennie and Andrew counted 14 nests here.

In Sassendalen we saw surprisingly few Pinkfeet. From the reports of Goodhart, Webbe and Wright (1955) and earlier writers we expected to find some hundreds of Pinkfeet here. In fact the largest flock we saw was 17. This and a flock of 14 were the only Pinkfeet we saw during our stay from 10 to 28 July except for about 3 family parties seen on a large pond about 3 miles from the sea on the east side of the Valley, on 21 July. We covered the valley as far as 5 miles inland and it is hard to believe that any geese were in this area unseen by us. They could easily have moved away on our arrival and would be impossible to see even with a telescope further up the valley or along the shore to the west. No recent nests were found here though M.M.R.F. and R.P. collected a piece of goose eggshell from the top of the coastal cliffs to the east of Sassendalen. This could have been taken there by a gull. On the sides of a small gorge on the east of Sassendalen about 4 miles inland N.G.B.J. found traces of 6-8 old goose nests, long disused but mostly conspicuous by the ring-shaped mound which builds up around traditional nest sites. The vegetation on these mounds was no different from the surrounding area, unlike that around occupied nests which is much more luxuriant.

On Gåsoyane, at the junction of Billefjorden and Templefjorden, on 29 July we disturbed a party of Pinkfeet at a small pond. They ran to the sea and disappeared before we could count them but there seemed to be about 6 adults and 15 goslings of various sizes, some quite large. We could find no disused nests in a fairly thorough search of the smaller island. We saw no geese at any of our stops in Templefjord or Billefjord.

In Petuniabukta we saw no geese during our first stay (30 July-3 Aug.) although we found one empty (but this year's) nest just north of Ebbadalen. On our return to the area on 18 Aug. we saw *c.* 20 goslings with *c.* 5 pairs of adult Pinkfeet on the shore at Ebbadalen. The goslings could fly, though not well. This was another observation which showed us how hard it is to see Pinkfeet with goslings. It is interesting to note that Pinkfeet still breed here where they were breeding in 1921 (Scott and Fisher 1953), despite visits by expeditions almost annually since 1949. Besides these family parties we saw a flock of 24 Pinkfeet on 25th with only 7 goslings in it. At Brucebyen on 26 August N.G.B.J. saw a few Pinkfeet, including a small flock of 15, but no goslings and no old nests. This area is often visited by shooting parties from the Russian mine at Pyramiden.

We were in Austfjord from 10 to 17 August and covered both shores as far north as 79°. We found no nests other than a long-disused one in Jaderindalen. On the eastern coast many moulted feathers were found and the rocky landscape with well vegetated valleys and ponds was judged more suitable for nesting than the west side. On 22nd at Zeipeldalen we saw 22 Pinkfeet flying south. They turned, circled and eventually flew into Zeipeldalen. Further north along the shore we saw 3 Pinkfeet flying south. We saw

Zeipeldalen

none at Hoegdalen. On 14th we saw a flock of 67 or 68 in Zeipeldalen which included no goslings. The flock was eventually flushed and parties flew about over Zeipeldalen and the coastal strip as far as Hoegdalen. Thus we have no evidence that Pinkfeet bred in Austfjord in 1957.

In Austfjord we saw some Brent Geese, including flying goslings. The first were 15 without goslings but mostly in pairs, on the shore at Zeipeldalen on 12th. A little further north along the shore, we saw a pair with five goslings. These flew off towards Gyllensköldholmane. On 14th at Zeipeldalen we saw three pairs and broods of 5 and 2 goslings. We visited Gyllensköldholmane and searched the larger island for deserted Brent nests but could find nothing distinguishable from Eider nests.

On 21st at Ebbadalen we saw 28 Brent Geese flying south from over the mountains and away past Brucebyen. These may have been this same group of birds beginning their autumn migration. In the 1930's Brents nested at Sassendalen and Gåsoyane, Dalgety et al (1931), but none were seen in Sassendalen in 1954 (Goodhart, Webbe and Wright, *loc cit.*) or in 1955 (Pennie and Andrew, *loc. cit.*) and we saw none in either place in 1957. Increased disturbance may well be the cause of their disappearance. It is to be hoped that mining never comes to the north and east coasts of Spitsbergen where birds still nest largely undisturbed. The Pinkfoot seems to have survived much better than the Brent, unless our failure to see large numbers in Sassendalen really reflects the state of the population, but it seems highly unlikely that so many geese belonging to just one area should suddenly have been exterminated.

Hatching and Fledging dates

Our observations allow us to make a fairly accurate comparison of hatching dates in 1957 with published records for other years.

We have used three methods for arriving at a mean hatching date for the colony. One depends on counting the number of nests examined each day which had females sitting. Plotting the proportion of nests being

brooded against days shows the day when half of the females had stopped brooding, and the day when most females ceased to brood. These give the median and approximate mean dates for cessation of brooding. This is likely to be later than the actual hatching date because the female broods the goslings in the nest for some time. The second method counteracts this lag. This was to count the number of goslings seen (in or out of the nests) each day. A histogram is made of the number seen as a proportion of the eventual total number of different goslings seen. For the first method the mean is 30 June and for the second 29 June. This difference roughly corresponds to the time for which the female broods the goslings in the nest. The medians are 30th and 28th.

These two methods are very approximate but allow one to fix a date on the basis of almost haphazard records made from a distance without disturbing the geese. For any future study of a Pinkfoot colony it is worth bearing in mind that one need not disturb the nests, and thereby possibly cause losses of eggs or goslings, to find hatching dates.

The third method, examination of nest contents from day to day, confirmed the other methods for eight nests. At these we could establish the dates of hatching and leaving the nest with accuracy:

Nests 1 and 4, hatching at 2300 hrs. on 27 June, still in nest 1800-2000 hrs. on 28th but gone by 1000 hrs. 29th.
Nest 2, none hatched on 27th, sitting on 28th and 29th, family seen leaving nest about 0800 hrs. on 30th.
Nest 6, dry goslings in nest late on 27th, gone by late 28th.
Nest 9, goslings seen in nest on 29th, just dry, left nest by midday of 30th.
Nests 10 and 11, dry goslings in nest on 30th, left that day.
Nest 13, sitting at midday on 30th, pair and 2 small goslings near nest on 1 July.

Goslings left 4 of these nests on 30 June, the same date as the majority of females stopped sitting. This data also gives some indication of how long goslings stay in the nest. The goslings seen newly hatched (still wet) in nests 1 and 4 stayed at least 20 hours but not more than 35 hours. Those in nest 2 were in the nest not longer than 56 hours and probably much less. Those in nest 9 stayed at least 20 hours and probably more than 5 hours more than this. So there are three records of a minimum of 20 hours, one maximum of 35 hours, another (less accurate) of 56 hours. It seems that normally goslings spend about 24 hours in the nest. Of course, once they are dry they can and do leave earlier if disturbed.

Hatching dates for other years can be obtained from published records. Lovenskiold's (1954) records suggest that most nests hatched between 7 and 15 July in 1949, between 5 and 10 July in 1952 and around 10 July in 1950. When the Sherborne-Cambridge Expedition visited Eskerfossan on 3 July, 1954, at least 4 birds were still sitting and possibly another 4, two nests were empty. This suggests that the majority hatched after 3 July. Dalgety found several clutches fresh on 20 June, most were a week or 10 days set. This would suggest a hatching date of around 10 July in 1930.

These records for other years come from a variety of localities and all show roughly similar dates. Thus it seems unlikely that De Geerdalen was

exceptional in 1957 and likely that most Spitsbergen Pinkfeet laid unusually early that year. This is supported by our observations of goslings on Gåsoyane on 29 July which were judged to be at least 3 weeks old and probably more, and by the flying goslings seen at Ebbadalen on 18 August. These must have been at least 7 weeks old (8 weeks fledging period (Dean, 1958)). This gives a hatching date of 27 June. One gosling which still could not fly on 26 August must have hatched between 1 and 7 July.

We were told by Spitsbergen residents and visiting scientists on the Norsk Polarinstitutt boat "Minna" that the winter had been exceptionally mild in Spitsbergen though they thought that the spring was not particularly early. Bearing in mind the observations of Goodhart and Wright (1958) in Greenland on the importance of snow clearing in time for geese to nest, it seems that the unusually low snowfall and high temperatures in Spitsbergen during winter allowed snow to melt earlier than usual on the Pinkfoot nest sites and the geese nested earlier in consequence. Despite a mild winter in Denmark and early gathering at the point of departure in West Jutland, Pinkfeet did not fly north any earlier in 1957 than in 1955 or in 1956 (mid-May in each year), according to Lind (1958). It is interesting to compare conditions in Spitsbergen in the summers of 1957 and 1958. In late June, 1957, there was no ice left in the fjords but at the same time in 1958 Petuniabukta and Austfjord were full of ice, the ice remaining in Austfjord until mid-July.

A superficial examination of the literature suggests that the Spitsbergen Pinkfeet begin their southward migration early in September. In 1957 ice formed on the calm water of Petuniabukta on 25 August, the sun was very low in the sky and there had been frosts at night for some time. But still on 26th we saw a flightless gosling and this was an early nesting year. If in normal years hatching is mostly about 10 July and departure 10 September, the goslings must be only just over 8 weeks old when they begin their migration. Clearly, the Pinkfoot breeding season can only just be squeezed into a Spitsbergen summer. Perhaps it is advantageous to the species not to breed at all if laying is delayed by late-lying snow for no goslings would be fledged in time to migrate south and they would presumably starve and freeze in Spitsbergen.

Breeding success

Eighteen pairs of Pinkfeet were nesting in De Geerdalen. When we arrived there were 16 more geese in the area. If they represented the survivors of the previous year's goslings, together with older birds which were not breeding, this small total would suggest that 1957 was a good year for breeding. However, we cannot be certain about this without comparing the ratio of breeders to non-breeders at De Geerdalen from year to year, because in Spitsbergen non-breeding birds seem to concentrate in areas away from the breeding colony, such as Reindalen where Goodhart, Webbe and Wright (*loc. cit.*) report predominantly non-breeding birds.

At the end of the incubation period 9 pairs whose eggs were counted had a total of 39 eggs. The clutches of another 7 pairs could be estimated from goslings seen in or out of the nest, or goslings and eggs in the nest, to amount to 28 eggs. So 16 pairs produced approximately 67 eggs, an average of 4.2 each.

The number of goslings hatched was observed in 7 pairs. They hatched 21 goslings. The number hatched was estimated for 3 pairs, and it was estimated that two of the other pairs hatched more goslings than we saw. This

CLUTCH AND BROOD SIZES OF PINKFEET

Nest number	Clutch		Goslings hatched	
	Observed	Estimated	Observed	Estimated
1	—	5	3	+1–2
2	4	—	3	—
3	6	—	—	0
4	—	3	2	+1
5	9	—	—	0
6	—	3	3	—
7	5	—	—	—
9	—	4	4	—
10	—	6	5	—
11	—	5	1	—
12	2	—	—	0
13	—	2	—	2
14	4	—	—	—
16	1	—	—	1
18	4	—	—	—
19	4	—	—	3
Totals	39	28	21	8–9
	67		29-30	

gave another 8-9 goslings and a total of 29-30 goslings from 10 pairs. Three pairs almost certainly hatched no goslings. This gives a mean of 2.3 goslings per pair. It is perhaps better to separate pairs hatching no goslings from those hatching some. This gives a mean of 2.9-3.0 goslings per brood, with 23% of pairs hatching none. Details are given in the table (p. 126).

We have much less information on the success in rearing goslings. Fourteen goslings were observed away from the nest and nine of these were seen up to the age of 2 weeks. Others were not seen, nor were their parents and they are as likely to have moved away as to have died. Our estimates of success in getting goslings away from the nest safely has a minimum of 26 and maximum of 40. The 14 goslings seen away from the nest were in 6 broods, average 2.3. The minimum estimate was for 9 broods, average 2.9 and the maximum for 13 broods, average 3.1. The broods of Pinkfeet seen in Ebbadalen in August mostly seemed to be of about 3 goslings.

In the Barnacle flock the three pairs with goslings (9 goslings) were accompanied by another pair with no young. These may have nested but failed as most broodless adults were in a separate flock of 22 birds. This suggests a low proportion of breeders among the adults even if all the previous

year's goslings had returned. The proportions of the Brent flock in Austfjord, 4 breeders, one broodless pair with them, 7 goslings, and 15 other birds, are similar.

We are uncertain of the extent of predation in De Geerdalen. There was a fox lair at the foot of the cliffs by the sea from which 3 cubs eventually appeared. But only 300 yards away on the gentle slopes was a Pinkfoot nest with 4 eggs, which presumably had survived quite a time, as had equally accessible nests at the gorge. We only saw the fox hunting in the tern colony but near its lair were the remains of several adult Pinkfeet. We found 3 pairs of wings with all the flesh eaten off the humerus and sternum but with wings quite intact and fully feathered. Does a fox only rarely find it necessary to tackle a goose at its nest but when it persists succeed in killing the adult? Or were these corpses of birds wounded by visiting hunters in the spring which the fox was easily able to catch? Some authors refer to Glaucous Gulls and Arctic Skuas as preying on eggs and goslings. We have no direct evidence about this but while we were examining nests both species appeared and flew about low overhead. We are fairly sure that they took nothing after we left as the geese returned very quickly but they certainly seemed very likely to take eggs if the geese were disturbed too often.

Nest Sites

Most of the nests at De Geerdalen were on or near cliffs at low altitude, i.e., near the sea or around the waterfall. No nests were seen on the higher cliffs on the mountains around the valley (which were, of course, very exposed). This seems to be the normal thing in Spitsbergen, Pinkfeet nesting on low cliffs where available, presumably for safety from foxes, but hardly ever on the ubiquitous higher cliffs. At De Geerdalen no nests were higher than 70 metres above sea level, most being about 40 metres.

Eight nests were on cliff tops, at the edge or up to 2 metres from it. These were all along the gorge and close together. Seven were on cliff ledges: five on the west cliffs, one at the gorge and one on the east cliffs. Three were on rocky hill sides, two of these near the gorge and one near the sea. All but one were accessible without climbing and goslings could have walked from them without falling. At the one exception they would have had to fall about 4 metres. Almost all nests were on mounds built up over the years, i.e., in traditional sites. The outlook or range of view from the nests varied. Most (7) gave a view through 360°, four had a view of 240°, 6 a view of 180°, one had a view of only 100°—the nest halfway down the side of the gorge.

The one nest we found in Ebbadalen was not on a cliff but in the open tundra with no protection other than a view in all directions. In Bellsund

C. Plowright (pers. comm.) saw three nests (eggs chipping on 30 June which confirms our hatching dates) on the tops of small cliffs formed by up-pointing strata near the shore, about 20 feet above sea level and 50 yards from the shore.

The deserted colony in Sassendalen was similar to the De Geerdalen site except that the cliffs were not of sheer rock but of more gently sloping crumbling sediment.

The nests in De Geerdalen were spaced from each other by varying distances. Eleven in the gorge were mostly within 10 to 40 metres of each other. The other eight were spaced along the cliffs running from the gorge east, and north-west to the sea and west along the shore. These were more widely spaced, five with intervals of 40 to 100 metres; three more than 100 metres apart.

Brooding and care of goslings

Our watches on brooding birds were never long enough to allow us to say anything definite on length of brooding spells except that they are very long. However, we did once or twice see females off their nests (not as a result of disturbances) and watched them return. We saw males away from the nests more often but they spent the greater part of their time near the nest, standing or sitting looking around "on guard" for long stretches of time. Most nests had a well trodden place near them covered in droppings where the gander habitually kept guard. Sometimes we saw a gander walking around feeding near the nest, and sometimes we saw one fly away to the river and drink, then return to the nest.

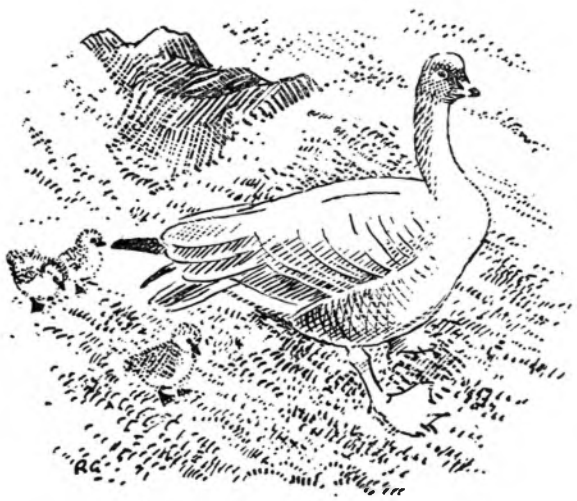
Pair at nest, female "concealing," gosling emerging from wing (from a photograph)

When we approached a nest the gander would often sit down and continue watching us, sometimes lowering his head in the concealing posture. Usually the gander flew away before the female. Ganders which adopted the concealing posture flew away suddenly, those which did not would first begin to walk away from the nest, then fly away. Most females adopted the concealing posture, then slowly stood and flew off. Females differed in their readiness to leave the nest on our approach. Some left when we were still 50 metres away,

others stayed until we were closer than 20 metres, one allowed us to get to 3 metres. This bird then stood and stepped off the nest but then sat down again before walking on and standing alert for some time before flying. These differences seemed consistent from one visit to the next, though we made too few visits to be sure of this.

A similar difference was noticed in pairs 3 and 9 in the female's attentiveness to her goslings. On 29 June when we visited nest 9 the female walked away from the nest, leaving the gander and 4 goslings standing by it. She later returned to the nest but on 30th, when the family was on the marsh, she again wandered off and the goslings became amalgamated with Pair 3's brood which had just left the nest. This desertion had been preceded by some threats and attacks between the two ganders. The actual taking over of the goslings by Pair 3 was not seen. It took place during about 10 minutes while the birds were out of sight but immediately afterwards male 9 threatened Pair 3 who retaliated and chased him off. Male 9 stood around a while with body feathers fluffed and head low (a posture sometimes seen in defeated birds) before walking off to join female 9 who was now some 100 metres away. Pair 3 kept their own and Pair 9's goslings for as long as we were at De Geerdalen (last seen 12 July).

Newly hatched goslings seemed to be brooded in the nest almost continuously. The only times we saw females get up off goslings in the nest were when we disturbed them and when the goslings left the nest permanently. We watched pairs 9 and 3 brooding goslings in the nest and in each saw goslings come out into the light. With female 9 a gosling put its head out over her wing and looked about, then came right out and sat on her wing, all this whi e the female was in the concealing posture, we being only 5 metres away. When a few minutes later the female got up and walked off, the goslings sat still for a moment, then stood and ran after her. They then stopped by the male and sat clumped together. At nest 3 the female was brooding 3 goslings and we saw them come out from under her one by one and walk around feeding near the nest. They seemed a little incapable. One feeding apart from the others ran back with waving wings (goslings often do this!) but ran straight into the



Pinkfoot leading goslings down steep side of gorge

gander, collided with him and fell over, got up and continued feeding with the others. Some minutes after all the young had started feeding the female stood up, stretched and started to feed. The goslings also fed right on the edge if the cliff, which did not provoke so strong a response in their parents as it did in us but nevertheless the gander put his head up (as in alarm) and the female, which was by then walking around, came up to the goslings near the cliff edge and did the strange low bill waving movement that adults with goslings do. A little later she began to walk along the cliff top doing the bill wiving movement and the goslings gradually followed—not keeping a constant distance or speed behind her but feeding, then rushing up to either parent or the other goslings when left behind. Travelling in this way the female led the family about 100 yards to the end of the gorge, down the slope towards the river. We lost sight of them for a while but next saw them in the river by a long shelf of snow overhanging the water. The adults got out on to the snow but the goslings did not follow. The female did more and more bill waving and got back into the water and out again. One gosling jumped out when the adults were a little way off but when the female again returned to the goslings in the river it got back into the river. They were then swept down-river followed by the adults in the water and running over the snow. Once the goslings disappeared under some snow. The adults stood looking about until the goslings reappeared further downstream when they ran off after them. Eventually the family landed on a gravel shoal, then made its way to the marsh where the goslings immediately began preening.

Goslings watched subsequently seldom preened, spending most of their time feeding or being brooded. Two broods watched about 2 days after leaving the nest were brooded about every hour for about half an hour. The beginning of brooding seemed determined by the female. Whenever she sat down the goslings stopped what they were doing and ran to her. The end of brooding came when the goslings had come out from under the female and started to feed again. The female would then get up and start feeding or preening. Gosling 2-3 days out of the nest seemed to follow their parents better than the goslings just out of the nest. Also very young goslings would follow either male or female, even rushing off after the male when he ran to attack other geese, only to get left far behind. This was not seen in slightly older goslings. Pairs with goslings on the marsh spent a lot of time "on guard," usually only one parent (mostly the male) standing still with head held high and tail low. This is almost a characteristic of Pinkfeet, other geese on guard seldom seeming to stand so erect. On seeing something, such as ourselves, they would lower their heads and walk or run away with much bill-waving, followed by the goslings. They rapidly went out of sight and if one looked away it was impossible to spot them again unless they happened to appear above the skyline.

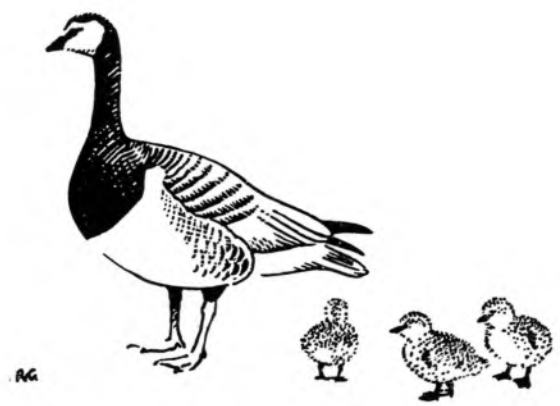
At first pairs with goslings kept to themselves but on 3 July pair 3 (with 7 goslings) were feeding near a pair with 2 goslings and they stayed together until 12 July when we last visited De Geerdalen. Other families seen at De Geerdalen were all scattered. But the pairs with goslings seen later at Gåsoyane and Ebbadalen were all together, and those in Ebbadalen were in company with broodless adults. The Barnacle families at Sassen were at first together, apart from the non-breeding flock, but joined this flock in mid-July. The same course of events seems to take place in Canada Geese in Britain (personal observation).

Moult

The moult period in Spitsbergen is from mid-July to mid-August (Lovenskiold 1954). We were in Sassendalen for part of this time. We saw two still-flying Pinkfeet on 13 July and moulted birds on 15 July and subsequently. Four non-breeding Barnacles had not dropped their primaries by 13th but all had by 21st. The parents kept their primaries until about 16th but had all lost them by 21st when their goslings were about two weeks old. The adult Pinkfeet seen at Gåsoyane had moulted; their goslings were at least 3 weeks old. We saw flying Pinkfeet in Austfjord on 12 August and subsequently. These had no goslings. On 18th we found flying Pinkfeet in Ebbadalen, with goslings. These observations are sparse but compatible with the view that non-breeders moult earlier than parents. Moulting, like hatching, seems to have been early in 1957. Lovenskiold claims that in most years many geese are still flightless after 15 August when the shooting season opens.

Ringed Geese

Two ringed geese were seen at De Geerdalen. The female of pair 9 (four goslings) had a numbered ring on her left leg and an orange colour ring on her right leg. A gander from another nest at the gorge, possibly nest 19 (4 eggs) had a blue or green colour ring on his left leg and numbered ring on his right leg. C. J. Pennycuick of the Sherborne-Cambridge 1954 expedition told us that one of these would have been ringed in Reindalen in 1954, among fully grown birds with few or no goslings and the other may have been ringed in Sassendalen in a large flock with a fair number of goslings. Similarly ringed birds were seen in Jutland in April and May 1957 by Lind.



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WATERFOWL AT COLD BAY, ALASKA, WITH NOTES ON THE DISPLAY OF THE BLACK SCOTER

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IN 1958, it was my good fortune to spend April and May in the area of Cold Bay, near the tip of the Alaska Peninsula, studying waterfowl. For the waterfowl enthusiast, Alaska will always hold a special fascination. This is the home of the Emperor Goose (*Anser canagicus*), the Pacific Brant (*Branta bernicla orientalis*), the Spectacled Eider (*Somateria fischeri*) and Steller's Eider (*S. stelleri*)—birds which relatively few ornithologists have seen in the wild but which are familiar to many through the writings of Brandt (1943), Bailey (1948) and most recently Fisher and Peterson (1955).

The main object of this expedition was to investigate the spring behaviour of Steller's Eider and of the Pacific Eider (*Somateria mollissima v-nigra*), and if possible to see something of King Eider and Spectacled Eider as well. I was particularly interested in the hostile and sexual behaviour which occurs before breeding and for this reason a centre for wintering birds was chosen in the belief that much of the pair-formation and related activities would occur before the birds moved to their breeding places. Cold Bay proved to be an ideal headquarters for these studies and during April I was able to watch large numbers of wintering Steller's on Izembek Bay; in May I camped in the middle of a large colony of Pacific Eiders at Nelson Lagoon when breeding was about to begin. My observations on these two species are being incorporated in a detailed analysis of Eider displays, not yet completed. Here I provide a record of the waterfowl species seen and report in detail on the displays of the Black Scoter (*Melanitta nigra americana*).

Waterfowl at Cold Bay and Nelson Lagoon

I arrived at Cold Bay on March 31—a sunny, crisp day which came as a pleasant surprise after warnings about the most miserable climate on earth. However, it was not many days before I was convinced that everyone was right. Robert D. Jones, the U.S. Fish and Wildlife Service Refuge Manager for the Aleutians, met me at the plane and took me to the comfortable house which serves as Refuge Headquarters. During the next few weeks, Bob showed me the best places for finding the birds I wanted to watch, and with his guidance and help I was able to see much more than I would have done by exploring on my own.

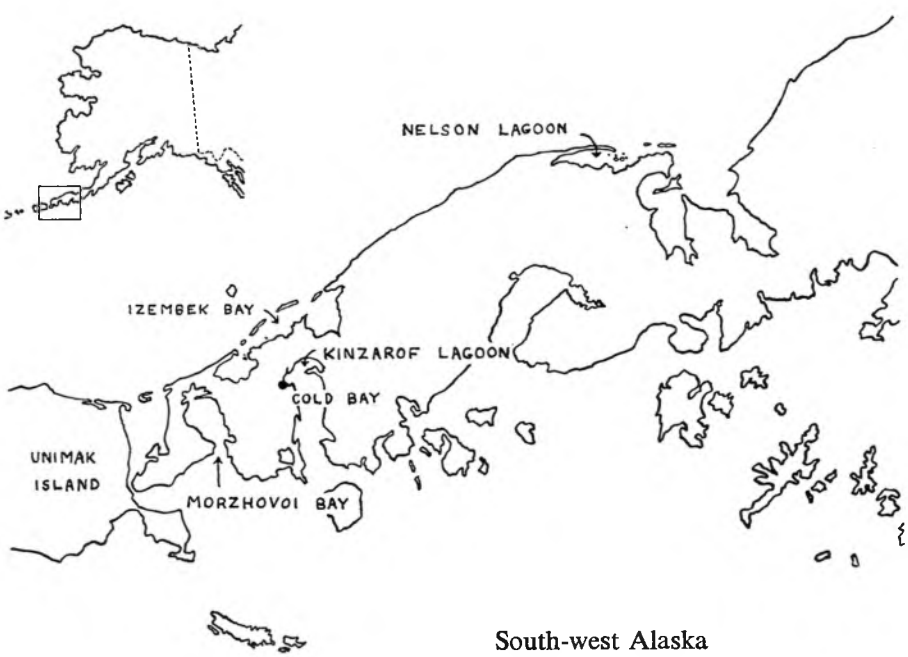
Cold Bay is undoubtedly one of the finest centres for seeing large numbers and great variety of wintering waterfowl. This is mainly due to the availability of several different types of habitat. The inlet of Cold Bay itself is on the south side of the Peninsula, providing a wild landscape of rocky shores and cliffs, rising steeply to volcanic peaks of 5,000 feet and more, which fringe the horizon to east and west. In early April, the deep waters off these shores were dotted with great flocks of Oldsquaw (*Clangula hyemalis*), Black Scoter and King Eider (*Someteria spectabilis*), and there were a few Surf Scoters (*Melanitta perspicillata*) and Pacific Eiders as well. By the end of April, almost all the Oldsquaws, White-winged Scoters (*Melanitta fusca dixoni*) and King Eiders had left the area but there were good numbers of

Red-breasted Merganser (*Mergus serrator*) and Black Scoter remaining. All around the rocky shores of Cold Bay, Harlequin Duck (*Histrionicus histrionicus pacificus*) were common, in pairs or in flocks of up to 40 birds.

At the north end of the bay, Kinzarof Lagoon provides a series of shallow, sheltered water areas which were favourite haunts of Whistling Swans (*Cygnus columbianus columbianus*), Greater Scaup (*Aythya marila mariloides*) and small numbers of dabbling ducks, including Mallard (*Anas platyrhynchos*), Pintail (*Anas acuta acuta*), Green-winged Teal (*Anas crecca carolinensis*), Gadwall (*Anas s. strepera*) and Shoveler (*Anas clypeata*). On April 29, Bob Jones and I watched a flock of 60 Whistling Swans on a small lake by the Lagoon. This probably represented a gathering of recently-arrived birds, as the flock dwindled during the next few days and pairs were seen flying out to the isolation of their breeding ranges widely scattered on the small lakes of the region.

The small tundra ponds and lakes of the northern side of the Peninsula itself provided breeding grounds for a few pairs of Mallard, Pintail, Black Scoters and Whistling Swans, but the commonest bird here was the Greater Scaup. Surprisingly, there were a few Bufflehead (*Bucephala albeola*) and I saw one American Goldeneye (*Bucephala clangula americana*) here too, though they must have been a long way from any suitable breeding grounds.

The main feature of the north coast of the Peninsula in this area is Izembek Bay—a shallow lagoon, 20 miles long and about 3 to 5 miles wide. At low tide the whole bay becomes transformed into a complex network of channels and exposed mudbars. Here is one of the great areas for Eelgrass (*Zostera*) and because of this it is perhaps the most important stopping place, mainly in April and September, for Pacific Brant on their migrations to and from the breeding grounds on the Alaska mainland. As Hansen and Nelson



South-west Alaska

(1957) have pointed out: "A unique opportunity, if weather ever permits, is available in September at Cold Bay to census a major portion of the Pacific Flyway Brant in one concentration by means of aerial photography."

Migrating Brant were seen on many days during April and the first week in May as they flew north up the inlet of Cold Bay and made the short land crossing to Izembek. Flocks of 20 to 100 birds were commonest, but I saw one group which included only 7 birds. As they made their way up Cold Bay, the Brant flew quite low—at most, a few hundred feet above the water. Occasionally flocks alighted at Kinzarof Lagoon, but mostly they continued on to Izembek. The strong tendency for these birds to keep over water was obvious from their behaviour when confronted with the land crossing of about 10 miles. One flock was seen to turn back several times, towering to a great height before finally going on. This aversion to flying over land was also noted by Littlejohn (quoted in Bent, 1925) who observed a similar northward flight up Morzhovoi Bay—the deep inlet west of Cold Bay. Presumably these birds were also on their way to Izembek Bay.

Izembek Bay is also a very important area for two other species—the Emperor Goose and Steller's Eider. Both species winter here in large numbers On April 10, in the course of a 30 mile boat trip, we saw about 15 large flocks of Steller's, varying in size from 1000 to several thousand birds. We estimated that there were at least 20,000 Steller's in Izembek.

I spent the period from March 31 to May 10 in these areas, concentrating most of the time on the Steller's Eiders in Izembek Bay. From May 10 to May 29, I lived at Nelson Lagoon, about 75 miles north-east of Cold Bay, on the Bering Sea coast. The main features of Nelson Lagoon are a long sandy spit which provides protection from the Bering Sea and a chain of small islands which are the nesting grounds for several thousand Pacific Eiders, as well as other sea birds. A few pairs of Gadwall were breeding on the islands, courting parties of Black Scoters were seen several times, and one pair of Red-breasted Mergansers and a few late Oldsquaws were noted also. Several thousand Steller's Eiders remained in the area in May. They were apparently non-breeders and the flocks were composed largely of brown, first-year birds with a sprinkling of males in adult plumage. The great flocks of Steller's had left Izembek Bay on April 29, and after this date only a few non-breeders remained there.

When I arrived at Nelson Lagoon, large numbers of Emperor Geese were still to be seen. By the 29th, they had almost all left. On May 18th, I was lucky to see a small group depart on their migration. The geese flew directly over me and I followed them with binoculars until they disappeared out over the Baring Sea to the north. As they flew away from me, it was obvious that the group was composed of several family parties and pairs. Some birds hesitated and circled as they passed over the north shore of the sand spit, but then they went on, rising steadily to a great height. If they continued on the same course, they would have reached the mainland of Alaska after a journey of about 200 miles across Bristol Bay.

As this observation shows, at least some Emperor Geese remain together in family parties until they set out in the spring migration to the breeding grounds. It was possible to pick out these units in all the flocks which were seen during April and May. Aggressive and sexual behaviour was also noted

to occur on the wintering grounds. On April 10, at Izembek Bay, I saw a prolonged fight between two Emperors as they stood breast to breast on a mud-bar among other geese, while on May 11 at Nelson Lagoon a pair was observed making pre-copulatory neck-dipping movements.

I did not have similar opportunities to observe the behaviour of Brant. These birds kept well off-shore and were very shy. However, one behaviour pattern was seen on many occasions from a distance, whenever a Bald Eagle (*Haliaetus leucocephalus*) or Gyrfalcon (*Falco rusticolus*) caused a flock to fly up and circle. Almost every time this happened, I noticed one or more groups of three geese involved in a chase. The chase appeared to consist of one bird pursuing another with a third bird following closely behind In one instance, four geese were involved. I can only guess that this chase is connected with the process of pair-formation. Superficially the chase resembles the well-known flights involving three birds which Hochbaum (1944) described as part of the territorial behaviour of the Mallard and other dabbling ducks on the breeding grounds. However, the Brant were flocked, on the wintering grounds, and there was no relationship of the flight to a specific area. Further study will be needed to determine the significance of these pursuits.

Black Scoter Display

One of the commonest waterfowl and one which I was able to watch both at Cold Bay and at Nelson Lagoon was the Black Scoter (*Melanitta nigra americana*). Since little has been written on the behaviour of this bird, I was glad to have several opportunities of watching the display, and at Nelson Lagoon I was fortunate to obtain movies of a courting party. Phillips (1926), in the section on display of the Black Scoter, quotes from accounts by Brewster and Brooks, and a number of the postures are briefly described. Gunn (1927) gave a fuller description for the European race (*M. n. nigra*), while most recently Humphrey (1957) has carefully described and figured certain displays of Alaskan birds. Since my notes add considerably to these accounts, I will give a digested summary of the behaviour which I saw and filmed, though this account must be considered preliminary and further study will be needed to complete a catalogue of the display postures and to achieve an understanding of their significance.

At the three places where I did most Scoter watching, there was a conspicuous preponderance of males. Pairs could be identified, but most birds were in small flocks which frequently resolved themslves into one or more courting parties. At times displays were seen when two males swam beside a female, but more often the group contained 5 to 8 males and one female.

Attention is drawn to courting parties from a considerable distance by the very frequent, mournful "*wheeuu*" *calls* given by the males. A bird giving these whistles may be seen to open the bill with a conspicuous drop of the lower mandible, and the bill remains open for several seconds.

While following the female, calling, and performing displays, the males adopt a very erect posture which involves a lowering of the rear part of the body and a raising of the tail. The intensity of this erect posture may vary, but in the most exaggerated form the tail is cocked up an angle of about 45°.

In courting parties I identified the following displays of the males:

Head-shaking. The male's most frequent movement. The lateral shaking of the head is very deliberate. Although this activity is common in displaying ducks of many species I have not watched any in which this display is so noticeable. There is a strong tendency for a head-shake to be given just after the bird calls. A shake is usually given at the end of a Low Rush (see below). In this case, the movement is probably functional in shaking water from the head. The female also head-shakes from time to time. I believe that this is associated with threatening movements towards males.

Low Rush. (The name used by Gunn; called by Humphrey " Forward Rush "). The bird suddenly begins to paddle vigorously, lowering the head as the body starts to move forward, and rushes over the surface of the water for a distance of 3 or 4 feet, churning up a great spray as it does so. At the peak of the rush, the head and neck are level with the surface. The bird comes to a halt abruptly amid a shower of spray, and usually head-shakes at the same moment. This display was very frequent, and it was seen on every occasion that a courting party was watched for any length of time. The position of the bird performing, in relation to the other birds, was variable. Sometimes it was done by a bird at the rear of the group apparently as a method of " catching up " with the female and the centre of display activity. At other times, it was performed alongside the female, and parallel to the direction in which she was swimming. It was also seen to be performed in front of the female and away from her. Only once did I see the Low Rush used as an overt attack by one male on another.

Shake. This movement, which appears identical with the comfort displaying males. The bird rises briefly on the water, the wings not opened, and a shaking movement passes over the body ending in a striking forward twitch of the head, which seems to be peculiar to scoters, as it is absent in the shake of most other wildfowl. Once a Shake was noted to follow a Low Rush.

Wing-flap. This common activity appears to be identical with the comfort movement of rising from the water, opening the wings, flapping them several times, and subsiding again on the water. As in the Shake, Scoters finish this movement with a striking forward twitch of the head, and this is given also by females. Gunn considered this to be " the most effective and curious display " and he named it " the Obeisance." I would rather consider the Wing-flap as a comfort movement which is used during display, and although it may well have signal function it does not appear to have been modified during the course of evolution to serve this end.

Preen. On seven occasions, a male was seen to give a Low Rush and immediately afterward he performed head movements which resembled preening. In most cases, the movement was so rapid and confused by flying spray that I could not be sure if it was indeed a preening movement. However, a film of one sequence clearly shows the bird nibbling at the feathers in the region of the shoulder or side of the breast. To summarize my notes on these seven sequences, I detected the following:

Low Rush followed by posture with head bent forward ...	3 times
Low Rush followed by probable preen on breast ...	twice
Low Rush followed by preen on back	once
Low Rush followed by preen on shoulder or side of breast	once

The occurrence of preening movements during display is well-known from the studies of Lorenz (1953) on Anatini, and I have found these movements to be widespread in Anatidae (McKinney, 1953). In this case, the preening does not appear to be constantly and rigidly directed toward the same part of the plumage as it is in many species of duck.

Short Flight. I saw about 20 Short Flights and this is undoubtedly a common display. The male takes off and flies about 4 to 8 feet; at the peak of the flight the bird is just clearing the surface of the water. At the moment of alighting, the feet are suddenly extended forward and the bird " puts on the brakes " very hard, at the same time pulling back the head, so that an upright posture is assumed as the first spray begins to fly. Immediately after the first contact with the water, the head goes forward again and the bird continues at a good speed in a Low Rush.

On one occasion, I filmed a " flight " in which the male used his wings but did not take off from the water. This resulted in a " flapping rush " resembling the dashing and diving which is well-known as an accompaniment to bathing in waterfowl. I do not know if this performance should be considered as an aberrant Short Flight or whether it is a distinct display which occurs rarely.

Most often Short Flights seem to be performed ahead of the main courting party. The flight carries the bird in front of the others or at least on a level with the leading birds. If the bird alights well ahead of the party he may turn round and swim back. Once I saw one male chase another repeatedly and the bird which was retreating did so by performing three Short Flights in succession. In most cases there was no obvious stimulus prompting a male to make a Short Flight. At times, two males would perform a flight almost simultaneously, but these were not instances of direct attack or escape.

Similar display flights are important elements in the performances of other waterfowl. The Short Flights of Bufflehead, American Goldeneye and Steller's Eider are quite similar and may well be homologous behaviour patterns.

Steaming. On examining the movie film of displaying Scoters, I detected a posture which seems to be separable as a distinct display component. After the " flapping rush " described above, the male involved and two nearby males adopted this posture briefly. The bird is half erect in the water, with the head held high and drawn back slightly; the breast is prominent in front. This may be what Gunn called the " High Rush " or it may be equivalent to the " chesty " attitude which he describes as being given by a male after the Short Flight as he swims back toward the female.

Tail-Snap. The sudden erection of the tail " over the back at a seemingly impossible angle " (Gunn) or " to the vertical . . . . or angled slightly over the back " (Humphrey) was seen clearly only three times. This may have been due to the difficulty of seeing the action when the birds were swimming in rough water. The one case on which my notes are most complete involved a male displaying beside a female with only another pair nearby. This male performed the sequence of calling with conspicuously open bill, suddenly erecting the tail, performing a Low Rush and then apparently preening on the breast immediately after completing the Rush. The Tail-snaps seen by Humphrey were given by a male displaying alone to a female.

Further observations will be needed to determine if this display is characteristic of the courting party situation or if it is more typical of the situation where a male displays alone beside a female.

Bowing. I saw very little of this activity, described by Humphrey. In one case it shows clearly in the movie, as a single forward and back movement of the head and neck, quite like an exaggerated swimming action and as Humphrey points out " very similar to that used by both sexes when disturbed or curious." In the movie, it was given by a male which was swimming quite close to the female, in the presence of another male.

Chasing. Overt aggression in the form of chasing and fighting was infrequent, as Gunn found when watching the European race. I saw a few chases where one male rushed across the water after another, but perhaps in this species, dominance relations among the males are settled without much direct contact. Often slight intention movements of chasing by one male were eonugh to make another male swim off a little way.

Behaviour of the female. The female is the focal point of the courting party and as she changes direction the males alter their course accordingly. She frequently makes threatening movements toward some of the males, turning her head toward the male in question and pointing the bill slightly upward. In more vigorous threat, the head is lowered to point directly across the water at the other bird. At times the female swims with the tail partly erect and she also gives head-shakes.

Copulation. I saw copulation only once, and I did not see the whole sequence of events which preceded mounting. The birds were noticed as the male performed a shake beside the female who had her head stretched forward above the water. He then mounted and copulation occurred. There cannot have been prolonged pre-copulatory display by the male in this case, as I had been watching the pair shortly before. After dismounting, the male adopted an erect posture and gave the whistling call several times.

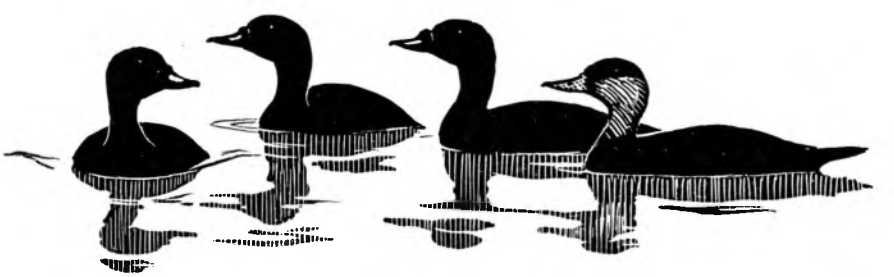
Conclusions. These observations are not sufficiently detailed to provide much evidence on the motivation and function of the displays. They are presented mainly to provide a basis for comparison with other species so that attempts can be made to define homologous behaviour patterns.

Further studies are needed on the Black Scoter and on the related species which are grouped in the tribe *Mergini* (the other Scoters, Goldeneyes, Bufflehead, Oldsquaw, and Mergansers). The Eiders were formerly included in the *Mergini* (see Delacour and Mayr, 1945; Scott, 1949) but recently Humphrey (1958) has suggested that they are more closely related to *Anas* than to the *Mergini,* and Scott (1957) adopted this arrangement in the " Coloured Key to the Wildfowl of the World." I believe that the problem of the relationships of the Eiders, and of the *Mergini* group as a whole, remains to be settled and a comparison of displays will certainly throw light on this subject. Delacour and Mayr (1945) have shown how behaviour patterns can be used as taxonomic characters in the Anatidae, while Lorenz (1941, 1953) used displays to determine relationships within the *Anatini.*

A detailed discussion of the relationships of the *Mergini* based on the evidence from displays would be premature at this time. Knowledge of many species is fragmentary, though several studies are in progress in North

America which will help to fill some of the gaps. Until we know for sure which species have and which do not have the various displays, and until our background knowledge of the significance of the displays themselves is devoloped, it will be difficult to establish homologies with confidence. When accurate and detailed descriptions of displays are available for many species, then we will be in a better position to synthesize and generalize.

Acknowledgements. This expedition was financed by the Wildlife Management Institute, and I am particularly grateful to Dr. Ira N. Gabrielson and Mr. C. R. Gutermuth for encouragement and help. The U.S. Fish and Wildlife Service in Alaska gave invaluable assistance and I am especially indebted to Mr. Urban C. Nelson and Mr. Robert D. Jones. Mr. H. Albert Hochbaum read the manuscript and made helpful suggestions.



Black Scoters

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WILDFOWL OF THE HEMIARCTIC

P. M. Driver

In the minds of many people the "Tree Line" is probably pictured as a more or less straight line of timber separating the snowy wastes to the north from the forest to the south. This picture, of course, is not a true one. Where the conditions in the North become too severe for trees to survive, the plant cover in any one area is very variable indeed. This is due to the fact that the terrain is seldom completely flat and unobstructed, and so the effects of wind in particular will vary considerably. The trees therefore die out gradually as one travels north, remaining in sheltered pockets far to the north of bare ground that is exposed and windswept. Wherever there is the lee of a rock, a hollow in the ground, or particularly the valley of a stream, trees will continue to survive in the struggle against the climate.

Other plants such as Willow and Dwarf Birch will survive in sheltered areas also, and so the fringe of the tundra is a sort of "emulsion" of scrub and small coppice in the irregular and undulating expanse of tundra. This emulsion has been well-named by Rousseau "The Hemiarctic." It is not truly arctic in the sense of wind-swept wastes of permafrost, but it has large arctic patches in it. The islands of scrub provide shelter for smaller plants, and animals, too, and so the Hemiarctic presents a fascinating ecological area where scrub-living organisms are becoming fewer and arctic ones taking over.

This principle applies to wildfowl as well as to other animals, and makes the task of authors of bird books more difficult. Snyder, for example, in his "Arctic Birds Of Canada," finds all records north of the tree line of Black Duck, Green-winged Teal, and American Goldeneye, among others, of sufficient interest to print.

I spent 3 months in the summer of 1958 with my assistant, C. W. Nicol, in the Hemiarctic to the south of Ungava Bay. This lies between Hudson Bay and Labrador and carries a large population of Sea Ducks, of various sorts, scattered around the coasts and estuaries. As the " Tree Line " however reaches the southern end of Ungava Bay, one may also find species of ducks not characteristic of the Arctic, and I will attempt to give an impression of the wildfowl population of the region by referring to the birds seen by us. Where possible, I will give the local eskimo name for the species.

It must be borne in mind that for much of the time we were restricted to the area of camp some 15 miles upstream from the Bay, but we did make occasional trips across the Tundra and up and down the river.

The Canada Goose (*Branta canadensis,* "Nudlik") is quite common in this area, breeding in isolated regions of scrub near water. At the end of August they were to be seen everywhere in groups of up to 20.

The Pintail (*Anas acuta,* "Ivurak") is also fairly common around False River. On a number of occasions we saw 1 or 2 near camp, male and female and immatures . I never became quite accustomed to seeing Pintail and Long-tailed Ducks on the same pond.

Much more common was the Black Duck (*Anas rubripes*). Snyder notes "Representatives of this species resort to the fringe of the arctic during the post-breeding period. Has been recorded for the estuary of the False River—

Aug. 25, 1948——." I cannot believe that other ornithologists than myself have not seen this species on the fringe of the Arctic. In our area it was common and breeding successfully. Blacks were seen almost every day throughout the season, and in August after fledging were particularly numerous. On 15 August, for example, Nic reported about 100 on Kohlmeister Lake, while I had myself seen 45 in one group elsewhere. Again, on 31st August I saw in the river a flock of 20 plus another group of about 50.

Green-winged Teal (*Anas crecca carolinensis*) are seldom recorded from the true Arctic fringe. It was interesting therefore to see a pair—apparently in their "loafing territory"—at the south end of Kohlmeister Lake on 3rd and 4th June, although one might expect it because the terrain here is wooded in the low-lying areas. Unfortunately we were not staying in the area, but later in the season a "small brown duck" with recently hatched brood was reported from near the same spot, and I much suspect that this represents the same family.

I only saw the Greater Scaup (*Aythya marila mariloides*) on one occasion —6 June—when there was a pair on a pond near camp. As Snyder says, this is "a subarctic species which strays into the fringe of the Arctic largely west of Hudson Bay."

One of the most interesting birds to see on the edge of the Barrens was the American Goldeneye (*Bucephala clangula americana*). This is a tree-nesting species and is supposed to be very rare north of the trees in the breeding season. I was therefore pleased to see this species in appreciable numbers through June, July, and August. I strongly suspect that False River is used as a "Summer Camp" for non-breeding males. Not once did I see a definite female, although there were flocks of up to 450 in the river whenever we moved between camp and the islands. The last record I have is for 31 August when I saw 20 individuals in the river.

The most numerous ducks in the area were—as one would expect—the Sea Ducks. The Long-tailed Duck (*Clangula hyemalis,* "Akik") was locally common throughout the area. This is a very widely distributed duck in the Arctic and breeds near tundra lakes and ponds. On 3 June we saw about 1,000 individuals in the estuaries of the Koksoak and False Rivers and in the Bay between them. This was shortly after the break-up of the river ice and the birds had not then dispersed to their breeding areas. Shortly after this, however, they had spread out over the tundra and by the end of July females with young were to be seen on the tundra ponds. One brood which I kept under observation became fully fledged on 1st September.

The Harlequin (*Histrionicus histrionicus histrionicus,* "Toolayonuk") did not breed in our area; they prefer fast running coastal or fresh water. On 6th August, however, a female appeared in the river with one young one just about fledged. Others were reported from the mouth of the river at about this time, and it looks as if the known breeding population on Baffin Island, and perhaps from the Labrador peninsula, spread southwards after the young leave the nest.

A very common duck in the area was the Northern Eider (*Somateria mollissima borealis,* "Mitik"). This species was breeding on islands in False River up to 10 miles from its mouth. On Humph Island, some 10 miles from the Bay, there were about 20 nests; on Middy Island, 2 miles north of this, about 26 nests, and on Bladder Island, nearer still to the mouth of the river to

the north, an estimated 6 nests. (The names for these Islands are my own—after 3 friends.)

During the breeding season the largest number of Eiders seen in one day was 320. At the end of August, however, we came upon a huge pack of Eiders in False River estuary. This pack consisted of adult and immature birds of both Northern Eider and King Eider, and numbered some 2,000 birds. I strongly suspect that the Eider colonies from this part of south Ungava Bay, and possibly from further afield, congregate in sheltered bays in the estuaries at this time of the year for the good feeding that seems to be there.

The Eider colonies in the river suffered considerably through predation by eskimos during the breeding season. Most of the Eiders on Humph and Middy had to lay a second clutch due to the first being taken by eskimos or by gulls when the female was frightened off the nest by eskimos, leaving the eggs uncovered.

The King Eider (*Somateria spectabilis,* "Kingalik"), as suggested above, must breed somewhere within easy reach of southern Ungava Bay, because of the presence of non-flying young in the pack seen on 31 August. We also saw ones and twos on 3, 18 and 20 June, when we happened to be passing the island area. Doubtless we would have seen more if we had been down the river more often, but the interesting point is that they do come so far south into the southern arctic fringe.

The Black Scoter (*Melanitta nigra americana*), while characteristically a sub-arctic bird was also present in False River during the summer, flocks of about 50, mostly males, being seen in the river between the islands on 6 June and 7 July, as well as a few individuals at other times.

The White-winged Scoter (*Melanitta fusca deglandi*) was also seen but in smaller numbers. On 18 June there were 2 in the river, and on the 26th there were 8, including 5 males. None was seen later.

A species we expected to see (and did) was the Red-breasted Merganser (*Mergus serrator serrator,* "Noovalik"). This sawbill has a breeding range extending north into the southern arctic and was breeding in moderate numbers throughout our area. On 6 June, for example, there were 5 pairs in the river near camp. Well grown young were seen from the beginning of August.

This brief account may serve to show the variety of species of ducks to be seen in certain regions of the Arctic fringe. During the summer of 1958 we saw, in one relatively small area, ducks of 12 species belonging to 4 tribes; a selection which can be expected in few places other than Collections.

IMPRESSIONS OF WILDLIFE IN CANADA IN THE SPRING OF 1958

S. K. Eltringham

ARRANGEMENTS were made by the Nature Conservancy for two members of the Wildfowl Trust scientific staff to visit Canada in the spring and summer of 1958 to observe the techniques of aerial surveys which are carried out by the U.S. Fish and Wildlife Service at that time of year. We had recently commenced aerial surveys of wildfowl in this country but a few months' flying had sufficed to demonstrate the many difficulties inherent in the technique, so it was hoped that such a visit would enable us to learn something from the experience of the Americans who have been flying these surveys for many years. The necessary funds were generously supplied by the Nature Conservancy and, in order that the grant should be used to its best advantage, the visits were made separately so that an observer could be in Canada for both the spring and summer surveys. I was there during May when the surveys of breeding pairs are made, while Mr. Hugh Boyd watched summer surveys of broods flown in July. It is not my intention to give a detailed report of the aerial survey techniques—some attempt at that has been made elsewhere in this Report—but perhaps a few of the many impressions gained of Canada and its wildlife may be of interest.

We had not long sailed before it was impressed upon me that I was soon to see many new and strange wild birds and mammals, for on the second day at sea an Albatross, a wanderer from the southern seas, kept pace with the ship, flying low over the water, using the upcurrents of the wind over the waves to keep it aloft. No less spectacular that day was the sight of the S.S. "United States" plunging through the rough sea at what must have been nearly 30 knots as she overhauled our not inconsiderable ship as quickly as if we had been some small tramp steamer. A further adventure next day relieved the monotony of the ocean when we passed within a few feet of a school of dolphins. Luckily I happened to be watching that part of the sea when they surfaced and I think I was the only person on the deck to see them. After that the many Fulmars that accompanied us for the last few days of the voyage seemed almost commonplace. The passage up the St. Lawrence was most impressive and we stopped at Quebec just long enough to enable me to obtain a glimpse of the old city. The walk from the docks to the town is long and unprepossessing and left very little time to see very much although I was rewarded by my first glimpse of a Mountie.

The next day I disembarked at Montreal and began the long train journey to Regina, Saskatchewan, where my tour was to begin. The route took us through pleasant wooded country and skirted the shores of Lake Superior which I found difficult to believe was a fresh water lake as I watched the huge breakers rolling in from a wide and watery horizon to crash ponderously upon a rocky coast. Although the skies were blue and the sun shone, there were indications that winter had not been left far behind. There were piles of snow in the woods and broken ice on the ponds and I was glad enough to climb back into the heated train when I got out to stretch my legs at Winnipeg. Once out on the prairie I began to see why I had come all this way, for everywhere there were ponds or sloughs, as they are called out there, and on each slough there were several pairs of ducks. Pintail and Mallard

predominated while Shoveler, Baldpate (American Wigeon) Blue-winged Teal and Lesser Scaup were very common. The Gadwall was seen occasionally but the Canvasback and Redhead were not much in evidence, although they are not rare.

Regina, I am told, is a beautiful city and certainly it has some fine modern buildings, but its unrelieved flatness did not strike me as attractive. However, whatever deficiencies it may have had were more than made up for by the warm hospitality of its people. Mr. Tom Harper of the Saskatchewan Wildlife Branch was most kind to me and introduced me to many of the men who had been making aerial surveys and I was able to hold many long and fruitful conversations with them. I was also privileged to meet Mr. Fred Bard, Director of the magnificent Provincial Museum of Natural History which was opened in 1955. The museum appears to be doing very good work for, although its collections are not large, the exhibits are displayed to their best advantage in large showcases with skilfully painted backgrounds. Teaching and research play a large part in the activity of the museum staff. There is a fine lecture hall in which films and lectures by staff members or visiting naturalists are well-attended. The museum scientists are responsible for plotting the track of the Whooping Crane which migrates through this part of Saskatchewan. Mr. Bard is a member of the twelve-man Whooping Crane Advisory Committee and the museum naturally takes a close interest in the status of this very rare bird which is on the verge of extinction. In the spring of 1957 only 27 Whooping Cranes were seen on their migratory route which passes from Texas through Saskatchewan to the Canadian Arctic. Because of this long migration, made twice each year, the natural hazards to which the birds are subjected, form a grave threat to the perpetuation of the species and it would appear desirable that an attempt to save the bird should be made through an avicultural programme. The successful work of the Trust with the Ne-ne is an obvious parallel. However, there is strong opposition from several well-known ornithological societies in America to the capture of any wild Whooping Cranes. This is unfortunate as the maximum reproductive potential of the species is not being realised in the wild for, although two eggs are usually laid, no more than one young is ever seen in a family party. If an analogy can be made with the Sandhill Crane, a near relative of the Whooping Crane, it is probable that the first young to hatch causes the death of the younger nestling by preventing it from feeding. If the breeding grounds of the Whooping Crane were not so isolated it might be possible for the second egg to be taken and hatched in captivity. Failing this, however, if only a few of the young birds were captured each year, it should be possible to build up a captive flock, for the birds have bred in captivity. At present about half a dozen are being kept and there is a breeding pair in the New Orleans Zoo, but no properly co-ordinated effort at a rearing programme is being made. It seems that if nothing is done this magnificent bird will very shortly join the ranks of the Dodo and the Passenger Pigeon.

While I was in Regina I had the opportunity of visiting the Wascana Waterfowl Park which is being developed under the surveillance of Fred Bard. The project is as yet new but seems to have great possibilities, for the area, a shallow natural lake surrounded by marshy ground, lends itself for a wildfowl sanctuary. There is, however, much local apathy and unfortunately the civic authorities have destroyed much of the habitat by 'tidying up' the shoreline with vast quantities of soil. The area is unfenced and a lot of trouble

was being experienced from dogs which were disturbing the nesting geese. As a protective measure Mr. Bard is experimenting with raised nests which seem to be successful as long as the nesting birds cannot see each other. Canada Geese were brooding while I was there and many species of duck were in evidence. I was perhaps more intrigued with many strange song birds, such as the Bronzed Grackle, Yellow-headed Blackbird and the Red-winged Blackbird which were new to me. The American Robin, a thrush and less elegant than our own Redbreast, was also very common.

At Regina I met Fred Glover of the U.S. Fish and Wildlife Service and flew with him to Edmonton, Alberta. The flight took us over some of the most productive duck country of North America, in fact the area is known to the hunting and biological fraternity as the Duck Factory, and from the air it was not difficult to see why the region is so suitable for ducks. The first part of the trip was over grassland prairie which is dotted with small sloughs of an average area of less than $\frac{1}{4}$ acre, giving the impression of a battlefield scattered with craters, each the home of one or more pairs of ducks. After a while the countryside changed and we were over the parklands, which resemble the grassland prairies except that each slough is surrounded by a grove of aspen trees. The effect from the air is particularly attractive. The next day we flew to Calgary, among the foothills of the Rockies which could be seen on the horizon. Calgary, like Edmonton, is a city where the American influence is quite marked. From Calgary I was able to fly with the survey crew who were carrying out their regulation flights along transects over the prairie in making an inventory of the breeding pairs of ducks. The four hour flight at a height of 100 ft. gave me a good opportunity of getting a close look at the country. The trip to the Saskatchewan border was over a large area of bald prairie, that is grassland prairie which has not been cultivated and which must appear now much as it did before the first settlers came, except that Hereford cattle have taken the place of the herds of Buffalo (American Bison) that once wandered all over North America. It is magnificent country, wild and undulating with occasional creeks and rivers in impressive gorges, of which the most striking was that of the Red Deer River which is spectacular and yet unspoiled. A few miles of such a river in this country would, I am sure, become a popular tourist centre with its concomitant plethora of hotels, restaurants, ice cream kiosks and car parks. Besides the many ducks we saw several Coyotes and I counted nine Antelopes in pairs or singly. This is the only antelope found outside Africa, although it is not closely related to the African forms. Their white rumps flashed prominently as they dashed wildly away at the approach of the aircraft but the Coyotes were more blasé and barely managed to look up as we passed over.

That afternoon we flew back to Regina, passing a large breeding colony of the North American Pelican on an island in Lake Johnstone, otherwise known as Old Wives' Lake. The origin of this more romantic name goes back to the time of the Indian tribal wars when a strong band of Indians had one evening besieged a smaller tribe near the lake. While waiting to administer the *coup de grâce* in the morning the invaders were careful to keep an eye on their foes, making sure that they did not escape during the night. Realising this, the would-be victims decided to sacrifice the old women of the tribe who dressed up as braves and tended the guardposts for the rest of the night while the wily young warriors made their escape across the lake. The old women were less fortunate and were slaughtered in the morning but they are

remembered in the name of the lake where now only the mild quarrelling of the nesting Pelicans disturbs the peace of this beautiful spot. Although I would not have missed this sight of the colony from the air, it was not until later, when I saw single Pelicans soaring overhead, that I was able to appreciate fully the size and also the grace of these apparently ungainly birds.

Before I left Regina I was taken on a car tour around Last Mountain Lake north of the city. The lake is about 50 miles long although never more than about two or three miles wide. We saw many ducks and I was able to appreciate the tediousness of ground surveys which were, and in some places still are made from the roads in lieu of the aerial transect system. The trip took us to some of the remoter farming country and the small towns had the appearance of a film set for a Wild West show.

I was sorry to leave my many friends in Regina but arrangements had been made for me to stay at Kindersley in west central Saskatchewan where I was able to see some of the fine work on the nesting behaviour of the Mallard which is being carried out by Bernie Gollop and Alex Dzubin of the Canadian Wildlife Service. For this purpose a study area of $10\frac{1}{2}$ square miles had been set aside near Pinkham, about 12 miles from Kindersley. This area is rather too large for two men to work without help, but the Canadian Wildlife Service and the Provincial Wildlife Branches have instituted the admirable office of Summer Assistant which is filled by University students on vacation. Summer vacations are rather longer in Canada than in England and consequently the student obtains some four months' experience of wild life management and first hand acquaintance with the many problems and hardships of field work. Such experience is probably instrumental in deciding many young zoologists to seek laboratory posts. The work has the additional advantage of helping to pay the student's way through college. How much better this seemed than vacation jobs as dishwashers, etc., which, whatever questionable value they may have in developing character, add nothing to the students academic education. At Kindersley four summer assistants were helping with the work on the Mallard nests which were first located by a systematic beating out of the rosethorn vegetation, here growing to a height of a couple of feet. This is a tiring and painful operation, even with the protection of canvas trousers, and the lack of these excused me from jobs more onerous than the mapping of various nests as they were discovered. This is an excellent way of finding nesting ducks and also any other wildlife that happens to be using the brush, including porcupines which it was extremely difficult to dissuade one of the dogs from attacking, despite a period of veterinary treatment necessitated by a previous encounter. Porcupine quills are barbed and can cause festering wounds in the mouth of any dog foolhardy enough to bite one. The Canadian Tree Porcupine is supposedly strictly a forest creature as it feeds on the bark of trees, but here it was maintaining itself on the bark of the rose bushes. They make no attempt to escape when discovered and defend themselves against attack with their tails. On one occasion we disturbed a family party and I was surprised to find that the young is black in colour.

The Striped Skunk was also quite common amongst the brush to which it was attracted by the ducks' eggs. They, too, made little attempt to escape and, although economical in the use of their scent glands, needed to be treated with respect. One of the party discovered a specimen by tripping over it and was

lavishly sprayed as a result. The smell is quite peculiar and most unpleasant. I discovered by experiment that their range was not quite 10 ft. although the specimen I was prodding had already had a go at someone else and was perhaps not at its best. Their defence posture is tail up and back to the foe which is closely watched over the shoulder. The dogs would never attempt to press home an attack upon a Skunk. Skunks and Coyotes were believed to be the principal nest predators although the Thirteen-lined Ground Squirrel and Franklin's Gull are also known to take eggs. A high proportion, sometimes as much as 80%, of the nests which we found were subsequently discovered to have been destroyed.

Several nests of the Short-eared Owl were revealed. One of these contained six young in markedly different developmental stages, as well as an egg. The eggs are laid at intervals and incubated immediately.

Many of the duck nests were at considerable distances, sometimes well over a mile, from the nearest pond and the losses of young birds during the long trek to water soon after hatching are known to be considerable. Originally the females had nested by the side of sloughs but these had subsequently dried up for the rainfall had been slight that year. In this way the effect of a wet or dry spring on wildfowl production can be profound and for this reason a count of the number of wet sloughs is made during the spring and summer aerial surveys and is used in forecasting the number of duck that will be available for shooting in the autumn.

While I was in Kindersley I accompanied Bernie Gollop and Alex Dzubin on two of the weekly censuses of the ducks in the study area. The principal events on these particular censuses were the sighting of three Buffleheads (a pair and a juvenile male) and two pairs of White-winged Scoters, but only two Canvasback were seen. As far as possible the census is made from a car as this seems to have a less disturbing effect upon the ducks than an observer on foot. The art appears to be to effect a compromise in choosing an observation point that is close enough to the birds to allow for adequate identification and counting, yet sufficiently far away not to flush them to another slough where they might be counted again. While returning from one of these censuses we were surprised to see an Antelope cross the road in front of the car. It is most unusual for this animal to be seen so far north.

One evening Bernie Gollop took me for a forty mile run down to the South Saskatchewan river which here is fast flowing through an impressive gorge, with minor valleys or coulees running at right angles to it. Antelope, Canada Geese and the Golden Eagle are reported to live here but we saw no sign of them on our visit. However, I was delighted to see at close quarters two male Mountain or Western Bluebirds which were quite as colourful as I had expected them to be. I was intrigued by the ferry across the river. It was attached to overhead cables but its sole motive power was the flowing river itself which acted hydrodynamically upon the boat when it was pointed upstream. It was a beautiful spot to which Bernie would retire whenever he felt the need of spiritual refreshment after a frustrating day in the field.

I left Kindersley with regret as my two weeks there had been most enjoyable but I was looking forward to seeing something of the parkland prairie at Vermilion, Alberta, which was to be my home for the next few days. Here I was well looked after by Harry Webster and Bob Harris of the

Canadian Wildlife Service. Harry Webster, with the help of Jim Lowther, a summer assistant and the only bearded man I met in Canada, was working on a study area in the form of a transect 50 miles long by 220 yards wide, running from the North Saskatchewan River near Elk Point, 30 miles north of Vermilion, to Buffalo Coulee, 20 miles south of the town.

Intensive ground counts are made of the duck within this area, a procedure which takes three men working from dawn to dusk four and a half days to complete. For comparison counts are made from the air of the same transect. That this is a simpler technique is illustrated by the fact that the transect is flown in half an hour. The results of this and similar work elsewhere are extremely valuable in evaluating the accuracy of the extensive aerial surveys which are made of duck populations in North America. One day I was taken along on a demonstration ground ' beat out ' which I found most interesting and enjoyable although I can well believe that four and a half days of it are quite enough. I was privileged to be given a few flights over the transect. This was most instructive and Harry and I were able to compare notes which surprisingly did not wildly disagree as far as the identified birds were concerned. The weather was perfect while I was in Vermilion, similar to the best summer weather that England can produce, and the countryside was free of the gigantic mosquitoes which occupied a deal of my attention at Kindersley. Consequently my memories of this stay are of the pleasantest. The beauty of western Canada lies in the countryside, particularly the wild countryside, for the towns are shoddy and unattractive, reminding one of a rundown holiday camp. Perhaps in a few years the small Canadian town will not exist as most of the young people are migrating to the big cities while more and more farmers are shutting up their farms for the winter, which, in Canada, means October to April, and moving to the city.

Towards the end of my visit Harry and Bob decided that I ought to see a bit of the wilder spots and arranged for a fishing trip to the Frog Lake region, east of Elk Point. Here the country is well wooded, being on the fringe of the coniferous forests which stretch far north to the treeless Arctic. The area was an Indian reservation and I was eager to see something of this attractive race. The route to the lake led us past a monument recording, tactlessly I thought, the massacre of white settlers by a rebel Indian chief towards the end of the last century. According to a little Indian boy, to whom we had given a lift, the best place for fishing was not Frog Lake itself but the appropriately named Fishing Lake a few miles away. This was reached at the end of a narrow twisting lane where we hired a boat from a blue-eyed Indian who was delighted to meet someone from England, as he had been stationed in Sussex with the Canadian forces during the first war. We had brought our own canoe so with Harry and I in the boat and Bob and Jim in the canoe we started to fish. As a fishing trip it was a farce for, although we saw fish occasionally, none condescended to bite. Our inferiority was impressed upon us by the only other occupants of the lake, two men in an outboard, who slipped past us on the way home weighed down with fish of all descriptions. We felt that they must have denuded the lake until, on returning to the shore and when only a few yards from the jetty, I felt a tug on my line as I was winding it in. I am an absolute novice as far as fishing is concerned and, in fact, I can only remember fishing on one other occasion previously, so it gave me no little satisfaction to reel in a fair sized ' jack pike,' while the experts had to land empty handed. However the fishing was

incidental to the enjoyment of the afternoon. We got to within a few yards of a Great Northern Diver, the Loon, whose wierd cry Bob was able to imitate in an attempt to persuade it to call back to us. There were many ducks, coots, grebes and strangely marked gulls, while a pelican sailed lazily past about 50 feet above us. The sun shone through its wings, outlining the limb bones and with its long snout reminding me a little of a Pterodactyl. We paid off the Indian for his boat and Bob bought two fish from him—no doubt this is a lively trade with unsuccessful fishermen. On the way back we had a good view of a large Porcupine standing in the road. We stopped as it made off and found its den of pine needles in the roots of a fallen tree. Also on the road was a dead Ground Hog which had been hit by a car. As it was not badly damaged it was taken on board by Bob who wished to prepare and mount the skin. The animal, with which I was not familiar, is a large rodent. A further stop was made in an ineffectual attempt to catch the sitting hen of a Hungarian Partridge whose nest had previously been located. This introduced bird, which is identical with our own Partridge, is remarkable for its large clutch and this specimen was brooding 24 eggs.

The next day I was due to leave Vermilion and Harry ran me into Edmonton, about 120 miles away, where I was to catch a train to Medicine Hat and stay the weekend with relatives. On the way in we paid a visit to Elk Island National Park which is the home of a large herd of Buffalo, besides Elk (Wapiti) and Moose. The park is densely timbered so that it is very difficult to see anything in it. It was raining heavily when we arrived and the dirt roads had become rivers of mud. We were very nearly bogged down on several occasions and had to turn back without seeing any Buffalo, much to my disappointment.

After an enjoyable stay at Medicine Hat, where I was introduced to the drive-in movie amongst other modern amenities, I moved on to Delta in Manitoba, stopping for the day in Regina to pay my farewells to the many friends I had made since arriving there. Careful readers of these Reports will be familiar with Delta so there is no need for me to expand further, save to say that the hospitality of Al Hochbaum was all that I had been led to believe. I enjoyed meeting Frank McKinney, late of Slimbridge, who had just returned from a couple of months in Alaska where he had been studying and filming the social and sexual behaviour of Pacific and Steller's Eiders. One event at Delta I feel I must mention was the sighting of a pair of Hooded Mergansers, the first I had seen in Canada.

And so my tour of Canada had ended. I stood on deck late at night as we slipped down the St. Lawrence and saw for the last time a wonderful display of Northern Lights. The sky was quite clear and was covered from one horizon to the other by a changing shimmering pattern of light. The next day in the Atlantic we passed close to icebergs which, as a result of the spring thaw, had by now reached the shipping routes. The remainder of the voyage was boisterous but uneventful and we arrived home to find England in the midst of a heat wave. Even after such a short absence, I was impressed by the lush greenness of England compared with the more arid conditions of the Canadian prairie.

A VISIT TO SOME EUROPEAN ZOOS

C. N. Vaisey

(Illustrated by Keith Shackleton)

TOWARDS the end of August, when the last of the season's hatch of goslings and ducklings were feathered and reasonably safe, a small party from the Trust including the Curator and Mrs. Johnstone took a busman's holiday, crossed over to the Continent and visited some of the zoos and wildfowl collections, exchanging views of the care and upkeep of the birds. The Zoos of Rotterdam, Antwerp, Hamburg, Cologne, Copenhagen and Stockholm and one or two private collections had been visited previously, but in 1958 the programme was rather more ambitious.

The 'Vanguard' containing the party and their luggage crossed from Dover to Ostende on 20 August and proceeded non-stop to Rotterdam.

On the journey it was noted that the harvest, mostly wheat and barley, was either already cut and stooked or actually being cut. No combines were seen and the carting was being done by farm waggons pulled by three lovely Percherons; six or eight sheaves to a stook and tied round the neck, straw four to five feet long. Between St. Niklaas and Antwerp for several miles on either side of the road were acres and acres of gorgeous begonias, of every imaginable colour and shade.

21st August. A morning visit to Mynheer Schuyl, a dealer in and breeder of wildfowl, who lives on the outskirts of Rotterdam. His estate is about an acre in size with, of course, a good supply of water, since every house and garden in these parts is separated from its neighbour and the highroad by a rhine, or its local equivalent. There is a large dry barn on the right, the floor of which is divided into pens and covered with dry peat. Infra red lamps are installed. Outside, each pair of birds has its pen and water separated on either side by a wooden partition about 3 ft. high, so that they do not see each other.

One pair of Hawaiian Geese is here on loan from the Trust, and appeared in excellent condition.

After saying goodbye to the Schuyls we drove to Blijdorp Zoo in Rotterdam where we lunched with Dr. Appelman, the Director, Dr. Van Bemmel, Assistant Director, and his wife, Colonel Geertsema, and Mr. Jack Death. Among the 83 species of waterfowl two Moluccan Radjah Shelduck (both males), three Spotted Whistling Ducks, and Smew were noted. The rare and valuable Manchurian Crane is represented and there is a fine collection of birds of paradise.

Pride of place amongst the animals must be given to the Clouded Leopard—surely one of the loveliest creatures in the whole world. There were, too, a pair of Lynx, with the fascinating ear-tufts; baby Servals about the size of small cats: both wild horses, Tarpans and Przewalskis: Pere David's Deer: and, of course, a pair of Okapis. The Okapi is found only in the Belgian Congo and is very strictly preserved. The cost of one animal is about £2,500. The history of the Milu or Père David's Deer is very interesting. Originating in East China they were exterminated there about a hundred years ago. A few pairs were rescued from various zoos (after the last had been wiped out in the Imperial Park at Peking) by the Duke of Bedford and brought over to England. He succeeded in breeding quite a large herd from these, and in 1956 two pairs from this stock were sent back to Peking. Not unlike what may one day be done with the Ne-ne, we hope.

Blijdorp Zoo issues a small guide in English, full of very useful information about animals and birds as a whole, and without bragging unduly about their own specimens—probably the shortest introduction to the living animals of the world ever published.

22nd August. Rotterdam being our headquarters for the next four days, we decided to leave the car there and go by train to Brussels where we had an appointment with the head of a firm of colour printers. One of the reasons for this was that we hoped to get our business done early and then pay a short visit to the Exhibition, and we doubted the car-parking arrangements; as a matter of fact we need not have done so, as we found there were parks to hold 5,000 cars all round the Exhibition. These were without attendants, a steady green light showing as long as there was a space available, but as soon as each park was full a winking red light warned drivers to try the next place.

Having finished our business in the city we were very kindly driven to the Exhibition. It was then nearly lunchtime and as we were due to visit Antwerp Zoo on the way back we had not much time to spare. It is obvious that when only a few hours are spent at such a vast Exhibition of this sort only very hazy impressions can be recorded.

For noise, ruthless efficiency, power and enterprise, the Russian Pavilion with its two Sputniks, the long central avenue with its endless clanking machinery on either side and, at the end, the huge overpowering statue of Lenin, was the most impressive. But we were grateful for the quiet relief of the British Pavilion, with its pageantry of distinguished figures in their Coronation robes, the quiet music, and at the turn of the stairs, that exquisite painting of the Queen.

M. van den Berg, the Director, and M. Carpentier, the Curator of Birds, showed us round the Antwerp Zoo. It is a pleasant, compact and tidy place with plenty of water, streams and ponds, and has a good and well-cared-for collection of some 60 species of waterfowl including African Pygmy Geese and Hartlaub's Ducks.

Other birds of note were Black Guinea Fowl, Great Bustard, Congo Peafowl (the first specimens to live in any Zoo). They have also a Manatee, a pair of Maned Wolves, Owl-faced Monkeys, Tarpans, and Gerenuks. The history of the Okapi here is a sad one. The first calf produced was killed by the mother almost as soon as it was born. The second she attacked as soon as it touched her teats, but spared it until the third day when she knocked it down and trampled it to death. The third calf was removed from the female as soon as it was born and put in an incubator, but the heat of this went wrong for two hours during the night and the calf failed to survive. The female is again pregnant and we wish them all luck.

We wish them all luck

23rd August. On our way to Amsterdam we stopped at Delft, a very pretty place with canals, old Dutch buildings and everything an artist could wish for, but a little sad for us as we failed to find what we went for.

Continuing our journey to Amsterdam we passed through huge fields of wheat, almost all stooked, only one combine being seen on the whole journey. The special breed of Fresians, which M. Schuyl had explained to us last year came originally from one island only, seemed very popular as we got nearer Amsterdam and good grass land. These beasts have only a white face, a white stripe on the belly and a white udder—all the rest is pure black if they are of this special breed.

We had lunch in Amsterdam and visited a fine Exhibition of Old Dutch Masters; very interesting, especially as there was a demonstrator in each room who collected groups of visitors and explained the pictures to them. Two hours was indeed better than nothing and it was possible to see the originals of so many pictures that one had previously only seen in reproduction.

After lunch we visited Wassenaar Zoo. The waterfowl looked sad in a muddy compound, several birds looking very bedraggled. The large outside aviaries for the Vultures were however quite good. The pride of the place is a huge glasshouse containing the restaurant and countless small and medium sized birds, some in aviaries with pools, rocks, sand, etc., and some free to fly about and nest overhead in the many tall trees and creepers. The best of the birds were the Vultures, Eagles, Shoebills and Oranje Rotsoous. Recently several birds had been killed in one of the outside aviaries, though no trace of entry by a predator could be discovered. A layer of fine white sand was put down all round the outside and made quite smooth; the following morning small footmarks were found leading to a hole in the wire netting. A tunnel trap was put down and a weasel subsequently caught.

24th August. Drove to Soest in the morning to visit Colonel and Mrs. Geertsema. Their house adjoins the Royal Palace and their garden and collection of wildfowl is very pleasing; there is a stream running through their grounds and there are plenty of trees, shrubs and fine lawns and everything is done to make the birds comfortable. There are Black Swans, several kinds of geese and ducks, also cranes, and aviaries for pheasants and small birds. There is, further, a Green Parakeet that flies free amongst the trees in the garden but comes at once when the Colonel whistles and perches on his shoulder—always the left shoulder, we were told.

After sherry, biscuits and discussion we left and drove on to the Ecoput forest inn for lunch. Here J. Death gave us a very interesting talk on the points of deer antlers; the inn here and the hall at Colonel Geertsema's house were covered with antlers of both red deer and roe.

After lunch we visited the Man In't Veld brothers at Apeldoorn. They are dealers and importers of wildfowl and know quite a lot about their trade. The pens here had tap water only, with zinc trays about 4 ft. square and six inches deep sunk in the middle of each pen. A wooden platform about a foot wide is built all round this to prevent puddling. One pen held 400 Carolinas and there were 50 White-faced Whistling Ducks in another; all the birds looked well and contented.

25th August. Left Rotterdam at 11.30 a.m. On the outskirts of Tilburg, in the midst of a thick pine forest, we found the Zoo of the Van Dijk brothers,

a rather sad spot in the wet, as it was when we arrived, but nice and shady in the hot weather. The area must be about 9 or 10 acres and animal houses, pens, and aviaries are dotted about in the trees, widely separated and often without a distinct path leading to them. This 'Zoo' is really a transit camp for the animals and birds and the Van Dijk's boast is that you can buy anything you see as they are collectors and distributors of live stock from all parts of the world. Few are kept here permanently, or indeed even for long if there is a good market for them.

The wildfowl were mostly in one pen, a sea of mud on the day we saw them and not a blade of grass to be seen anywhere. The soil is black and peaty—it looked as though it were composed of sand with centuries of pine needles mixed with it—not unlike parts of the country around Bournemouth. There were hundreds of White-faced Whistling Ducks standing in the mud and shuffling their wings, 8 Whitefronts, 4 Red-breasted Geese, 2 Common Herons and, as is usual in these parts, half a dozen or so 'call ducks.'

All the aviaries were of the usual type and rather full of birds, including the following: nearly all the species of cranes, Cuban Flamingoes, Screamers, Hammer Heads, Purple Gallinules (53 counted), Nicobar Pigeons, and in one aviary of mixed birds were seven Rose-coloured Starlings, three of them singing lustily in the rain.

The food of the wildfowl seemed to be chiefly lettuce, runner beans and maize, the latter rather large and not crushed.

We were shown the carpenter's shed where all the crates were made; from the smallest to hold a few mice—no bigger than a cigar box, to the crates on rubber wheels that will take elephants and giraffes. In another shed there must have been sixty to eighty monkeys, each in a separate crate just big enough for them to move. (They travel best like this).

The walls of the pens and enclosures for the larger animals are faced with slabs of cement shaped like leaves and overlapping each other—sort of pancakes slapped, wet, one on top of the other.

The Van Dijks have their other business in the town of Tilburg itself. This is under the charge of the younger brother. The elder of the two, who had taken us round the Zoo, insisted on getting out his car and showing us the way. This place consists in the main part of four enormous buildings of four storeys each, possibly part of a grain store at one time. On each floor are thousands of small birds of every possible kind, in cages or small aviaries in three layers. The whole building is further filled with escapees who fly round overhead and cluster on the windowsills. The smaller birds were often mixed, but the larger ones — doves, parrots, etc., — were mostly all one kind in separate pens. It is quite impossible to estimate even roughly the number of birds here, but it must have run into many tens of thousands.

There were store rooms, offices, packing and despatch rooms on the other side of the road and, of necessity, another carpenter's shop.

After leaving Tilburg we made our way in the direction of Frankfurt; with some difficulty and in pouring rain we finally found beds for the night at Roermond, a very pleasant place indeed, but surprisingly empty; the dining room and food were good and mine host extended a more than warm welcome to us. All the tables in the lounge and sitting room were

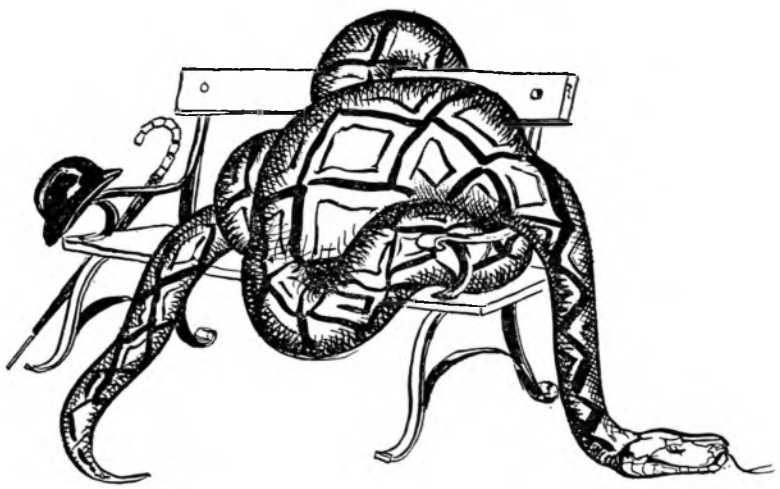
covered with hearthrugs—there seemed to be no special reason for this except that they matched the carpets.

26th August. Left Roermond at 8.30 a.m., joined the Rhine valley at Cologne and continued by the riverside to Coblenz. The vineyards we saw on the way were very wonderful, frequently seeming to flourish almost on the sides of a precipice. Several pairs of Buzzards were seen, but no Eagles yet. There were many oxen pulling heavy fourwheeled wagons, and also more than one pair ploughing. Ploughing with oxen must be a beautifully restful job compared with a Fordson Major.

We lunched at Boppard, by the riverside and thence to Frankfurt, crossing the river at Mainz; between here and Frankfurt we passed through large areas of market garden and were impressed by acres of asparagus on a scale never seen at home.

27th August. To Frankfurt Zoo in the morning. This is one of the many German Zoos that had been severely bombed, and, as a consequence of this 'slum clearance' all the pokey, out-of-date animal houses had to be replaced with, of course, large modern buildings and all the latest improvements and new ideas. Apart from this, it is a very progressive Zoo in every way and aims at interesting the unwilling public rather than merely amusing it. The name and a coloured print of each bird is displayed on a small board outside all the pens for everyone to see; and in addition there are large distribution charts for each animal in all the animal houses, and also a genealogical chart.

There is one other point of interest: no visitor is allowed to feed any animal or bird. If they do they are fined Dm. 2.50 and escorted to the exit! There are of course large notices warning the visitors of this regulation. As a consequence it is the cleanest zoo ever seen; none of the pens, cages and enclosures are littered with nuts, banana skins, biscuits, or bits of paper.



No visitor is allowed to feed any animal or bird.

The collection of wildfowl was small but well housed and in good condition, but there was nothing of special note among them.

There were two Lion cubs, only a fortnight old, playing in the straw in one corner of ther cage whilst their mother sat alone in the opposite corner. The zoo also has Black Leopards, Ocelots, Cheetahs and Caracals. All species of Apes are represented, including a Bonobo, the only other one in captivity being at Blijdorp, in Rotterdam. The most prized exhibit is a Zabra Antelope, the only one in captivity anywhere. The rare and expensive Gerenuks have bred here and successfully raised two young. You may or may not notice in one cage a queer little ' hedgehog thing ' poking its snout out of a bed of straw; anyone who troubles to read the description printed below the cage will discover that it is an Echidna: an Australian marsupial that lays an egg which it hatches in its pouch. The baby sucks the milk through its mother's skin as there are no teats.

One rather delightful exhibit in an out-door pen is a herd of Chinese Water Deer. The male has no horns but two tusks in the upper jaw, which project three inches or so outside the lower jaw.

At the exit of the lion house you may see through a large sheet of plate glass all the meat hanging in cold storage; the whole room is lined with white tiles, there are no flies and it would put many a butcher's shop to shame. All the food for the carnivora is cut up and prepared here, under the public eye. A quaint idea.

28th August. We arrived at Frankfurt Airport at 7.0 a.m., became airborne at 7.30 a.m. and touched down in Berlin at 9.10 a.m. Templehof is a fine airport. The aircraft taxi right up to the terminal buildings and one steps, under cover, from the plane into the building.

Thence by bus to Charlottenburg. A fellow-traveller—an American resident in Berlin—was our helpful guide on the journey. The bus dropped us outside our hotel in the Kurfurstendamstrasse. The Manager informed us that there was no telephone communication with East Berlin and no taxi would leave the Western sector. We could go to East Berlin by private hire car, and this we did. Our driver spoke perfect English and acted as guide and advisor. Approaching the Brandendurg Gate we saw Russian soldiers on guard at their vast War Memorial. The Tor, damaged but miraculously still standing, is surmounted no longer by a quadriga but by a Red Flag—not, our guide assured us, that of Russia but of Communist Berlin. Here the West Guards stopped us, but after a few words from our driver we were allowed through the gate to the Eastern police; we showed our passports, stated our business, and all was well—we were on our way. We drove through the abomination of desolation (20,000 people were killed in one raid we were told), past heaps of rubble that were once world-famous hotels and museums, past Hitler's Chancellery and death place, the wreck of the Reichstag, and from Unter den Linden into the Stalinallee. Here, under the inscrutable gaze of a massive statue of Stalin, is the shopwindow of Communism. The great width is divided by fine flower beds and the strasse is lined with vast buildings of cream stone—a mere facade, through which could be seen acres and acres of ruins. Here all the shops have a large H.O. displayed, signifying that they are state controlled.

Our faithful driver would not leave us at the Tierpark until he had been assured that they would be responsible for bringing us back before nightfall.

We were taken round by Herr Grummt, the Assistant Director, and Herr Michaelis, who was the Publicity Officer but could speak little English; nevertheless the deference shown to visitors from the Wildfowl Trust was obvious and gratifying.

The East Berlin Tierpark is vast—400 acres in extent—but unfinished; it may some day become a sort of super Whipsnade. Parties of women were digging, putting in posts for fencing, etc.—all volunteers, the Director told us.

The collection of waterfowl was very good; they have 68 different species including a Black Spurwing, but no *Mergus* of any kind. There was plenty of water, but the grass where most of the birds were was long and coarse and obviously not cut at all. Food seemed to be wheat, maize and bread. Plenty of fish, both small and large, but dead, were being fed to the Pelicans, Storks, Cranes, etc.

Most of the animal houses and bird aviaries are as yet rather primitive and there are few new ones, but the paddocks and out-door pens are splendid: in most of them there is nothing but a ha-ha or water to keep the animals in their place. The magnificent Polar Bear enclosure must have had thousands of tons of huge rocks brought in and erected—there is even a waterfall of possibly 20 feet into the pool below.

There had been here the Giant Panda which was caught in Red China and so was sent first to the East Berlin Zoo, but as the price asked was fifty thousand dollars, it was sent on to Frankfurt and after that to London. On the Sunday before our visit the attendance was 50,000, and it usually amounts to about $1\frac{1}{2}$ million annually.

Herr Grummt drove us to the underground station in East Berlin, bought our tickets and took us through the barrier himself. The ticket collector, an incarnate Mme. Defarge, paid us no heed. The rolling stock, stations and officials all seemed rather worn and sad, but the train was crowded with Berliners travelling quite freely between East and West.

The West Berlin Zoo is another of those with grand new animal houses, the old original ones having been destroyed—" by Lancasters " we were told in an aside. The wildfowl collection was small, but did include a very fine pair of Black-necked Swans.

Among the animals the two-toed Sloths and Spectacled Bears were specially worth notice. Here is what must be the finest Aquarium in Europe. There are over 800 species of fish, among them many exquisite coral fish, all beautifully displayed. The building is on four floors and a central well houses nineteen of the known species of crocodiles and alligators.

An international exhibition of Guppies was being held at the time of our visit. Other queer objects in this house were a Giant Frog which is fed on chicken and cockroaches, and the Frilled Lizards. The 'frill' is a fold of skin that hangs round the shoulders like a cape. When the Lizard is annoyed the frill opens out just like an umbrella. (See *Ninth Annual Report*, p. 73).

It was dusk when we left and a jackal was howling.

In the afternoon of August 29th we returned from Berlin to Frankfurt.

30th August. Left Frankfurt at 7.30 a.m. 'Elevenses' and light lunch at 10.0 a.m. near Ulm, having driven 150 miles through the mountains, mostly on an Autobahn, in $2\frac{1}{2}$ hours, and paused to watch a pair of eagles hunting.

We arrived at the Astoria Hotel, Munich, at 12.30 and had lunch, 252 miles from Frankfurt. Afterwards we drove twenty miles or more through lovely country, over narrow roads with no direction posts and no sign of human beings, and then, in the midst of a forest of Austrian pines we came suddenly upon a lake with a group of long stone buildings nestling in the trees by its side. This was the Max Planck Institut, Seewiesen, though you might rather expect it to be the palace of a fairy princess.

There was no porter's lodge, and huge iron gates barred the way. But pressure on a bell push in one of the enormous stone pillars produced a blast of German from a small grid not previously noticed, just below. All seemed rather hopeless until at last a very friendly American voice joined in and its owner soon followed to unlock the gates and let us in. This kindly soul was doing research work here and when things were explained to him told us that Dr. Lorenz was away but of course we could come in and he would show us round.

The lake itself is about 10 or 15 acres and on the south and west trees come right down to the water's edge. To the north is a floating weedbank and on the west is the small gravel beach where the Institut is situated and its workers live. There are perhaps 8 or 9 small rafts anchored at different spots out on the lake where the birds can rest when they so desire. There are several pens along the gravel shore reaching into and enclosing portions of the lake. In these there are many birds under observation; geese and ducks cluster tamely round one's feet. Two observation towers, one of which has a bedroom on the top floor, are fitted up with telescopes. Many of the birds present are wild of course, but the permanent inhabitants are either pinioned or feather cut as they are always under observation. The study of these birds and their behaviour is one of the main objects of the Max-Planck-Institut, as it is largely used by ethologists. The administrative buildings and their equipment are sheer delight to the eye as well as the mind. The laboratories and offices open out to aviaries and both fresh and salt-water fish aquaria. There appeared to be every kind of laboratory equipment, and, in addition, a most luxurious library and reading room. We were given tea by Dr. Beatrice Lorenz, a daughter-in-law of Dr. Konrad Lorenz, and after looking over the Landrover of our kind American—which was being modified for his coming expedition into the wilds, we drove back to Munich.

31st August. Munich—a large Zoo and a lucky one, in that they have a stream of gin-clear water, similar to the Itchen or the Test, that never muddies or dries up. Diving duck can be watched feeding on the bottom in water of a depth of 3 to 4 feet. There are countless rainbow trout swimming in all parts of the stream, up to 6 or 7 lbs; none under half a pound were seen. How does this fit in with the Pelicans? It seems this was something we forgot to ask.

The stock of wildfowl looked splendid, as one would expect, and we were shown 7 young Plumed Whistling Duck, bred this year and now nearly fully fledged. There were many other interesting babies including a very small Gnu, a yearling Gauer, and two baby Porcupines little more than a week old; they already had quite a useful quantity of quills 4 to 6 inches long, on their backs, but these are quite soft and supple like pieces of string when they are born, so there is no need for an expectant mother Porcupine to

have a worried look. This Porcupine had produced three babies but being provided with only two teats an attempt had been made to rear the third baby on a bottle. Unfortunately it died after two days. Evidently the milk was not suitable, but to try to persuade a female Porcupine to give a sample of her milk for analysis might have been a problem.

There was quite a stud of Tarpans, Przewalskis, Onagers and Kulans, besides all the Zebras. And a most interesting Pony-Zebra stallion of 4-5 years, all grey with no sign of a stripe anywhere. All 38 kinds of Guinea-pig are represented, including the original wild form that are speckled grey, like a Plymouth Rock fowl. We were amused to see drain pipes up-on-end for the Cranes and Storks to feed from.

The Director, Herr Heinz Heck, and his nephew Dr. Heck, junior, spent the whole morning taking us round the Zoo, and then to the restaurant for a grand lunch, after which we wandered slowly through the Zoo to the Director's house. There we were joined by the youngest Heck, Director of the Aquarium and Reptilia—a cheerful soul. Before we left the Munich Tiergarten we were shown Herr Heck's treasures, trophies and paintings.

After a drive of 3¾ hours we arrived at Lindau at 7.30 p.m. and found rooms in a charming hotel on the front overlooking Lake Constance. It was not until the morning that we discovered we were on an island.

1st September. Left Lindau and travelled by way of Zurich to Basel. Much of the country between Zurich and Basel is planted with tobacco, many acres of it on either side of the road for miles.

2nd September. Basel Zoo at 10.30 a.m. where we were met by Dr. Wackernagel, Assistant Director, who showed us first their young Flamingo and told us all about it: six nests were built, of mud, at the edge of the water, with a hollow on top of each where the eggs were laid and incubated. The bases of the nests almost touch each other, they are cylindrical, quite hard and smooth, without cracks, and diminishing in diameter. The nest in which the young bird was reared was 2½ feet high. Copulation had been seen to take place in deep water, and eight eggs were subsequently laid but only one was fertile. The young bird was covered with dark grey down and the bill was like the adult's though in proportion. The birds get a 25% protein feed—shrimp, kelp and carrot.

The Zoo has a plentiful supply of water from springs within its boundaries, and there is a lovely natural waterfall (continued for 10-15 yards as a rapid) from an artificial lake on high ground to one on a lower level; the trees around could with advantage be cut back. There is a good selection of geese and ducks, including three pairs of Scoters and one female Velvet Scoter.

Stars among the animals were a baby Rhinoceros, who was out in the open with its mother and the keeper; a Zebra filly two days old; Swiss Marmots; Prairie Dogs. Sophy, the Gorilla from Rotterdam was there, with her keeper, waiting to be mated to the male Gorilla. The female Orang came into labour about 4.30 while we were at tea.

Present at lunch were Dr. Lang, the Director of the Zoo, and his wife, Dr. Wackernagel, Dr. Nouvel—Director of the Paris Zoo, an unidentified Fraulein, and the Slimbridge party. After lunch Mr. Freeman Shelley of Philadelphia Zoo joined the party.

The equipment and luxury of the new Keepers' quarters passes belief. There are separate bedrooms for each person, full length baths and showers,

wardrobes, a drying room, dining room, library and sitting room—all beautifully furnished—and kitchen, larder, food store, and laundry. The animal and bird-food store, in another part of the same new block, had 16 huge hoppers on the top floor which led down to the room below. The food noticed in the hoppers included sunflower seeds, dried peas, beans, maize, crushed maize, millet, crushed oats, barley, meal both coarse and fine. This room contained fresh fruit and vegetables, light wheelbarrows with pneumatic wheels, plastic buckets, panniers, etc.

In still another room were breeding boxes for locusts, cockchafers, grasshoppers, etc. Inside were pieces of apple, lettuce, and a few rolled oats; locusts or cockroaches were there in swarms. There may have been as many as 60 or 80 of these cages. The room temperature was observed to be about 78°.

Before leaving we were given tea—ice cold with lemon—in Frau Lang's sitting room, to the accompaniment of an obliggato of " Colonel Bogey " whistled by the pet parrot.

Some of the aviaries here were constructed of vertically stressed steel wires instead of netting, giving an impression of less obstruction to viewing the birds.

3rd September. Before leaving Basel at 9.0 a.m. we telephoned Dr. Lang to find that the Orang baby, a male, had been born and all was well. We arrived in Heidelburg at 3.30 p.m.

4th September. Left Heidelberg at 9.10 a.m. Through glorious fir forests, seeing many buzzards. Thence to Saarbrucken, Chalons sur Marne, and on to Meaux where we arrived at 6.40 p.m.—301 miles for the day's run.

It was interesting to note dew-ponds all round Verdun (of proud memories) which is on high down-land, very like Salisbury Plain; which, of course, also abounds in dew-ponds.

On 5th September we drove from Meaux to Paris, where we stayed until 9th.

7th September. Collected from our hotel by Dr. Chauvier, Assistant Director of the Paris Zoos, and taken to the Jardin des Plantes where Dr. Nouvel awaited us.

We were driven round to Vincennes, about a mile away, where we had lunch in the Zoo restaurant. The restaurant overlooked a paddock where 4 Cheetahs were really able to gallop; this must be a wonderful thing for them as they are known to be the fastest beasts in existence over a short distance.

We visited the young Okapi's pen and were allowed to pat and make much of it, which she stood very well. This is the first specimen bred in captivity.

There were some newly arrived Cotton Teal, and a pair of Whooper Swans, at present with three half grown cygnets. We were shown the Condor, caught 56 years ago and already an adult bird at that time. There was quite a flock of South African Spoonbills, much smaller than the Western variety, and a beautiful deep pink turning to dark red on the flight feathers. They are fed on shrimps and vitamin B^{12}.

The Cotton Teal here are fed on millet, wheat and ' mild ' pimento.

Dr. Chauvier showed us the antivenom serum kept always ready in the Reptile House. It is of no avail for a Moccasin bite. He also very kindly turned the Clouded Leopard out of her den for us to see.

9th September. Parc Zoologique de Cleres. This is the perfect spot for a private collection of wildfowl. The chateau and grounds belong to M. Jean Delacour, and are under the supervision of Mr Frank Fooks.

The chateau is a magnificent place, now filled with caged birds. The Magistrate's court was once housed there, in a fine galleried room. It was the German H.Q. during the war and many of the lovely portrait paintings in the room where they had their Mess have bullet holes through the eyes—good shooting but not such good manners.

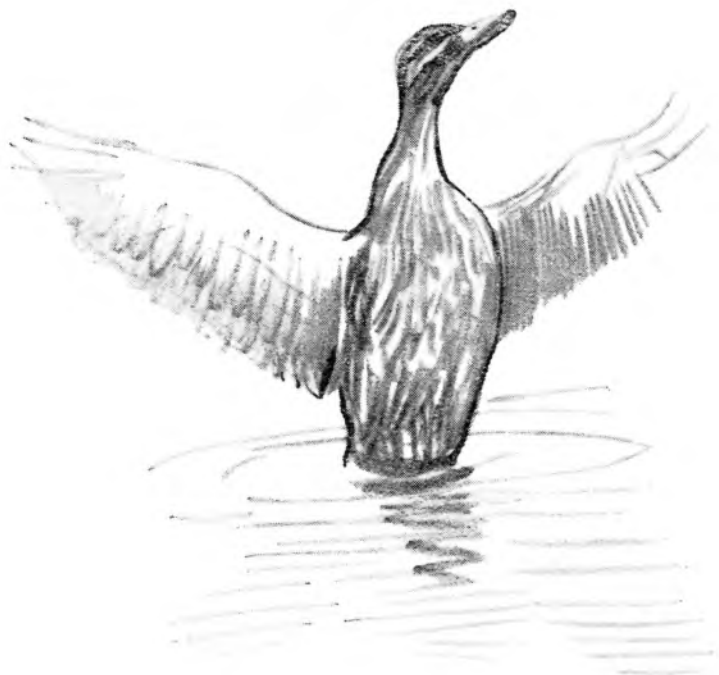
The collection of wildfowl is wonderful and must be one of the best. All the birds seem in good condition and breed freely. The pair of Ne-ne on loan from the Trust were quite aggressive and should breed next year.

There is plenty of water and grass and no restriction on food. The whole place is beautifully kept and makes one wonder how big a staff they have.

One did not hear anything about poaching, which apparently would be very easy. But one interesting thing Mr. Fooks told us about predators: it is not crows or hawks or Buzzards that are his chief enemy, but polecats. They seem to be perfect terrors, but a good many are caught.

That afternoon we left for Dieppe and thence to Newhaven on the S.S. Londres. We were honoured by an invitation from the Captain to visit him on the Bridge. Here the wonders of Radar were explained and demonstrated. Our tour was now completed. We had driven 2,500 miles through five countries and visited 17 Zoos and Collections.

Everywhere " the Wildfowl Trust " was held in very high regard and the hospitality shown to us was overwhelming.



BRITISH LITERATURE ON EUROPEAN WILDFOWL

G. V. T. Matthews

Discussions on the means of encouraging and co-ordinating research on wildfowl biology took place at the 3rd Congress of the International Union of Game Biologists at Aarhus, October 1957. One of the suggestions put forward was that representatives should prepare lists of papers published in their own countries since the end of World War II and that these lists should be exchanged. This is the British contribution, covering the years 1945-1957 inclusive.

This list is limited to books, papers and notes published in Britain which dealt specifically with the European Anatidae. General faunal studies with references to wildfowl are not included. The numerous local annual bird reports come within this category. Also excluded are more than a hundred short notes which do nothing more than record the sighting of some species of wildfowl in a new corner of this small island. A complete list of publications is very difficult to achieve, and notice of any omissions would be welcome.

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(1947) Mating behaviour of Wigeon and Red-breasted Merganser. *Brit. Birds* 40:186-187.

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(1955) Whooper Swans in Southern Lakeland. *Bird Study* 2:143-151.

R. H. ALLEN & G. RUTTER (1956) The moult-migration of the Shelduck from Cheshire in 1955. *Brit. Birds* 49:221-6.
(1957) The moult-migration of the Shelduck from Cheshire in 1956. *Brit. Birds* 50:344.

H. G. ALEXANDER (1952) Whooper Swan in Wigtownshire in August. *Scot. Nat.* 64/3:178.

M. J. ARDLEY (1951) Wigeon summering in Northamptonshire. *Brit. Birds* 44:206.

E. A. ARMSTRONG (1953) Effective distraction display by Mallard. *Brit. Birds* 46:410.

E. L. ARNOLD (1948) Behaviour of Whooper Swan. *Brit. Birds* 41:312.

G. ATKINSON-WILLES (1953) Wildfowl Counts. *Devon Birds* 6/1.
(1954) Wildfowl Counts. *Bird Study* 1:117.
(1955) National Wildfowl Counts. *Bull. B.O.C.* 75:118.
(1955) Wildfowl Counts in the British Isles. *W.T. 7th Ann. Rep.* 29-38.
(1955) Winter counts of Mallard in Britain, 1951-54. *W.T. 7th Ann. Rep.* 39-45.
(1957) Wildfowl counts in the British Isles. *W.T. 8th Ann. Rep.* 23-34.
(1957) Fluctuations in the wintering population of Tufted Ducks in Great Britain. *Nat. Wildfowl Counts 4th Ann. Rep.*

G. ATKINSON-WILLES & J. G. HARRISON (1952) Wildfowl Counts (1947-52). London.

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L. M. BAKER (1953) Wildfowl Law. *W.T. 5th Ann. Rep.* 133-136.

A. BALDRIDGE (1955) Red-breasted Mergansers breeding in Anglesey. *Brit. Birds* 48:135.

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A. WETMORE (1952) The scientific names for the Bean and Pink-footed Geese. *Ibis* 94: 360-361.

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V. C. WYNNE-EDWARDS (1957) Harlequin Duck in Shetland. *Brit. Birds* 50: 445.

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G. K. YEATES (1947) The Greylag Goose. *Field* 190: 178-179.
(1955) A visit to Krossargil, North-central Iceland, 1954, with special reference to the Pink-footed Goose. *W.T. 7th Ann. Rep*: 146-152.
(1956) Photographs of Pink-footed Goose. *Brit. Birds* 49: Pl. 9, 11-12, 14.

Wildfowl Ringing

Details of the numbers of birds ringed and of selected recoveries have been published:—

A. LANDSBOROUGH THOMSON Progress of the ringing scheme. (1945-1957) (number of *Anatidae* ringed) *Brit. Birds* 38: 294; 39: 175; 40: 272; 41: 300; 42: 179-80; 43: 173; 44: 309; 45: 356; 46: 291; 47: 364; 48: 464, 466; 50: 40, 453.

E. P. LEACH & R. SPENCER Recovery of marked birds (1945-1957) (selected recoveries of *Anatidae*). *Brit. Birds* 38:350; 39:367-368; 40:363-364; 41:366-369; 42:269-271; 43:318-320; 44:298-301; 45:277, 241-245; 46:294-300; 47:368-378; 48:471-478; 50:47-53, 461-466.

E. P. LEACH British recoveries of birds ringed abroad. (selected recoveries of *Anatidae*). *Brit. Birds* 1945, 38:226-227; 1948, 41:178, 204-205; 1950, 43:286-288; 1952 45:460-462; 1956, 49:439-443.

P. SCOTT & H. BOYD Goose and duck ringing and recoveries, 1948-57. *W.T. Ann. Rep.* 1:43-46; 2:25-27; 3:15-26; 4:12-26; 5:19-44; 6:10-27; 7:14-28; 8:13-23.

ELEVENTH ANNUAL GENERAL MEETING

MINUTES

THE Eleventh Annual General Meeting of the Wildfowl Trust was held at the Royal Society of Arts, John Adam Street, London, W.C.2 on Thursday, 15th May, 1958, at 5.30 p.m.

The following Officers and Council Members were present:

Field Marshal the Rt. Hon. the Viscount Alanbrooke, K.G., G.C.B., O.M., G.C.V.O., D.S.O. (President)
Guy Benson, Esq. (Hon. Treasurer)
Michael Crichton, Esq.
K. Miller Jones, Esq.
Peter Scott, Esq., C.B.E., D.S.C. (Hon. Director)
Miss P. Talbot-Ponsonby

The Minutes of the Tenth Annual General Meeting which had been circulated with the Report of the Council were taken as read and signed by the President.

1. The Hon. Director, Mr. Peter Scott, gave a brief survey of news from the New Grounds and Peakirk. He made particular reference to the successful breeding season with the Hawaiian Goose in this country, and reported a total of nineteen Ne-ne goslings at the New Grounds. There was now known to be a total of 156 Hawaiian Geese in the world, made up as follows:—

Estimated wild birds in Hawaii	35
In captivity in Hawaii	47
Slimbridge	54
Peakirk	2
Leckford	12
Rotterdam	2
Cleres, France	2
Connecticut	2

Other interesting species breeding at the New Grounds included the Pacific Black Brant and New Zealand Scaup, each of which was breeding for the first recorded time in captivity.

During the breeding season of 1957, 91 forms laid and 72 forms were reared, with a total of 770 babies which represented 75% of those hatched at Slimbridge. The figures for the first breeding season at Peakirk were 15 forms laid and 146 young reared.

Important new arrivals of waterfowl at the Wildfowl Trust since the previous Annual General Meeting included New Zealand Blue Duck, Moluccan Radjah Shelduck, Australian White-eye, Black-headed Duck, Northern Red-billed Whistling Duck, all of which were new to the collection; and a further group which had previously been represented, New Zealand Brown Duck, Falkland Island Flightless Steamer Duck, Kerguelen Pintail, Hartlaub's Duck and European Scoter.

Turning to the Accounts, the Director explained a number of items in the Income and Expenditure Account and Balance Sheet. Mr. H. K. Hallam enquired whether the item ' subscriptions ' under Income included

subscriptions from Peakirk. The Director answered that it did, and although certain items of income and expenditure at Peakirk were listed separately for information only, in general all figures relating to the running of the Waterfowl Gardens were included in the Headquarters Account headings for the sake of clerical economy. Vice-Admiral Waller enquired whether the Trust's annual report in its present form might prejudice our case with the Inspector of Taxes regarding the payment of income tax on Covenants. The Director said that should it prove so, the Trust might either have to consider publishing the Report in a less lavish form or charging the membership for it. Mr. Quintin Riley said that this had been found necessary in the case of the Polar Record—the organ of the Scott Polar Research Institute. The Hon. Director then moved the adoption of the Report of Council for the year ending 31st December, 1957. Mr. Quintin Riley seconded the motion which was carried unanimously.

2. Mr. M. R. Boardman proposed the election of the Council's nominees for the vacancies on the council which were as follows:—

   John Berkeley, Esq.
   Michael Bratby, Esq.
   James Robertson Justice, Esq.
   Major General C. B. Wainwright, C.B.

   The proposition was seconded by Mr. Jack Williams and carried unanimously.

3. Mr. J. O. Death proposed the election of the following Officers:—

President:	Field Marshal the Rt. Hon. the Viscount Alanbrooke, K.G., G.C.B., O.M., G.C.V.O., D.S.O.
Vice-Presidents:	Sir Percy Lister
	Captain R. G. W. Berkeley
Trustees:	The Rt. Hon. the Lord Kennet of the Dene, G.B.E., D.S.O., D.S.C.
	The Duke of Beaufort, K.G., P.C., G.C.V.O.
Hon. Director:	Peter Scott, Esq., C.B.E., D.S.C.
Hon. Treasurer:	Guy Benson, Esq.

   Mr. C. N. Norris seconded the proposition which was carried unanimously.

4. Mr. Peter Scott moved the resolution increasing the maximum age of Gosling Members:—That the following alteration be made to the Rules of the Wildfowl Trust: Rule 5(v) For " 16 years " wherever it occurs substitute " 18 years." Mr. Guy Benson seconded the resolution which was carried unanimously.

5. Mr. Guy Benson proposed that Messrs. S. J. Dudbridge & Sons of Stroud, Gloucestershire, should be appointed Auditors to the Wildfowl Trust for the ensuing year pursuant to Rule 10 (1). Mr. Michael Crichton seconded the motion which was carried unanimously .

   Business being concluded, the meeting was closed by the President who expressed the gratitude of Members to the Director for all that the Trust owed to his inspiration and enthusiasm, and the immense amount of time and work he had put into its development.

MEMBERSHIP

THE membership of the Trust increased by over 200 during 1957, to a total of 5320 on 1 January, 1958. Increases occurred in all the classes of membership except Corporate Members and Contributors, especially in Life and Gosling Members. During the first half of 1958 most classes continued to grow, although there was a slight decline in Full Members.

January 1957		January 1958
120	Life Members	138
3308	Full Members	3315
—	Junior Compounded	1
1261	Associate & Parish Members	1383
217	Gosling Members	300
160	Corporate Members	154
28	Contributors	29
5094		5320

CLASSES OF MEMBERS

Life Members: (a) up to 50 years of age: £52 10 0 } One
(b) over 50, not over 60: £26 5 0 } Final
(c) over 60: £10 10 0 } Payment

Entitled to all privileges of Full Membership (see below) during life, and exempt from payment of any subscriptions, excepting any sum being paid yearly under Deed of Covenant.

Full Members: Annual subscription £2 2s. 0d. Entitled to free access to pens and observation-huts at the New Grounds and at Peakirk, with one free guest, one free copy of the Annual Report for each year of Membership and of all Bulletins issued during Membership, and to attend and vote at the Annual General Meetings.

Junior Compounded Members: Only persons under 21. One payment of £10 10s. 0d. Entitled to all privileges of Full Membership (as above) until attaining the age of 21. May then, if they wish, pay another 40 guineas and be elected Life Members.

Associate Members: Annual subscription 10/-. Entitled to free access to pens and observation huts, and to free copies of all Bulletins. (Associate Members may, by subscribing One Guinea, also have one copy of each Annual Report posted to them on publication).

Gosling Members: Annual subscription 7/6d. Limited to persons under 18 Entitled to free access to pens at the New Grounds, and at Peakirk, on Saturdays and Sundays. (With the aim of encouraging interest in Wildfowl among children, a system has been introduced of grades of Goslings, with appropriate distinguishing marks and promotion by recognition-test. Full particulars of this scheme are given in the separate Leaflet available at the Gate Houses at Slimbridge or Peakirk).

Corporate Members: Annual subscription £2 2s. 0d. Limited to Educational Institutions. Entitled to free access to pens and observation-huts at New Grounds in parties of 10 or more by arrangement with the Gate-House. (Sundays before 2 p.m. excepted). One free Annual Report; one copy of all Bulletins during Membership.

OBITUARY

THE Council has learned with regret of the deaths (notified since the last issue of the Annual Report) of the following Members:

The Rev. R. B. Abell
G. N. Besly
Mrs. E. W. Bishop
W. J. Brymer
Miss Leila Bull
Mrs. J. C. Cadbury
Miss B. M. Carlisle
Miss Mabel Clifford
Dr. Elsie T. D. Cooper
Miss Mary Cruddas
C. Cullimore
Captain R. Dalrymple
The Lord Dunleath, C.B.E., D.S.O.
C. W. Dyson Perrins
Miss M. P. Estridge
Major J. H. Franklin
Mrs. H. S. Godsmark
F. H. Godwin
Major A. F. Gordon
C. Greenwood
Mrs. M. A. Haslam
Lt. Col. J. L. Hesleton, D.S.O., M.C.
A. H. Higginson
Mrs. E. G. Lawson
Henry S. Loebl
Lt. Col. J. Mahoney, O.B.E., M.C.
Major P. W. Murray-Threipland
J. Neal
Mrs. Eustace Palmer
W. B. Parr
Lt. Col. L. P. Payne-Gallwey, O.B.E., M.C.
R. H. Penley
Mrs. Philip Ransom
Mrs. H. K. Reeves
Miss L. M. Rimes
T. P. Rogers
G. H. Stansfield
Lt. Col. J. A. Stirling
Mrs. Alice Storey
Captain C. G. C. Sumner, O.B.E., R.N.
Miss E. M. Symon
G. E. R. Thatcher
Major G. M. Thompson
Eleanora Lady Twysden
Miss D. M. Wethered
E. G. Whitehead

THE WILDFOWL TRUST

BALANCE SHEET, 31st DECEMBER, 1957

LIABILITIES

£		£ s. d.	£ s. d.
	Sundry Creditors:—		
4965	On Open Accounts		8591 6 6
	Loan Accounts:—		
	Balance, 31st December, 1956 ..	12517 13 10	
	Add Further Advances	40 0 0	
		12557 13 10	
	Less Repaid	1055 0 0	
12518			11502 13 10
	Reserve Account:—		
	Balance, 31st December, 1956 ..	3500 0 0	
	Less Transferred to Income and Expenditure Account	1500 0 0	
3500			2000 0 0
	Income and Expenditure Account:—		
	Balance, 31st December, 1956 ..	5083 19 9	
	Less Excess of Expenditure over Income for the year	91 19 2	
5084			4992 0 7

ASSETS

£		£ s. d.	£ s. d.
	Cash:—		
52	In Hand	40 10 1	
3846	At Bank, Westminster Bank Ltd. ..	795 11 10	
17	At Bank, Lloyds Bank Ltd. ..	23 0 7	
3915			859 2 6
606	**Sundry Debtors and Payments in Advance**		893 14 8
	Valuation:—(As valued by the Honorary Director).		
8736	Wildfowl	8577 0 0	
375	Land Rovers	280 0 0	
2295	Coops, Henhouses, Huts, etc. ..	4317 0 0	
—	Publications	1250 0 0	
—	Longaston House	1467 0 0	
11406			15891 0 0
	Narrow Boat:—		
1000	Valuation, 31st December, 1951 ..	1000 0 0	
	£ s d.		
325	Less Rents paid to 31st December, 1956 .. 425 0 0		
100	Rent due for year ended 31st December, 1957 100 0 0		
		525 0 0	
575			475 0 0

			Notes.—1. The Narrow Boat is hired from the Trust under a ten-year agreement at £100 per annum, payable by quarterly rents of £25 in advance, as from 21st October, 1952, with the option to purchase for ten shillings, after rents amounting to £1000 have been paid.		
			2. The rent for the year ended 31st December, 1957, had not been paid at that date and the sum of £100 therefore is included in the Sundry Debtors.		
			New Buildings, etc., New Grounds, Slimbridge, Glos:—		
11363			Balance, 31st December, 1956 ..	11362 13 10	
1200			**Less** Written off to 31st December, 1956 ..	1797 13 10	
598			Written off in year ended 31st December, 1957 ..	597 16 3	
		9565			2395 10 1
					8967 3 9
			Note.—The New Buildings, etc. to be written off over a period not exceeding that of the lease.		
£26067		£27086 0 11	£26067		£27086 0 11

We have examined the above Balance Sheet of The Wildfowl Trust, dated 31st December, 1957, together with the accompanying Income and Expenditure Account and find them to be in accordance with the Books and Vouchers produced to us and the information and explanations given to us.

STROUD, Gloucestershire.
11th April, 1958.

S. J. DUDBRIDGE & SONS,
Auditors.

THE WILDFOWL TRUST

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1957

EXPENDITURE

£		£ s. d.	£ s. d.
9704	To Valuation, 31st December, 1956 ..		11406 0 0
	Membership:—		
793	Office Expenses, Postages, etc. ..	723 3 7	
1233	Printing and Stationery, General ..	1187 10 10	
1753	Salaries of Administrative Staff ..	2196 3 9	
267	Telephone	400 8 8	
116	Bank Charges	144 11 11	
387	Miscellaneous Expenses	688 6 5	
1500	Printing Annual Report	2378 4 11	
185	Expenses of Annual Dinner ..	106 9 3	
257	Staff Travelling Expenses	403 4 11	
6491			8228 4 3
	New Grounds and Peakirk:—		
4778	Salaries of Outside Staff	7654 0 4	
438	Staff Travelling Expenses	681 8 3	
883	Purchases and Transport of Wildfowl and Eggs	1145 15 5	
3189	Food for Wildfowl	4524 8 2	
467	Rent, Rates and Insurance ..	590 12 2	
1913	Materials, Repairs and Replacements	1454 4 1	
605	Vehicles and Mechanical Equipment and Expenses	613 3 6	
309	Fuel and Power	845 13 10	
145	Hatching Expenses	168 0 8	
1688	Hostel Upkeep	1257 19 0	
14415			18935 5 5
6692	Purchases for re-Sale at Gate Houses		9203 9 2
	Scientific and Educational:—		
2485	Salaries	4315 0 6	
250	Rocket Netting Expenses	625 14 1	
73	Expenses of Lectures	328 0 9	
468	Travelling Expenses	744 19 6	
853	Abberton Ringing Station	893 0 0	

INCOME

£		£ s. d.	£ s. d.
	By Membership:—		
7161	Subscriptions, Ordinary	7767 15 6	
592	Subscriptions, Life Members ..	355 0 0	
2144	Income Tax on Covenants ..	— — —	
1272	Donations	663 1 5	
192	Receipts from Annual Dinner ..	105 16 6	
246	Receipts from Sale of Annual Reports	260 19 3	
11607			9152 12 8
	New Grounds and Peakirk:—		
12865	Gate Takings	16933 9 6	
648	Sale of Surplus Wildfowl	2201 14 10	
13513			19135 4 4
8984	Sales at Gate Houses		11242 11 2
	Scientific and Educational:—		
216	Fees and Collections at Lectures ..	859 1 9	
496	Duck Adoption	478 12 10	
263	Donations for Abberton Ringing Station	263 0 0	
2471	The Nature Conservancy Grant ..	4825 0 0	
397	Nuffield Trust Grant	530 0 0	
400	Bristol Zoo Grant	650 0 0	
4243			7605 14 7
11406	Valuation, 31st December, 1957 ..		15891 0 0
—	Transferred from Reserve Account		1500 0 0
—	Balance, Excess of Expenditure over Income for the year		91 19 2

61	Orfeton Ringing Station				79	10	0	
542	Borough Fen Decoy				731	19	9	
294	Wildfowl Counts				239	15	4	
610	Scientific Equipment and Expenses				560	17	0	
177	Duck Adoption				172	5	9	
87	Aerial Survey				742	15	5	
—	Taxidermy				61	16	0	
5900								9495 14 1
	Capital Expenditure:—							
2575	**Peakirk Development**				2178	0	5	
	New Grounds:—	£	s.	d.				
—	Mower	168	8	5				
—	Deep Freeze	50	0	0				
—	Hostel Equipment ..	135	19	0				
—	New Area Development	1786	18	2				
382	Sales Hut	—	—	—				
29	Gates	—	—	—				
85	Laboratory	—	—	—				
318	Tower	—	—	—				
857	Garages	—	—	—				
161	Pump	—	—	—				
282	Office Equipment ..	—	—	—				
2114					2141	5	7	
	Scientific and Educational:—							
		£	s.	d.				
—	Boat and Trailer ..	130	9	4				
—	Coloured Film ..	279	7	7				
150	Grant to Expedition ..	—	—	—				
—	Building Conversion ..	556	2	10				
					965	19	9	
—	**Longaston House**				1467	7	0	
4839								6752 12 9
598	Written off Buildings							597 16 3
1100	Transferred to Reserve Account ..							— — —
14	Balance, Excess of Income over Expenditure for the year ..							— — —
£49753								£64619 1 11

Note.—The figures in the margin are those for the year ended 31st December, 1956 and are given for the purpose of comparison only.

£49753 £64619 1 11

WILDFOWL TRUST STAFF

Full-time members at 31 December, 1958

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M. Fisher (Curator, Peakirk)
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M. Davy
I. Fairbairn
Mrs. P. Hall
M. Henchman
R. J. Pearce
L. T. C. Shakespear
L. P. Alder
A. Huggins
G. Huggins
J. Parsons

Research and Conservation

Dr. G. V. T. Matthews (Assistant Director (Research))
H. Boyd (Senior Biologist)
G. L. Atkinson-Willes
J. V. Beer
Dr. S. K. Eltringham
Dr. G. Lapage
P. J. S. Olney
Miss E. Temple Carrington
W. A. Cook
R. King
N. Phillips

Administration

E. A. Scholes (Secretary)
H. G. Gower (Bursar)
Miss E. R. Gregorson
D. Eccleston
C. M. Garside
Miss N. Rees-Williams
Miss W. Young

Gates and Sales

Mrs. S. T. Johnstone
Miss N. Hall
Miss J. Price
Miss D. Seeley
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Three mistakes in the attribution of the illustrations have been detected too late for correction in the photogravure section. On p. 192 the picture of Brent at Den Helder is by Dr. R. G. Broekhuysen, that of the captive flock by Peter Scott. The illustrations on p. 194 are by P. Talbot-Ponsonby, those on p. 195 by J. V. Beer. The upper photograph on p. 202 is by Dr. J. M. Harrison (not Dr. J. G. Harrison).