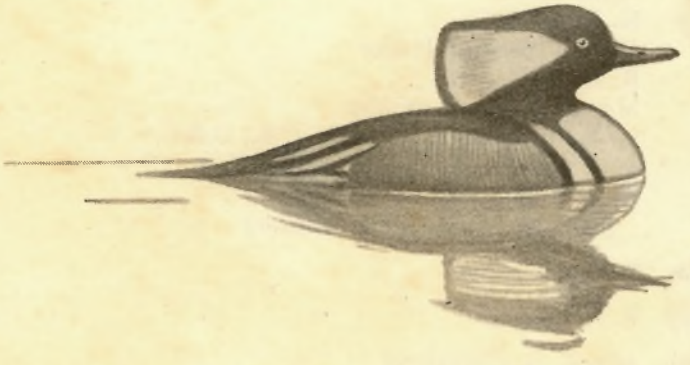
THE NINTH ANNUAL REPORT OF

THE WILDFOWL TRUST

1956–1957

EDITED BY PETER SCOTT
AND HUGH BOYD



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THE WILDFOWL TRUST

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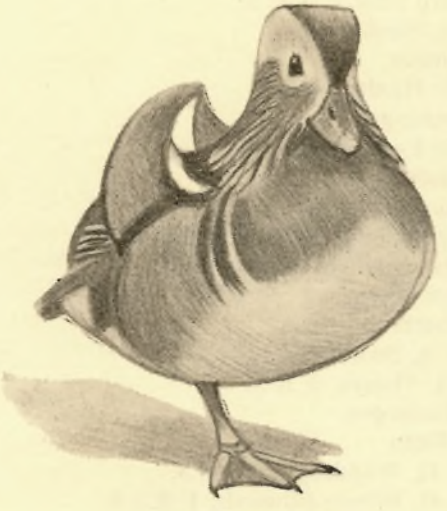

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REPORT

THE Trust was honoured by a visit of His Royal Highness Prince Philip, Duke of Edinburgh, on 15 May 1957. Prince Philip spent the night as the guest of Mr and Mrs Scott.

On 12 April 1957 the Peakirk Waterfowl Gardens were declared open by His Royal Highness the Duke of Gloucester in an informal ceremony. This second Trust establishment has quickly become a success. An account of its formation is given on p. 9, illustrated by photographs on pp. 201–203.

This Report covers the period September 1956 to August 1957. During the period popular interest in the Collection at Slimbridge continued to grow in a most gratifying way. The total number of visitors in the calendar year 1956 was about 120,000. In 1957 this figure was reached before the end of August. Membership stood at 5094 in January 1957, another record figure. The enlargement of the enclosures at Slimbridge being undertaken in the winter of 1957–58 will be described in our next Report.

The formation of a second Trust Collection, together with the completion of ten full breeding seasons at Slimbridge, provides an appropriate occasion to review the Trust's avicultural achievements since its formation. The first geese released in the pens at Slimbridge in September 1946 amounted to about 50, of 18 forms; and in February 1948 the Collection consisted of 433 birds of 67 forms. The Collections at Slimbridge and Peakirk now contain about 1747 birds of 148 forms (116 species). In 1957, 770 young birds, of 72 forms, were reared in the Collection.

In addition to the details of the 1957 breeding season, this Report includes other 'annual' features, notably the details of geese seen at the New Grounds in the winter of 1956–57 and accounts of duck, goose and swan ringing during the year. A large part of the work of the Trust cannot be dealt with usefully on such a periodic basis, but extensive studies have begun in two fields new to the Trust's research programme: a systematic investigation into the food of wildfowl and the use of aircraft in surveys of the distribution and number of wildfowl. The objects and methods of these studies are described on pp. 38–41 and 47–51.

Some of the highlights of the world tour made by the Honorary Director and Mrs Scott from November 1956 to February 1957 are brought together in the Director's account of Australasian wildfowl. The three papers which follow, though by other authors, all deal with species or areas seen during the world tour. Mr Warham's description of the nesting of the Pink-eared Duck (pp. 118–127) adds some important facts and some magnificent photographs to our knowledge of this improbable-looking bird. Professor W. H. Elder reports (pp. 112–117) on some recent discoveries he has made about the present status and behaviour of the Ne-nes living in the mountains of Hawaii. Mr David B. Marshall contributes an authoritative account (pp. 128–137) of the wildfowl of western North America, and particularly California, laying stress on the problems of their conservation.

Several other papers are concerned with wildfowl conservation in Europe. Dr Hoffmann's account (pp. 154–156) of his research station in the Camargue is all too modest: La Tour du Valat is now one of the principal sources of information about the ducks of western Europe. We are glad to be able to provide

a complete translation of a long paper by Drs Teplov and Kartashev (pp. 157–169) dealing with wildfowl and shooting in central European Russia, since this provides much detailed information about the Russian approach to conservation.

A series of short papers on geese includes three dealing with work not carried out by the Trust but devoted to species and problems in which we are particularly interested. Dr Holger Holgersen's account (pp. 170–174) of the winter recoveries in Europe of Pink-footed Geese ringed in Spitzbergen by British expeditions in 1952 and 1954 shows how remarkably distinct this population remains from that of Iceland and Greenland wintering in Britain, even when severe weather forces the Continental population to make abnormal dispersal movements. Mr Burton's observations on wintering Brent Geese (pp. 175–179) provide almost all the detailed information yet collected on the age-composition of British flocks, an essential step towards a true picture of population changes in this species. The expedition to East Greenland in 1956 (Dr Wright and Mr Goodhart, pp. 180–192) failed in its original task of capturing flightless geese for ringing, but achieved a most useful clarification of the effects of spring weather on the breeding success of geese and other Arctic-nesting species.

Mr Spenceley's notes on the South Georgia Teal (pp. 196–198) provide another example of a catching expedition which failed but which managed to add to our knowledge of breeding biology.

The paper by Dr Jeffery G. Harrison (pp. 193–196) on skull pneumaticity in wildfowl breaks new ground and illustrates how birds from the Trust Collections contribute to science even after death.

This year, for the first time, the List of Members is omitted from the Report, in order to reduce the cost. We hope subsequently to repeat the list at intervals of two or three years.

PEAKIRK WATERFOWL GARDENS

It was a landmark in the history of the Trust when its first branch, at Peakirk, was officially opened by H.R.H. the Duke of Gloucester on 12 April 1957.

One of the main objects of this scheme is to provide sufficient funds to enable the Trust to take on the lease and maintenance of Borough Fen Decoy, which has been operated by members of the Williams' family since its construction in about 1640. Members may remember the Appeal for funds to help save this ancient and famous decoy which was launched in April 1955. It was not until the end of that year, when Mr Williams, who operated the decoy, moved into a house in Peakirk called The Goshams, with five acres of marshy-wasteland and orchard attached, that the idea of a waterfowl garden was born. Early in 1956 negotiations were started for obtaining the adjoining seven acres of land, which was largely osier bed but had in it a large L-shaped pond with ten islands in it. The acquisition of this adjacent and most attractive piece of land was highly desirable and was finally achieved.

During the spring and summer of 1956 the ground was cleared, bushes were torn out, grass was sown and parts of the osier bed were cleared in preparation for pens and ponds to be constructed. All this initial clearance work was done entirely by kind friends of The Wildfowl Trust, who gave their time and energy, the loan of a tractor and many other kinds of help. Willow posts for the fence were desperately cut and planted in the summer in the hope that they would strike and so provide living fence posts. Many struck, but some were too late.

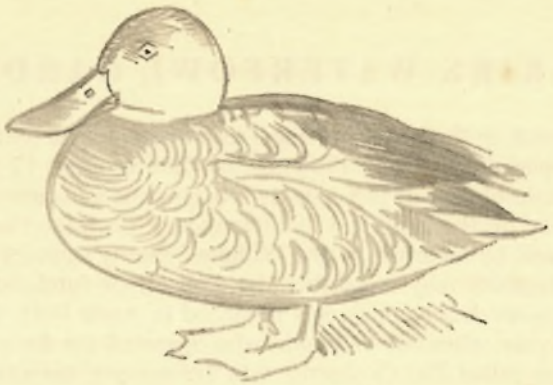
The Director was just able to direct operations on the all-important business of pond construction before going off on his world tour. But in his absence work continued apace. The fences were erected, donations of grass seed, bulbs, shrubs and gravel were received, and at the end of November 1956 the first consignment of birds from Slimbridge went to Peakirk.

By April, when the official opening ceremony was performed, the gardens, though still a little new-looking, were already clothed with green grass and daffodils, and the birds had started well into the breeding season. By that time there were birds of sixty different kinds there, including a pair of Ne-Ne. In fact, the breeding season was immensely successful, and it may be that we shall be able to send birds to Peakirk to breed which will not do so at Slimbridge.

Apart from the objects of this branch mentioned earlier, it is also of great value to have a place which can be used as a reservoir for birds, and an alternative collection, as the danger of epidemic amongst the birds at Slimbridge cannot be entirely dismissed.

The Trust is very grateful to the Peakirk Committee which was set up to help with the development, many of whom gave considerable donations in kind, and especially to Mr R. E. M. Pilcher, the distinguished surgeon from Boston, who was Chairman of this Committee and is now on the Council; he gave unsparingly of his time (and petrol) for the cause.

During the summer months from April to September 1957, 25,158 people visited the new Waterfowl Gardens, not counting members, which is a very good beginning. Membership of The Wildfowl Trust entitles you to free entry both at Slimbridge and Peakirk, and it is hoped to make it possible for members to be shown the duck decoy, by previous arrangement, during the summer months.



THE FIRST TEN YEARS OF THE SLIMBRIDGE COLLECTION

by Peter Scott

A COMPLETE collection of the Anatidae would consist of at least one pair of each of the 247 different kinds known to science. No such collection of living birds has ever been assembled, or probably ever will be. Nevertheless, most ambitious collectors hope to make their collections as complete as possible. And yet such a collection would scarcely be worth the effort required to bring it together if it did no more than satisfy the magpie instincts of the collector himself. A collection of living waterfowl, however, has much more to offer, for it has a contribution to make in the fields of science, of education, of conservation, and perhaps in the wider field of recreation in which things of beauty are to be enjoyed by man. That a comparative collection such as the one at Slimbridge offers opportunity for important research in behaviour and the study of evolution, as well as for education and recreation, has been amply demonstrated during the past ten years.

At present the collection at Slimbridge consists of some 1300 birds of 147 different forms. It is the most representative collection in the world, and probably the most representative that there has ever been. Of the great collections of the past, the finest was undoubtedly that of Mr Jean Delacour at Clères in Normandy in the period between the wars. Other famous collections were those of Lord Derby at Knowsley, Lord Lilford at Lilford, Mr St. Quentin at Scampston, the Duke of Bedford at Woburn, Mr Blaauw at Gooilust in Holland, the brothers Stevens at Walcot, Mr Ezra at Foxwarren, Mr Spedan Lewis at Leckford, Sir Philip Sassoon at Trent Park, Dr Derscheid at Sterrebeck in Belgium, and of course in many zoos.

Almost all these fine collections have been sadly ephemeral. They have mostly depended on the enthusiasm of a single person and have disappeared with the passing, or with the changing interest, of the enthusiast. Collections on the scale which existed in the past have become too expensive to be maintained by private individuals and, at least in Europe, they are now only practicable for some kind of society or institution. To be sure, there are a great many small and very delightful private collections in Britain—more than 200 of them—and in the U.S. there are some rather larger ones. But the really representative collections are to be seen in the zoos (some of them better than at any time in the

past), at Clères in Normandy which is open to the public, at Peakirk and at Slimbridge. Only at Slimbridge are more than a hundred kinds represented. Let us hope that the framework of the Wildfowl Trust will be sturdy enough to survive through many generations in a changing world.

Slimbridge, in its present form, owes its origin to the quite small collection which I maintained at my lighthouse on the Wash before the Second World War. The birds were dispersed when the war began, and only a handful still survived at the end of it. But I was determined to begin again. The lighthouse offered little chance of expansion and lacked fresh water, and from 1946 onwards the decision to start afresh on the Severn Estuary began to crystallise.

Some of the birds which had been at the lighthouse had spent the war in Scotland at the home of my friend Gavin Maxwell, and he had also collected quite a number of other geese. In the autumn of 1946 these birds were moved to Slimbridge as the nucleus of the new community. They consisted of 50 geese of 18 different kinds.

From this small beginning the great collection was gradually built up. Table I shows how it has grown.

When the first birds arrived, only the Rushy Pen and the Orchard were fenced, and even these had not been completed. The 50 geese were released for the first night into the rooms of the uninhabited bungalow, and driven round in flocks into the pens on the following morning. The following year the Decoyside Pens were constructed, and it was not until 1948 that the Big Pen, which at that time included the North and South American Pens and the present Tower Pen, was added to bring the Trust's enclosure to about 21 acres. In the winter of 1949–50 the Big Pen was divided into a series of large pens and a row of small ones, and in the following year a path was laid along the bank dividing them. Then in 1954 the Rushy Pen was enlarged, and a new pond was dug, beside which the old barn was rebuilt with a higher roof and a new house was built in which I now live and work.

A new pond was dug in the Big Pen in 1955, making the path into a causeway at one point, and finally, in 1957, an additional area of 6 or 7 acres (the exact amount has not yet been determined) was made available to the Trust, and this is now being developed in the light of our experience of laying out the enclosures in the past. It is likely to become the most beautiful part of the Trust's enclosures and includes a large number of new ponds, some of them more than 15 feet deep, an artificial hill and a range of covered aviaries for the more delicate species.

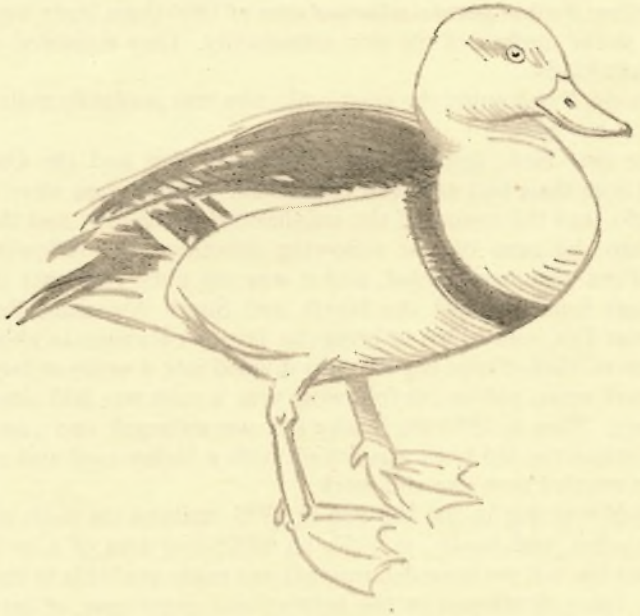
The Trust has been most fortunate in its Curators, who have been, without exception, extremely conscientious people. In the earliest days the birds were in the charge of John Yealland and Miss Eunice Overend. In 1950 Tommy Johnstone, who had been joint Curator, took full charge when Mr Yealland became Curator of Birds at the London Zoo.

The overall figures for rearing success shown in Tables I and II reflect a tremendous advance in the technique of rearing waterfowl under bantam foster-parents. The quipment and methods now used represent a process of evolution in design and detail at all stages from the nest boxes and baskets to the electrically heated brooders.

It seems that the Trust has been the first to breed only two species—the Cape Shoveler and the Bewick's Swan—but there is a satisfactory number of first records for Europe, and several species appear only to have been bred once

previously. In addition, the trust has built up successful breeding stocks of a number of species which, although they had been bred occasionally, were not well established in captivity. These include the Cuban and Wandering Whistling Ducks, Orinoco Goose, Cinnamon Teal, Marbled Teal, Red Shoveler and Ringed Teal.

Table III shows the rare species which have laid eggs, and Table IV shows the number of species and subspecies which are currently to be seen in the Wildfowl Trust's Collection and nowhere else in this country.



The First Ten Years of the Slimbridge Collection

TABLE I

Numbers in the Collection

	Birds (50 geese of 18 spp. in autumn 1946)	Forms and Spp.
1948	440	'over 70'
1949	650	106
1950	700	119
1951	920	130
1952	996	136
1953	1050	136
1954	1100	135
1955	1100	134
1956	1200	139
1957	1301	147

TABLE II

Breeding

	Forms Laying	Forms Reared	Goslings and Cygnets	Ducklings	Total Reared
1947 ..	10	14 (incl. eggs from elsewhere)	18	31	49
1948 ..	27	17	—	—	147
1949 ..	45	37	41	269	310
1950 ..	—	39	61	221	282
1951 ..	51	44	72	338	410
1952 ..	74	59	111	350	461
1953 ..	70	51	137	248	385
1954 ..	73	46	125	144	269
1955 ..	75	57	144	270	414
1956 ..	86	67	176	326	502
1957 ..	91	72	178	562	740

TABLE III

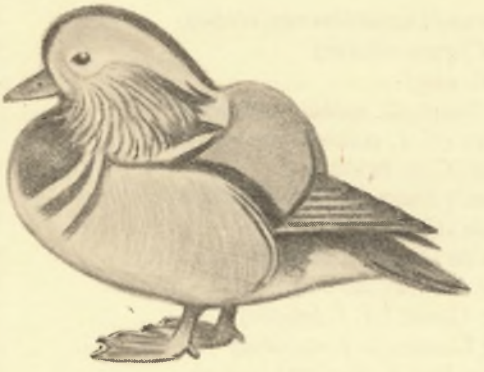
The following species, which have rarely or never before bred in captivity, have nested in the Trust's grounds

	Previous Breeding Records	
	World	Europe
Magpie Goose	1	0
Southern Red-billed Whistling Duck	—	0
Bewick's Swan	0	—
Coscoroba Swan	1	—
Ne-ne or Hawaiian Goose	—	0 (in recent years)
Hawaiian Duck	—	0
Philippine Duck	1	0
Cape Shoveler	0	0
New Zealand Scaup	—	0
Ring-necked Duck	—	0
Southern Pochard	—	0
Comb Duck	1	1
Goosander	?	?
Smew	1	1
Ruddy Duck	—	1

TABLE IV

The Wildfowl Trust is the only place in Great Britain where we believe the following species and subspecies are on show

Spotted Whistling Duck
Northern Red-billed Whistling Duck
Trumpeter Swan
Pacific Black Brant
Moluccan Radjah Shelduck
Falkland Flightless Steamer Duck
Bronze-winged Duck
Hottentot Teal
American Green-winged Teal
New Zealand Brown Duck
Hawaiian Duck
Florida Duck
North American Black Duck
Chinese Spotbill
New Zealand Grey Duck
Abyssinian Yellowbill
Blue-winged Teal
Cape or South African Shelduck
New Zealand Blue or Mountain Duck
Baer's Pochard
Lesser Scaup
Hartlaub's Duck
White-winged Wood Duck
King Eider
Common Scoter
American Goldeneye
Buffiehead
Smew
Hooded Merganser
Red-breasted Merganser
Goosander
Maccoa Duck



SLIMBRIDGE, 1947–57

Census of Birds in the Collections, 31 October 1957

THE nomenclature and order used in this list is that used in the revised *Key to the Wildfowl of the World* by Peter Scott (1958). The exact composition of the collections is always changing. This list was compiled at the latest possible date before publication. The figures following each name show the number of birds at Slimbridge and Peakirk, in that order. Figures in parentheses refer to full-winged birds. Those preceded by the symbol '*c.*' are only approximate totals.

The latest published list of birds in the Slimbridge Collection appeared in the *Fifth Annual Report*, pp. 52–53. Compiled at 30 April 1952, it recorded 963 birds of 136 forms, together with 33 hybrids. The present list includes 1747 birds of 148 forms, with 56 hybrids. In addition, principally in winter-time, there are numbers of wild birds in the enclosures of the species marked thus *.

	Slimbridge	*Peakirk*
Magpie Goose (*Anseranas semipalmata*)	14 (2 FW)	
Spotted Whistling Duck (*Dendrocygna guttata*)	3	
Eyton's Whistling Duck (*D. eytoni*)	3	
East Indian Wandering Whistling Duck (*D. a. arcuata*)	14 (5 FW)	
Fulvous Whistling Duck (*D. bicolor*)	*c.* 25 (13 FW)	6
Black-billed Whistling Duck (*D. arborea*)	8 (5 FW)	
Javan Whistling Duck (*D. javanica*)	10	
White-faced Whistling Duck (*D. viduata*)	17 (12 FW)	
Northern Red-billed Whistling Duck (*D. a. autumnalis*)	2	

	Slimbridge	*Peakirk*
Southern Red-billed Whistling Duck (*D. a. discolor*)	*c.* 20 (15 FW)	
Coscoroba Swan (*Coscoroba coscoroba*)	3	
Black Swan (*Cygnus atratus*)	4	2
Mute Swan (*C. olor*)	3	
Black-necked Swan (*C. melanocoryphus*)	4	
Whistling Swan (*C. c. columbianus*)	2	
Bewick's Swan (*C. c. bewickii*)	4	2
Eastern Bewick's Swan (*C. c. jankowskii*)	1	
Whooper Swan (*C. c. cygnus*)	5	
Trumpeter Swan (*C. c. buccinator*)	6	
Swan Goose (*Anser cygnoides*)	5	4
Western Bean Goose (*A. f. fabalis*)	5	2
Russian Bean Goose (*A. f. rossicus*)	3	
Pink-footed Goose (*A. brachyrhynchus*)	7	8
European White-fronted Goose (*A. a. albifrons*)	6	2
Pacific White-fronted Goose (*A. a. frontalis*)	2	
Greenland White-fronted Goose (*A. a. flavirostris*)	6	
Perry River White-fronted Goose (*A. a. gambelli(?)*)	2	
Lesser White-fronted Goose (*A. erythropus*)	8	4
Western Greylag Goose (*A. a. anser*)	*c.* 20	7
Eastern Greylag Goose (*A. a. rubrirostris*)	8 (1 FW)	6
Bar-headed Goose (*A. indicus*)	18 (14 FW)	5
Emperor Goose (*A. canagicus*)	15 (6 FW)	4
Lesser Snow and Blue Goose (*A. c. caerulescens*)	7 (2 FW)	6
Greater Snow Goose (*A. c. atlanticus*)	23 (19 FW)	1
Ross's Snow Goose (*A. rossii*)	32 (20 FW)	2
Atlantic Canada Goose (*Branta c. canadensis*)	3	
Dusky Canada Goose (*B. c. occidentalis*)	4	2
Taverner's Canada Goose (*B. c. taverneri*)	15 (11 FW)	5
Cackling Goose (*B. c. minima*)	6	
Hawaiian Goose (*B. sandvicensis*)	37	2
Barnacle Goose (*B. leucopsis*)	26 (22 FW)	3
Russian Brent Goose (*B. b. bernicla*)	4 (2 FW)	
Atlantic Brent Goose (*B. b. hrota*)	2	
Black Brant Goose (*B. b. orientalis*)	11	
Red-breasted Goose (*B. ruficollis*)	30 (1 FW)	2
Ruddy Shelduck (*Tadorna ferruginea*)	4	4
Cape Shelduck (*T. cana*)	4	4
Australian Shelduck (*T. tadornoides*)	6	2
New Zealand Shelduck (*T. variegata*)	6	4
Moluccan Radjah Shelduck (*T. r. radjah*)	1	
Australian Radjah Shelduck (*T. r. rufitergum*)	4	2
Common Shelduck (*T. tadorna*)	2	11
Egyptian Goose (*Alopochen aegyptiacus*)	4	2
Orinoco Goose (*Neochen jubatus*)	10 (5 FW)	5
Abyssinian Blue-winged Goose (*Cyanochen cyanopterus*)	3	1
Andean Goose (*Chloëphaga melanoptera*)	6	

	Slimbridge	*Peakirk*
Ashy-headed Goose (*C. poliocephala*)	9	2
Ruddy-headed Goose (*C. rubidiceps*)	4	2
Upland Goose (*C. p. picta*)	4	4
Falkland Upland Goose (*C. p. leucoptera*)	18	6
Cape Barren Goose (*Cereopsis novae-hollandiae*)	12 (7 FW)	2
Falkland Flightless Steamer Duck (*Tachyeres brachypterus*)	2	
Andean Crested Duck (*Lophonetta specularioides alticola*)	6 (1 FW)	3
Bronze-winged Duck (*Anas specularis*)	2	
Marbled Teal (*A. angustirostris*)	17	4
Cape Teal (*A. capensis*)	15 (6 FW)	14
Hottentot Teal (*A. punctata*)	10	
Versicolor Teal (*A. v. versicolor*)	16	5
Puna Teal (*A. v. puna*)	5	3
African Red-billed Pintail (*A. erythrorhyncha*)	14	6
Southern Bahama Pintail (*A. bahamensis rubrirostris*)	10 (5 FW)	14
Brown Pintail (*A. georgica spinicauda*)	3	
Northern Pintail (*A. a. acuta*)	20*	19
Kerguelen Pintail (*A. a. eatoni*)	5	
Chilean Teal (*A. f. flavirostris*)	7	7
Sharp-winged Teal (*A. f. oxyptera*)	5	
Green-winged Teal (*A. c. crecca*)	10*	8
American Green-winged Teal (*A. c. carolinensis*)	5	
Baikal Teal (*A. formosa*)	15	2
Falcated Teal (*A. falcata*)	8	2
Australian Grey Teal (*A. gibberifrons gracilis*)	6	
Chestnut-breasted Teal (*A. castanea*)	22 (6 FW)	12
New Zealand Brown Teal (*A. aucklandica chlorotis*)	6	
Mallard (*A. p. platyrhynchos*)	?*	?*
Hawaiian Duck (*A. p. wyvilliana*)	12	2
Florida Duck (*A. p. fulvigula*)	10	2
North American Black Duck (*A. rubripes*)	6	
Indian Spotbill (*A. p. poecilorhyncha*)	8	2
Chinese Spotbill (*A. p. zonorhyncha*)	5	
New Zealand Grey Duck (*A. s. superciliosa*)	6	2
Australian Grey Duck (*A. s. rogersi*)	6	
Philippine Duck (*A. luzonica*)	*c.* 15	16
African Yellowbill (*A. u undulata*)	8	3
Abyssinian Yellowbill (*A. u. ruppelli*)	4	
African Black Duck (*A. s. sparsa*)	6	3
Abyssinian Black Duck (*A. s. leucostigma*)	1	
Gadwall (*A. s. strepera*)	5*	9
European Wigeon (*A. penelope*)	10*	15
American Wigeon (*A. americana*)	9	2
Chiloe Wigeon (*A. sibilatrix*)	15 (5 FW)	6
Prairie Blue-winged Teal (*A. d. discors*)	7	
Atlantic Blue-winged Teal (*A. d. orphna*)	1	

	Slimbridge	*Peakirk*
Northern Cinnamon Teal (*A. cyanoptera septentrionalium*)	10 (1 FW)	15
Andean Cinnamon Teal (*A. c. orinomus*)	6	
Garganey (*A. querquedula*)	6*	4
Argentine Red Shoveler (*A. platalea*)	7	
South African Shoveler (*A. smithi*)	9	2
Common Shoveler (*A. clypeata*)	10*	16*
Ringed Teal (*A. leucophrys*)	22	4
Blue Duck (*Hymenolaimus malacorhynchos*)	3	
European Eider (*Somateria m. mollissima*)	10 (2 FW)	
King Eider (*S. spectabilis*)	2	
Red-crested Pochard (*Netta rufina*)	14	8
Rosybill (*N. peposaca*)	7	8
South African Pochard (*N. e. erythrophthalma*)	15	4
South American Pochard (*N. e. brunnea*)	5	
Canvasback (*Aythya valisneria*)	6	
European Pochard (*A. ferina*)	7*	17
Redhead (*A. americana*)	9	2
White-eye (*A. nyroca*)	8	
Baer's Pochard (*A. baeri*)	5	
New Zealand Scaup (*A. novae-seelandiae*)	6	
Ring-necked Duck (*A. collaris*)	6	
Tufted Duck (*A. fuligula*)	10*	13
Lesser Scaup (*A. affinis*)	7	
European Scaup (*A. m. marila*)	8	6
Brazilian Teal (*Amazonetta b. brasiliensis*)	10	
Australian Wood Duck (*Chenonetta jubata*)	4	
Mandarin Duck (*Aix galericulata*)	*c.* 40 (20 FW?)	19
Carolina Duck (*A. sponsa*)	*c.* 30 (10 FW?)	36
Comb Duck (*Sarkidiornis m. melanotos*)	4	2
South American Comb Duck (*S. m. carunculatus*)	8	
Hartlaub's Duck (*Cairina h. hartlaubi*)	6	
White-winged Wood Duck (*C. scutulata*)	8	
Muscovy Duck (*C. moschata*)	3	
Spur-winged Goose (*Plectropterus g. gambensis*)	4	
Black Spur-winged Goose (*P. g. niger*)	2	
Common Scoter (*Melanitta n. nigra*)	7	
Barrow's Goldeneye (*Bucephala islandica*)	12	1
European Goldeneye (*B. c. clangula*)	10	
American Goldeneye (*B. c. americana*)	1	
Bufflehead (*B. albeola*)	1	
Smew (*Mergus albellus*)	7	
Hooded Merganser (*M. cucullatus*)	2	
Red-breasted Merganser (*M. serrator*)	7	
Goosander (*M. m. merganser*)	8	
North American Ruddy Duck (*Oxyura j. jamaicensis*)	*c.* 30	2
Maccoa Duck (*O. j. maccoa*)	3	

Hooded Merganser

HYBRIDS

	Slimbridge
Fulvous Whistling Duck × Red-billed Whistling Duck	1
Red-billed Whistling Duck × White-faced Whistling Duck	2
Swan Goose × Greylag Goose	3
Swan Goose × Eastern Greylag Goose	1
Swan Goose × Blue Snow Goose	1
Swan Goose × Greater Snow Goose	2
White-fronted Goose × Bean Goose	2
Greylag Goose × Barheaded Goose	3
Greater Snow Goose × Lesser White-fronted Goose	3
Ross's Goose × Emperor Goose	1
Dusky Canada Goose × Greenland White-fronted Goose	1
Dusky Canada Goose × Swan Goose	1
Taverner's Canada Goose × Greenland White-fronted Goose	1
Taverner's Canada Goose × Lesser Snow Goose	3
Red-breasted Goose × Lesser White-fronted Goose	1
Cape Teal × Chestnut-breasted Teal	4
Cape Teal × Brown Pintail	1
Cape Teal × Tufted Duck	1
Bahama Pintail × Chestnut-breasted Teal	2
Brown Pintail × Red-crested Pochard	2

	Slimbridge
Mallard × Pintail	3
Mallard × Australian Grey Duck	2
Mallard × Philippine Duck	2
Mallard × African Yellowbill	2
Mallard × Red-crested Pochard	2
African Yellowbill × Common Pochard	2
African Yellowbill × Red-crested Pochard	2
South African Pochard × Chestnut-breasted Teal	2
European Pochard × New Zealand Scaup	2
Carolina Duck × Chiloe Wigeon	1

THE BREEDING SEASON 1957

by S. T. Johnstone

ABOUT 770 birds were reared at the New Grounds this year, representing some 75% of the babies hatched. Altogether, 91 forms laid, and of these 72 were reared. These figures are in each case the best we have obtained. In addition, 146 birds of 15 species have been reared by Major Mark Fisher in the first season at Peakirk—a most excellent effort on which he is to be congratulated. One feels that one must stress the undoubted help that the glorious weather of May, June and July gave to our effort, but a change in the method of feeding the young must be recorded. The usual soaked biscuit-meal was replaced by dry turkey starter crumbs. This would seem to have had a very beneficial effect on the ducklings, both on their survival and on the rate of growth; particularly was this so in the case of the Shelducks.

The manner in which baby waterfowl manage to hold on to their slender thread of life, despite the various and many methods of feeding and rearing to which they are subjected by aviculturists, makes one realise how unwise it is to dogmatise upon the precise method which should be used, but the 1957 breeding results would seem to suggest that we have evolved one satisfactory means of rearing swans, ducks and geese. Lest we feel too satisfied with our efforts, we must recall the failure of the Bewick's Swan to produce any young. The first clutch of five fertile eggs was spoiled by the pen being frightened from the nest by the visiting public. Unfortunately, the second clutch of three eggs was laid after she had sat through a full incubation period on the first, and was infertile. It is remarkable that a bird which normally breeds in the short Arctic summer should have re-nested at all under the circumstances.

The other major disappointment was the loss of nine of the fifteen Ne-ne goslings hatched—three from aspergillosis and six as a result of a gape-worm infestation. In this case the parasite was *Cyathostoma*, a larger and more lethal worm than the usual *Syngamus trachea*.

An interesting 'first' at Slimbridge was the rearing of three female Smew from eggs laid by the wild-caught female that we acquired in 1953. This species had previously only been bred, so far as we know, by Messrs Ronald and Noel Stevens at Walcot Hall in the 1930s.

TABLE I

Breeding Analysis 1957—Slimbridge

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Clear	Addled	Dead in Shell	Hatched	Reared	Remarks
Magpie Goose	1	6.4	15	2	1	—	11	10	
Wandering Whistling Duck	1	3.4	17	4	—	—	13	3	
Fulvous Whistling Duck	6	2.4	137	55	8	2	72	52	
Cuban Whistling Duck	1	6.5	6	3	3	—	—	—	2 females laid, mated to Red-breasted Whistling Ducks 2 hatched.
Southern Red-billed Whistling Duck	3	10.5	33	13	5	2	13	3	
Black Swan	2	3.2	28	17	—	1	8	7	
Bewick's Swan	1	15.4	8	3	5	—	—	—	
Canada Goose	1	29.3	7	—	—	—	7	5	
Dusky Canada Goose	1	5.4	5	5	—	—	—	—	
Taverner's Canada Goose	3	11.4	18	12	—	—	6	6	
Cackling Goose	1	25.4	4	4	—	—	—	—	
Ne-ne	7	30.1	70	42	11	3	14	5	
Barnacle Goose	6	21.4	48	19	—	—	29	23	3 killed by hen
Red-breasted Goose	5	16.5	31	17	2	1	11	10	
Swan Goose	2	3.4	28	15	4	2	7	5	
Western Bean Goose	4	27.4	4	1	—	—	3	3	
Greenland Whitefront	2	12.4	11	7	—	—	4	4	3 hybrids
Lesser Whitefront	2	26.4	9	5	—	—	4	4	1 hybrid
Greylag	4	1.4	30	14	—	5	11	11	
Eastern Greylag	2	16.3	12	2	—	—	9	6	3 hybrids. 1 crushed by hen
Barhead	5	26.3	35	28	—	3	4	4	
Emperor Goose	3	2.5	16	9	—	—	7	3	2 killed by hen
Lesser Snow Goose	1	6.4	4	3	—	—	1	1	
Blue Snow Goose	1	12.4	12	7	1	1	3	3	
Greater Snow Goose	7	15.4	64	40	6	2	16	6	6 hybrids
Ross's Goose	7	25.4	23	7	3	—	13	13	
Cape Shelduck	2	10.4	13	4	1	1	7	7	

TABLE I—*continued*

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Clear	Addled	Dead in Shell	Hatched	Reared	Remarks
New Zealand Shelduck	1	18.4	6	—	—	—	6	4	
Red-backed Radjah Shelduck ..	1	2.4	9	5	—	—	3	1	
Common Shelduck	1	1.5	2	2	—	—	—	23	From eggs and ducklings sent in
Egyptian Goose	1	10.3	14	2	—	—	12	11	
Orinoco Goose	3	17.3	40	13	1	1	25	19	
Abyssinian Blue-winged Goose ..	1	11.5	5	4	1	—	—	—	
Ashy-headed Goose	1	15.5	6	4	—	—	2	—	2 killed by hen
Ruddy-headed Goose	1	12.4	4	3	—	—	1	1	
Greater Magellan	1	15.3	15	3	1	—	11	11	
Cereopsis	3	24.12.56	25	9	4	—	12	7	
Andean Crested Duck	2	16.3	16	10	—	—	6	5	
Marbled Teal	3	22.4	41	20	1	—	20	17	
Cape Teal	3	25.4	30	7	1	2	19	13	
Versicolor Teal	4	13.3	38	4	—	—	33	14	
Puna Teal	1	20.4	9	9	—	—	—	—	
Bahama Pintail	3	11.5	27	5	—	—	22	14	
Chilean Pintail	1	5.4	5	3	—	—	2	2	Hybrids
Pintail	4	4.4	41	8	—	1	32	22	
Chilean Teal	1	28.4	5	3	—	1	1	—	
Australian Grey Teal	1	12.3	13	5	3	—	5	3	
Chestnut-breasted Teal	5	5.3	81	19	7	—	55	47	8 hybrids
Hawaiian Duck	2	4.4	13	1	6	—	3	1	
Florida Duck	1	3.4	5	5	—	—	—	—	
Mottled Duck	1	15.4	6	3	—	—	3	2	
North American Black Duck ..	1	25.3	17	3	—	—	14	3	
Indian Spotbill	1	22.4	9	4	1	—	4	1	
Australian Grey Duck	1	1.4	8	2	—	—	6	6	
Philippine Duck	5	6.4	54	17	7	—	28	22	
African Yellowbill	2	1.4	10	4	—	—	6	3	3 hybrids
African Black Duck	2	1.4	15	4	—	2	9	8	
Gadwall	1	12.4	11	—	—	—	11	10	
European Wigeon	3	13.5	25	7	—	—	18	15	

TABLE I—*continued*

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Clear	Addled	Dead in Shell	Hatched	Reared	Remarks
American Wigeon	1	7.6	9	9	—	—	—	—	
Chiloe Wigeon	6	2.4	102	56	12	2	32	26	
Cinnamon Teal	4	27.4	41	13	1	1	26	10	
Andean Cinnamon Teal	1	23.4	4	1	—	—	3	—	
Garganey	1	5.5	9	9	—	—	—	—	
Red Shoveler	1	8.4	8	4	—	—	4	1	
Cape Shoveler	2	25.3	18	7	3	—	8	6	
Common Shoveler	2	1.5	16	12	—	—	4	4	
Ringed Teal	4	12.3	47	6	—	—	41	30	
Red-crested Pochard	3	13.3	42	22	2	—	18	13	
Rosy-bill	1	12.5	8	1	3	—	4	2	
Southern Pochard	3	4.3	16	4	1	—	11	5	
Canvasback	1	29.4	8	1	5	—	2	—	
European Pochard	2	21.4	12	4	3	—	5	5	
Redhead	2	20.5	11	4	—	—	7	5	
New Zealand Scaup	1	14.4	12	—	—	—	12	10	Hybrids
Tufted Duck	1	4.6	7	2	—	—	5	1	
Lesser Scaup	1	2.6	6	3	—	—	3	3	
Common Scaup	2	10.5	11	4	—	—	7	6	
Mandarin	7	3.4	81	21	2	2	56	43	
Carolina	8	4.3	154	79	4	14	57	37	
Comb Duck	1	2.6	12	4	2	—	6	2	
South African Comb Duck ..	1	15.6	11	1	—	1	9	1	
Spur-winged Goose	1	7.4	1	1	—	—	—	—	
Eider	2	20.5	8	4	—	—	4	3	
Barrow's Goldeneye	1	10.5	5	3	—	—	2	1	
European Goldeneye	1	15.4	7	2	2	—	3	—	
Smew	1	7.6	5	—	—	—	5	3	
Red-breasted Merganser	1	10.6	18	18	—	—	—	—	
Goosander	1	13.5	12	1	—	—	11	—	
North American Ruddy Duck ..	12	10.5	—	—	—	—	—	*c.* 40	Number unknown; all reared by parents

TABLE II

Breeding Analysis 1957—Peakirk

Species	Number of Breeding Pairs	1st Egg	Number of Eggs	Clear	Addled	Dead in Shell	Hatched	Reared	Remarks
Greylag	—	10.4	3	—	3	—	—	—	Greylag mated to Canada Goose
Greater Snow Goose	1	1.6	1	1	—	—	—	—	
Egyptian Goose	1	7.5	9	—	—	—	9	7	
Lesser Magellan Goose	1	20.5	5	5	—	—	—	—	
Cereopsis	1	12.3	4	4	—	—	—	—	
Cape Shelduck	1	10.4	5	3	—	—	2	2	
Cape Teal	2	27.4	41	—	14	—	27	22	
Chilean Teal	1	10.4	12	8	—	—	4	3	
Bahama Pintail	2	3.6	18	9	1	—	8	8	
Pintail	1	10.5	9	—	—	4	5	5	
Chestnut-breasted Teal	1	29.4	14	2	—	—	12	10	
Chiloe Wigeon	1	20.5	2	2	—	—	—	—	
Philippine Duck	2	10.5	25	3	3	—	21	17	
Gadwall	1	20.5	4	—	4	—	—	—	
Cinnamon Teal	1	20.5	21	—	2	—	19	14	
Shoveler	2	10.5	18	—	—	9	9	9	Heavy hen broke eggs
Common Pochard	1	6.5	9	—	—	—	—	8	
Red-head	1	3.6	9	4	—	—	5	—	Hen killed ducklings
Rosy-bill	1	15.5	10	4	1	—	5	4	
Red-crested Pochard	2	4.4	22	2	6	1	13	4	
Mandarin	2	20.4	41	6	13	4	18	12	1 Mandarin mated to Spotbill and produced infertile eggs
Carolina	7	31.3	108	21	17	18	52	20	

WILD GEESE AT THE NEW GROUNDS 1956–57

THE winter of 1956–57 was the poorest for the goose watcher since the Trust was founded. The most geese seen were about 3300 on 2 February, and four species were recorded; only in 1951–52 was the maximum less than this, and only in 1947–48 had so few species been seen.

EUROPEAN WHITE-FRONTED GOOSE (*Anser albifrons albifrons*)

The first twenty-eight geese were seen on 24 September. The total rose to just over two hundred by the end of September, an unusually large number for that time. Further small additions occurred at fairly frequent intervals until early December, reaching a total of 980 on 8 December. Subsequently no substantial change occurred until after Christmas, when new arrivals brought the flock to 1800 on 4 January. More arrivals took the total to 2700 on 24 January, but some birds then left, so that at the end of the month only 2100 remained. A major influx then took place, and on 2 February the flock was estimated at 3300, the highest total for the season. After 5 February numbers dropped again to 2000, and remained at about that figure until nearly the end of the month. There was a return to 3000 on 26 February (an influx at this time seems to occur regularly), followed almost immediately by the beginning of the spring exodus: 1860 on 3 March, 1500 on 8th, 1475 on 11th, 336 on 13th, 3 on 16th, 2 on 18th. No more were seen until a solitary bird was noted from 11 June to 4 July.

Among the early arrivals the mean brood size was 4·67. It decreased throughout the season to only 2·50 at the end of February. Both these values are extremes, the mean brood size in October in the years 1949–45 being 3·46 and that for February being 2·66. First-winter birds made up 38% of the early arrivals and 35% of the flock on 1 January, but later in January and in February they accounted for only 27%. Evidently 1956 had been a successful breeding year, but losses of young birds during the winter must have been unusually heavy.

LESSER WHITE-FRONTED GOOSE (*Anser erythropus*)

Three were seen in January and February 1957: a first-winter bird on 19 January and two in adult plumage on various dates between 19 January and 1 March. Both adults were seen on the same day, though not together, on 25 January and 10 February. Some of the records of single adults on other days cannot be definitely identified as one rather than the other of the two, although the specific identification is not in question.

BEAN GOOSE (*Anser fabalis*)

One seen on 29 December and 6 January.

PINK-FOOTED GOOSE (*Anser brachyrhynchus*)

Seventeen seen on 2 October, increasing to 52 by 7th and fluctuating between 65 (4 and 11 November) and 29 (17 November) until late November, dwindling to one by 8 December. No more were seen except for a single juvenile, present from 10 January to 26 February, and a single adult seen between 26 February and 15 March. Twenty-two of 55 seen on 27 October were young birds, 21 in seven family parties and one unattached. Three of the parents carried rings, two put on in Iceland in 1953 and one apparently ringed somewhere in Britain in 1952. The proportion of young birds is higher than that encountered in rocket-netting catches elsewhere in Britain in October 1956, suggesting that the Slimbridge birds had a more successful breeding season than most.

WILD DUCKS AT THE NEW GROUNDS 1947–57

THE first five Trust Reports included notes on the status of ducks on the Severn estuary. These short annual summaries were discontinued because they seemed largely repetitive and of merely parochial interest. This review of ten years of observation has two main claims on the attention. First, as a summary of apparent changes in the status of species visiting the estuary of the Severn, and second, as a report on the effects of the development of the Trust collection on the numbers and habits of the ducks frequenting Berkeley New Decoy and the pens and enclosures which have gradually been constructed around it. The two are in practice not separate, for there is constant traffic between the river and the pens; but for some species it is appropriate as well as convenient to write as if they were.

The area of the estuary which has been most closely watched is that bounded in the north-east by Frampton Pill, on the south by the New Grounds, on the south-west by the breakwater at Purton, and on the west and north by the main river channel, which lies much nearer to the Forest of Dean shore (from the Severn Bridge to Awre) than to the New Grounds. Scarcely any observations have been made from the north-west shore itself. This omission is probably not serious, since the best refuges and feeding-places for ducks are on the south side of the channel. For the same reason, the comparative paucity of records

from elsewhere on the estuary detracts little from the representativeness of the observations, the New Grounds being much the most-favoured gathering-place on the river. The causes of this popularity are not far to seek: the topography has been augmented by the protection afforded for many years by the owners of the Berkeley Estate, so that human disturbance of ducks resting or feeding off the New Grounds is very slight by comparison with that occurring elsewhere.

The powerful optical equipment and hides provided by the Trust help greatly in examining ducks scattered over the very considerable area they frequent. But an important limitation on duck-watching is provided by the strict application of the principle that the wintering wild geese are not to be disturbed by watchers. On very many occasions the presence of geese on the Dumbles has effectively prevented thorough examination of the ducks on the river, with the inevitable loss of much valuable information. (Though regrettable in this context, this is of minor importance when viewed in the perspective afforded by the aims of the Trust.)

SPECIES OCCURRING ANNUALLY

MALLARD (*Anas platyrhynchos*)

This is by far the most plentiful breeding species in and around the Trust Collection, and is also the most numerous visitor from August to October. The local breeding population was augmented by the release of 130 hand-reared birds in the summer of 1948, and has since been reduced by the removal of moulting adults in July (in 1955 and 1956) and by the collection of eggs and ducklings. Thus, the breeding population has been subjected to continual interference, which has kept it from increasing as rapidly as it might otherwise have done. But the autumn and winter visitors have been afforded sanctuary. They are often much more numerous than the residents. The largest number of

Mallard seen on the river was about 2000, in January 1949. There is often a peak at that time, although in most years this is smaller than the highest autumn total. Maximum autumn counts ranged from 1350 in 1950 down to 400 in 1954.

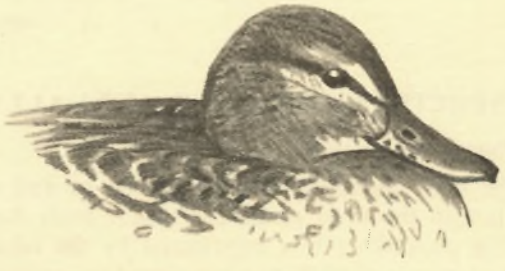
TEAL (*Anas crecca*)

Abundant on the river in most seasons from December to March, the highest total satisfactorily determined being 1700 on 31 December 1951. Gaps in the records are particularly obvious for this species, due largely to inadequate searching of the estuary during the midwinter months.

Teal are difficult to count when on the water at high tide (because of their mobility) and very difficult when on the sides of the mudbanks at low water (because of their immobility). They also come and go in comparatively large units, so that big flocks have been found only occasionally, rather than day after day. Thus it has been impossible to provide a reliable picture of changes within any season or to make valid comparisons between seasons. Recorded seasonal maxima have varied between 1700 in 1951–52 and only 200 in 1955–56, but there are no indications of prolonged trends, either upwards or downwards.

Small numbers of Teal occur in August and September. Only in one year have large numbers been seen early in the season (600 on 25 September 1949). Because the decoy is operated most intensively in the early autumn (due to the presence of large numbers of Mallard), these early-season visitors have provided a disproportionately high proportion of the Teal ringed at Slimbridge. The early arrivals seem mostly to breed in Norway and Sweden, birds from Finland and Russia not arriving until November or later. Two-thirds of the same-winter recoveries of Slimbridge-ringed Teal are from elsewhere in Britain and over half the remainder from Ireland, so that birds travelling south-west to France and the Peninsula seem to form a comparatively small proportion of the visitors to Slimbridge. In some years there has been a marked 'spring passage', notably in 1951 when 380 were seen in the first week of April; usually less than one hundred are present at that time.

The numbers of Teal frequenting the Trust enclosures have not increased like those of several other species. The decoy remains the most popular haunt, and only exceptional individuals appear to tolerate the human disturbance in the pens. It is notable in this connection that wild Teal taken into captivity rarely become tame and do not often breed.



Teal ♀

GARGANEY (*Anas querquedula*)

Occurs annually in the Trust enclosures in very small numbers between March and September, most records referring to single birds or pairs. Odd individuals

have stayed in the pens for many weeks (notably one that remained from late September to December in 1952). Garganey were taken occasionally in the decoy when it was being operated for the market; there is no clear indication of any important change in the frequency or duration of visits in recent years.

GADWALL (*Anas strepera*)

Before the establishment of the Trust there were very few records of Gadwall in Gloucestershire. In the winters of 1948–49, 1949–50 and 1950–51 two, three and six wild birds were present in the enclosures. The occurrence of others since has been obscured by the development of a small feral population, the progeny of full-winged, hand-reared birds which now nest in the immediate vicinity but outside the pens. The largest numbers are seen in January, perhaps because the Gadwall which choose to live on the estuary for much of year then come into the pens in search of food (as do a considerable proportion of the local Mallard). The largest counts in recent years have been 32 in 1954–55, 15 in 1955–56 and 23 in 1956–57.

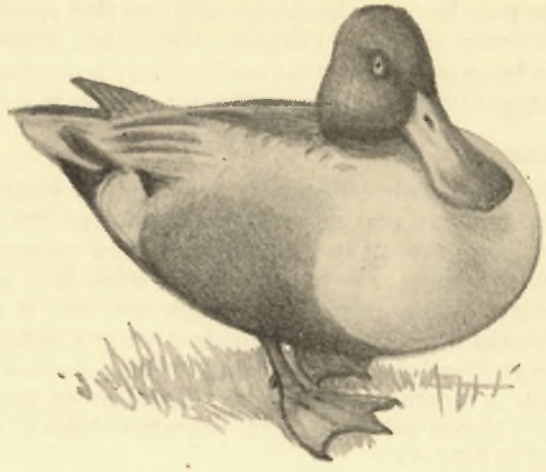
Two recent discoveries of Gadwall ringed at Slimbridge are of interest in showing the truly wild nature of some of the birds frequenting the Collection: 939059, ringed as a young female on 18 August 1954, was shot in October or November 1956 at Fiélouse in the Camargue (in the south of France); 938904, a female ringed 14 March 1956, was found on 1 August 1956 at Nowe Dolno, near Paslek, Poland (*c.* 54° 02′ N., 19° 27′ E.).

WIGEON (*Anas penelope*)

In December and January Wigeon are usually the most numerous duck on the estuary. Recorded peak numbers have varied between 700 (December 1945) and 3000 (December 1954), but anyone who has attempted to count large numbers of Wigeon on an estuary will appreciate that accurate and complete counts of the larger assemblies have not often been obtained. The first autumn arrivals have usually been in late September, though sometimes not until October. Departures in the spring have been almost complete by mid-March, though in 1952 and 1956 small flocks remained until late April.

Many years ago considerable numbers of Wigeon were taken in the decoy, where now they occur irregularly in small numbers and few are caught. The most interesting change in the behaviour of the wintering Wigeon has been the great increase in the numbers visiting the Trust enclosures in recent years. Twenty or more were seen in the Big Pen as early as 1948, but since the enlargement of the Rushy Pen in 1954, numbers have been much greater, reaching 500 in February 1956. These large flocks feed in the pens in the early morning, few of the birds remaining when there are many people about.

Wigeon



Shoveler

One or two pairs of full-winged Wigeon have nested in the area in the last three years.

PINTAIL (*Anas acuta*)

The numbers of Pintail recorded from the estuary seem to have increased considerably in the last ten years. There are no records of flocks over a hundred before February 1945, but since then each winter has produced more than that. In late December 1954 over 500 were seen on the river. In the cold weather of February 1956 there were over 200 in the Rushy Pen alone. Pintail seem to become tamer than other wild ducks, except Mallard and Tufted, and many of the winter visitors to the area spend most of their time as voluntary members of the Collection. The species is plentiful only between mid-November and early March.

Very small numbers of hand-reared Pintail have been allowed to remain full-winged since 1948, but no feral population has become established.

SHOVELER (*Anas clypeata*)

This species, too, may have become rather more plentiful in recent years, though the largest group yet encountered is only 100 (in February 1956). Usually the total present in the area from August to March lies between 30 and 70, the birds moving freely between the river and the enclosures. Recoveries of ringed birds show that in some winters, if not in all, early autumn visitors pass on to Ireland or France (particularly in 1947–48 and 1953–54). Most of the autumn visitors appear to breed in Holland, and there is no evidence yet that any come from farther east than Denmark, although birds from Russia and the Baltic are known to visit eastern England. If there is a local breeding population it must be very small.

TUFTED DUCK (*Aythya fuligula*)

The great majority of Tufted Ducks visiting the river are merely transients, only at all numerous at times when hard weather has frozen most inland waters. Flocks of up to 30 have occurred in most winters, and probably did so in earlier years, too. But, since the construction of the deep pond in the Rushy

Pen, a wintering population of wild Tufted has remained for several months. In February 1956 the flock in the Rushy Pen reached 110. Numbers last winter (1956–57) were much smaller.

POCHARD (*Aythya ferina*)

Like the Tufted, the Pochard is essentially a transient visitor to the river, perhaps less numerous now than formerly (flocks totalling 150 seen in November 1947 were far larger than any reported recently). In the Trust enclosures it is rarely found in numbers, 40 in February 1956 being the only large party yet seen. A few persisted in the Rushy Pen in the winter of 1956–57, and it is possible that these are the forerunners of a regular wintering population, though it is unlikely that this will ever grow to any great size.

SHELDUCK (*Tadorna tadorna*)

The account of the status of this species given in the *Fifth Annual Report*, p. 34, requires little amendment in the light of more recent observations, especially as the close watch kept on numbers in June, July and August in 1950–52 has not been sustained. It appears that the number of pairs nesting successfully on the south side of the estuary, between Purton and Frampton, is very small in proportion to the number of adults present in midsummer. The greatest number of ducklings seen in this area in any year was 87 in July 1951, the progeny of about a dozen pairs. In other years very few were successful: in 1956 only 28 young birds are thought to have fledged. Peak numbers of adults in June and July lay between 183 and 260 in the years 1947–52. There may have been fewer in recent years, for no midsummer counts of that size have been made since. In August only a few adults remain, and in most years many of the juveniles also desert the area in autumn, a total of 210 on 23 September 1953 being much the highest autumn total. Not until February did numbers rise much above 50, but in some years (notably 1948, 1950 and 1957) they then rose to 200 or more.

In April 1955 a pair of Shelducks was caught for the first time in the decoy. Three more have been caught since, all while taking up breeding territories in the spring. A pair of wild Shelducks bred successfully in the decoy wood in 1957, rearing five young.

VAGRANTS

BLUE-WINGED TEAL (*Anas discors*)

A drake appeared in the pens on 26 December 1956, and was captured almost at once, to be pinioned and added to the permanent collection. Despite its quick capture, this bird seems very probably to have been wild, since no full-winged Teal are known to have been bred in Europe in recent years. It appears to belong to the dark Atlantic coast population recently separated from the typical Prairie form as *A. d. orphna.*

AMERICAN WIGEON (*Anas americana*)

Though a drake was seen off the New Grounds on 9 March 1946, none has been seen since.

RING-NECKED DUCK (*Aythya collaris*)

An adult male in the pens, 12–14 March 1955, provided the first British and

European record since the specimen used by Donovan as the type which was 'exposed for sale in Leadenhall Market, London', in January 1801, and was said to have been taken in Lincolnshire.

SCAUP (*Aythya marila*)

Two seen on the canal, and also at Frampton Gravel Pits, on several days early in February 1956, were the first reported from the area since a single bird seen in October 1937.

GOLDENEYE (*Bucephala clangula*)

One in December 1944, the only pre-Trust record. Since reported as follows: Three on 2 March 1947 (estuary); one 5 March 1948 (decoy); one 21 November 1948 (estuary); one 21 January–15 February 1956 (pens); three 29 April 1956 (estuary).

LONG-TAILED DUCK (*Clangula hyemalis*)

Two on canal 21 November 1948; one 13 November–10 December 1954; one first half of February 1956.

COMMON SCOTER (*Melanitta nigra*)

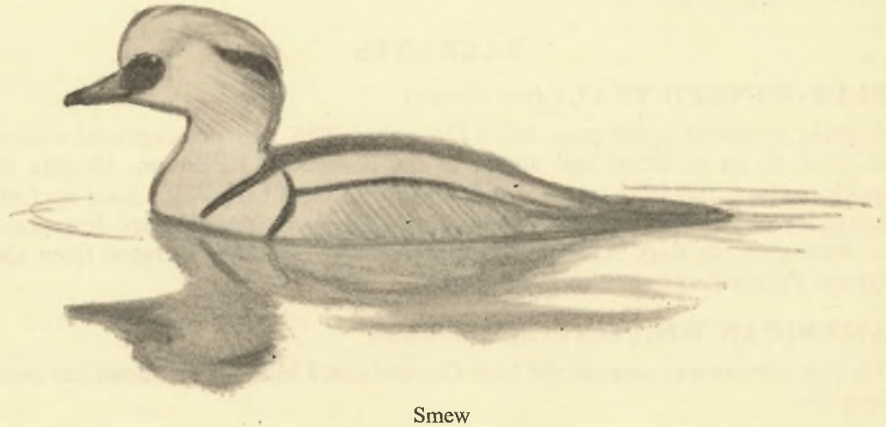
Two (males) 14 October 1946; five 19 October 1947; two on canal (probably females), 1 April 1949; a female, 20–21 March 1954; a male, 29 June 1957. All on the river, except those in 1949.

GOOSANDER (*Mergus merganser*)

A female, 2 March 1947; two, 22 January 1954; a female, 5 March 1956.

SMEW (*Mergus albellus*)

One red-head in decoy, 20–22 November 1955; 14 (including two adult males) on river, first week of February 1956.



Smew

RINGING 1956–57

Duck Ringing

THE numbers of ducks newly ringed at the four major ringing stations in England and Wales are shown in Table I.

TABLE I

Ducks Ringed at the Principal Ringing Stations in England and Wales 1956–57

Species	Abberton	Slimbridge	Borough Fen and Deeping Lake	Orielton	Total
Shelduck ..	—	2	—	—	2
Pintail	7	17	1	—	25
Teal	2265	121	21	166	2573
Mallard	468	689	324	12	1493
Gadwall ..	15	—	5	—	20
Wigeon ..	156	—	28	—	184
Garganey ..	13	—	—	—	13
Shoveler ..	16	11	7	6	40
Pochard ..	3	—	46	—	49
Tufted Duck ..	18	—	78	11	107
Scaup	7	—	—	—	7
Goosander ..	1	—	—	—	1
	2969	840	510	195	4512

The total number ringed was just over a thousand fewer than in 1955–56, largely because of a drop of 858 in the number of Teal newly ringed at Abberton and a fall of 197 in the Slimbridge Mallard total. But the contribution of the Abberton station, operated by Major-General C. B. Wainwright, C.B., ably assisted by Mr R. King, continues to be most impressive in its abundance and variety, amounting, as in the previous season, to two-thirds of the Trust's duck-ringing programme. The Borough Fen catches were disappointing because of a shortage of Teal, but Mr C. Dandridge did well with his traps on the near-by Deeping Lake, which provided three-quarters of the winter's haul of diving ducks. Mr R. M. Lockley, at Orielton, was out of luck. He is hoping to operate traps on another pond in the coming season.

Neither of the ringing stations in Norfolk—How Hill, Ludham (Messrs C. A. and M. R. Boardman) and Mileham (Mr P. L. Wayre)—could be operated in 1956–57. The loss here has been in part offset by ringing in some new localities elsewhere in England. Thanks to the collaboration of Mr R. Barker, 40 Mallard were ringed near Ormskirk, Lancashire, in June and July 1956. Mr Geoffrey Mills began to use traps at Hawkestone Park, Shropshire; 23 Mallard were the only ducks ringed. Mr Mills hopes to transfer his traps to a lake less subject to human disturbance.

In June 1957 attempts were made to catch flightless ducks at two reservoirs in Somerset. The yield was only 21 Mallard, but the experience gained should later prove fruitful. We are much indebted to Miss E. M. Palmer and Mr A. Knowles for assistance at Durleigh Reservoir, and to Mr K. B. Brown, Fishery

Officer of Bristol Waterworks Company, and his staff, for their collaboration at Chew Valley Lake.

Goose Ringing

During the summer of 1956 various attempts were made to improve the efficiency of the rocket-netting equipment. The principal object was to reduce the interval between the firing of the rockets and the final settling of the extended nets on the ground (and over the geese). Dr T. Nonweiler and Mr S. Gover, of the College of Aeronautics, Cranfield, Bucks, carried out theoretical and practical investigations of the trajectory of the nets. They succeeded in decreasing the settling time of the nets quite substantially by adding weights to the rockets so as to produce a much flatter trajectory. Dr S. W. Green of the Royal Aircraft Establishment, Westcott, Bucks, studied the performance of the existing igniters and the possible advantages of smokeless compositions. It was not possible to apply his findings at once because of the modifications they necessitate in parts of the equipment, but they offer the prospect of further improvement in the performance of the rockets.

Lieut.-Colonel C. F. Tumber, of the Royal Military College of Science, again gave much of his spare time to the preparation of the rocket charges and igniters and to checking the serviceability of the rockets. Pye Telecommunications Ltd generously loaned radio equipment, of great value in co-ordinating the catching operations.

The Trust is very much indebted to all these gentlemen and organisations for their expert assistance and advice. We only regret that the results achieved in the autumn of 1956 did not do full justice to their efforts.

In the seventh season of the Pinkfoot study, an expedition made nine catches in Scotland and eastern England during October 1956. The first catch, in Kinross, amounted to 434 geese—433 Pinkfeet (one of which was leucistic, being pale pearly fawn colour, and was kept for the collection at Slimbridge) and one Greenland Whitefront. This was the largest catch there has yet been. But none of the remaining catches exceeded 166, and the final total of 1233 geese was a little smaller than that reached in 1955 and well below the 1954 bag of 1572. The comparative failure of the later efforts was not due to technical difficulties, for the efficiency of the nets (measured by the proportion of the geese in the catching area which were actually caught) was higher than in earlier years. It had been a bad breeding season, and young birds comprised only 17% of the catch, compared with an average of about 30%. This scarcity of young birds probably added to the difficulties of catching, since relatively unwary youngsters often provide the necessary 'lead' into the catching area.

But, in any event, the unforeseeable and the unforeseen will always play a large part in the tactical aspects of rocket-netting, so that steadily increasing success should not necessarily be expected.

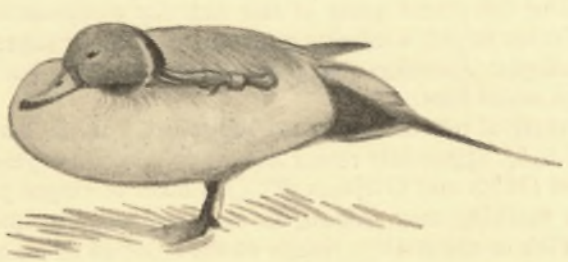
The role of ill-fortune in goose catching was dramatically illustrated by the complete failure to make a catch of Whitefronts at Slimbridge during ten days in February 1957. The final promise of a large flock in the catching area was destroyed by the unwelcome appearance of some (human) visitors on the sea-wall despite a number of warning notices.

More catches of moulting Canada Geese were made in June 1956 and June 1957, resulting in the ringing of considerable numbers in Derbyshire, Nottingham, Cheshire and Yorkshire, and the distribution of surpluses from these areas in Westmorland, Lancashire, North Wales, Shropshire, Staffordshire, Pembrokeshire, Somerset, Dorset and Kent. Members of local Wildfowlers' Associations were largely responsible for the release of the geese at the new sites. The Trust is glad to have served as an agent both in relieving landowners of the burden of too many resident geese and in providing Wildfowlers' Associations and other interested people with geese for stocking or re-stocking suitable waters. But whether it is possible or desirable to continue to function in this way requires careful study, in view of the increase in the scale of these operations during the last five years.

Swan Ringing

The status of the Mute Swan has aroused considerable interest in recent years, resulting in an inquiry into the size of the British-breeding population, undertaken by the British Trust for Ornithology (the results of which have not yet been published in full) and an increased awareness of our ignorance of many aspects of the life-history of this familiar species. Ringing and other types of visible marking should help to increase our knowledge, and so the Trust has begun to explore the techniques of catching and marking swans, hitherto neglected except for the traditional 'swan-upping' on the Thames, in which birds belonging to the Crown and to the Dyers' and Vintners' Companies of London are caught each year. The capture of swans elsewhere has proved more difficult than the colourful ritual on the Thames would suggest: the total ringed in 1956–57 has been only 47. The outstanding problem is to devise a mass-capture method for the flocks of several hundred which assemble in a few places widely scattered about the country.

If such a method can be found and applied successfully to swans not rendered flightless by the moult, it would, of course, be of the greatest interest to mark Whooper and Bewick's Swans, whose abundance and distribution in winter seem constantly to be changing.



THE DUCK ADOPTION SCHEME

Under this scheme, on payment of 5*s*., the subscriber is allotted a duck (or goose or swan, if preferred), and given particulars of its species, the number on its ring and the date and place of ringing. If the bird is later recaptured or recovered the subscriber is notified of the date and place of recovery and any other details reported by the finder; and all subscribers receive, for the next two years after contributing, a summary annual report of interesting recoveries.

In 1956, the ninth year of the scheme, the gross income received was £496, contributing, after deduction of the costs of administration and of the report to adopters, about £320 to the cost of ringing. Though this was a most useful source of income, the yield of the scheme dropped by nearly £200 as compared with 1955. Since it is the Trust's aim to expand, not merely continue, the ringing programme, it is important that interest in the adoption scheme should be revived, and members are invited to help. Members and their friends wishing to adopt ducks or geese should write to the Assistant Secretary, The Wildfowl Trust, Slimbridge, enclosing 5*s*. for each bird. Adopted Duck Tokens (analogous to Book Tokens) are available, price 6*s*.

SURVIVAL OF GREENLAND WHITE-FRONTED GEESE

by Hugh Boyd

SINCE 1946 the ringing of birds in Greenland has been actively encouraged by the Danish authorities, under the leadership of Dr Finn Salomonsen. 835 White-fronted Geese of the race *Anser albifrons flavirostris* were ringed from 1946 to 1956 and had yielded 193 recoveries by the spring of 1957. Dr Salomonsen has published details of the recoveries overseas. Most have been in Ireland, with smaller numbers in Iceland and Scotland, a few from England and Wales and one from eastern Canada. The published records have been used, together with unpublished data on recoveries in Greenland, to provide estimates of the survival of full-grown geese of this race for comparison with what is now known of other British wintering populations. A short paper will appear in *Dansk Ornithologisk Forenings Tidsskrift* early in 1958, but the principal findings may be noted here.

The annual survival rate of Greenland White-fronts more than two years old is estimated at 66%, apparently rather less than that of European White-fronts (72%), Pinkfeet (74%) and Greylags (77%). Losses of ringed juveniles in the first year after marking may amount to as much as 46%, and those in the second year of life to about 43%. Nearly all the reported losses are due to man.

Most occur between October and February (in Ireland) and in July (in Greenland).

The White-front population breeds along the west coast of Greenland from about 64° N. to 72° 30′ N. Ringing has been done in sixteen places widely scattered over the breeding range. Recoveries show that the geese breeding north of 69° N. concentrate in winter in Co. Wexford, while those breeding farther south are scattered widely in Ireland. The northern breeding population is apparently increasing, but the existing data are insufficient to show whether this is due to smaller adult losses than those suffered by the southern breeding birds or to greater breeding success. Continued ringing should solve this problem.

Tufted drake

WILDFOWL COUNTS 1956–57

Fluctuations in the Winter Population of Tufted Ducks in Great Britain—A Summary

by G. L. Atkinson-Willes

The Fourth Report on National Wildfowl Counts, published by the Trust in December 1957, *was devoted to a study of the numbers of Tufted Ducks found in winter in Great Britain. We reprint here the summary of that paper. The full report, issued free to all participants in the Count Scheme, is available from the Trust at* 2*s.* 6*d.*

ONE of the main difficulties in assessing trends in the populations of any species by means of wildfowl counts is that continuous records over periods of sufficient length are available from only a small proportion of the waters now counted. In the case of the Tufted Duck (*Aythya fuligula*), however, it can be shown that the small samples of records available for long periods give much the same

picture, in the years to which they are common, as the much larger samples available in more recent years.

Five samples of comparative counts have been assembled, varying in size and length from one of 165 waters for the six years, 1950–51 to 1955–56, to one of 601 waters for the single season 1955–56. The patterns of the seasonal fluctuations in the numbers of Tufted Ducks (*Aythya fuligula*) presented by the five samples are first compared and shown to be similar in the years for which they are all available. From this it is inferred that the smaller samples are as reliable as the larger ones.

The trends in population are also examined by this method with the larger samples being used to confirm the results of the longer but smaller ones. During the period 1950–51 to 1955–56 wide variations in the numbers present in October, November, February and March may be detected, with increases in the level of population in these months in 1955–56 and to a lesser extent in 1954–55. In January, however, which is the month in which the population of Tufted is most likely to be stable, no variation between the levels in the six years is detectable. From this it is inferred that although early and late in the season the British wintering population of Tufted may be augmented by varying numbers of immigrants, the basic population in January, after the arrival of the autumn immigrants and prior to the hard-weather influxes, has been constant throughout the six years under review.

Examination of relative numbers of Tufted Duck counted in different areas and on different habitats reveals a variety of population patterns. In particular, reservoirs appear to be of great importance, as although they comprise only 20% of the waters counted, they carry up to 60% of the birds recorded throughout most of the winter. As a great deal of information on the size and depth of reservoirs is already available, it is intended that the behaviour of the populations of Tufted on them shall be the subject of a further, more detailed, paper.

THE PLACE OF AERIAL SURVEYS IN BRITISH WILDFOWL RESEARCH

The Alternative Methods of Population Study

A BASIC requirement for programmes of conservation is a knowledge of the size and distribution of the animal populations concerned. The capture/recapture technique can estimate population size, but a general knowledge of distribution is implicit in the sampling process. Moreover, it is necessary to use traps which are mobile (or used in large numbers throughout the country) and which do not result in trap-shyness developing. Neither of the usual duck-catching devices, decoys and cage-traps, meet these requirements. Only Shelducks congregate in suitable numbers to be driven into stake-nets when flightless in the moult. Most ducks only form dense flocks on water or mud banks, where rocket-propelled nets cannot be used.

The majority of duck populations and some of the geese can therefore only be studied by direct survey methods. In some cases where the population is relatively small and restricted, a complete census can be the aim. Generally, only the population found in sample areas can be surveyed. But if this sample

is representative, changes in its size and composition can be taken as reflecting those in the population as a whole. Further, if the habitat range of these species is limited and the proportions of the different habitats covered by the survey can be determined, then appropriate extrapolation of the census figures will give an estimate of total population. The larger the sample the greater will be the accuracy of the final estimates.

Ground Survey of Wintering Flocks in Britain

The Wildfowl Trust has taken over (from the former Wildfowl Inquiry Committee) and expanded the Wildfowl Count Scheme of surveys from the ground in Britain. Under this organisation some 700 volunteers count the number of ducks and geese present on selected inland and coastal waters. This is done at monthly intervals throughout most of the year, on fixed dates. Regular information over a number of years is now available for more than 500 waters and partial information for a further 500. Even so, probably less than 1% of the inland waters alone are being surveyed, and there are great tracts of important duck country too far from the large towns to be covered by watchers living there. Attempts are being made to expand the survey, but a limit is imposed by the distribution and numbers of competent ornithologists willing to undertake this arduous task. If the present corps of observers did not give their time free and pay their own travelling expenses, the present limited survey would cost considerably more than ten times the modest sum now provided by the Nature Conservancy for running expenses. It is clear that little could be done by the employment of professionals to supplement the amateur effort.

Even if a small number of professionals were made available, each man could, on the ground, cover only a limited number of the more isolated waters or a limited stretch of coast on a count day. Moreover, they, like the present observers, would be unable to count birds lying well off-shore. This part of the population is of particular interest, since many wildfowlers opine that it contains three times as many birds as can be seen from the shore—a point which it is clearly desirable to check. A species which is of especial conservation interest, the Brent Goose, spends almost the whole winter below high-tide mark and may easily be missed from the shore.

Aerial Survey of Wintering Flocks in America

In North America, with its much greater expanses of sparsely populated country, the problem has been tackled for more than twenty years by the use of aerial survey methods. These have not been restricted to wildfowl alone—Bison, Elk, Wild Sheep, Sea Lions and deer having been counted in this way. The cost per square mile has, by some estimates, been less than one two-hundredth part of the cost of a ground search by professionals. Moreover, extensive areas could be searched that were quite beyond the scope of ground crews—nine man-weeks were spent in counting the deer on 746 square miles; a ground survey of the area would have taken more than three man-centuries!

The American winter flocks of wildfowl have been subjected for many years to an extensive sample census regularly towards the close of the shooting season. In January 1957, 150 aircraft were used, flying a total of 85,615 miles. All the indications are that estimates of numbers in flocks of wildfowl made by skilled observers from aircraft are as accurate as those made from the ground. When visual observation is supplemented by high oblique or vertical photographs as a permanent record, the final accuracy will be greater.

Aerial Survey of Breeding Populations in America

For the past nine seasons the Americans have, in addition, been making censuses of the breeding population in the summer quarters, as these are considered to give a better indication of the subsequent autumn population, which is the basis used for adjusting shooting regulations each year. Under these conditions the birds are much more scattered and are liable to be hidden by vegetation. They therefore form the most stringent test of the efficiency of aerial survey, and a number of reports on this score have been issued.

It is not claimed that aerial survey will, in these conditions, reveal the same number of birds as the ground coverage. In general, fewer birds will be recorded. But since we are only attempting to sample the population, it is only required that the method should produce consistent results.

From several detailed comparative investigations the American Fish and Wildlife Service workers have concluded that aerial survey of breeding populations is an efficient as well as economic method of making a sample census. The reliability of aerial survey of winter flocks is unquestioned.

Aerial Survey in Europe

Nearer home, the survey of moulting Shelduck on the Grosser Knechtsand in north-west Germany in August 1955 has pointed out the value of the aerial method using both visual observation and photographic records. The report of the commission indicated that without air cover the duck concentrations could hardly be located, let alone counted.

Since January 1955 Dr L. Hoffmann has made frequent aerial censuses of the ducks wintering in the Camargue area of southern France (see pp. 154–156 of this Report, and L. Hoffmann et J. Penot: 'Premier recensement des canards hivernant en Camargue' in *La Terre et la Vie*, 1955, pp. 315–320).

On 21 January 1956 a photographic flight was carried out by Dr J. K. S. St Joseph, Curator of Aerial Photography, Cambridge University, on behalf of the Nature Conservancy. In less than two and a half hours the entire coast of the Wash was surveyed for two distinct species—Brent Geese and Oystercatchers. Mr I. C. T. Nisbet, who made counts visually and from the oblique photographs, has estimated that in the latter case the standard error was between ½% and 1%.

Clearly aerial survey is a technique that must be introduced into British wildfowl research, particularly to fill in the inevitable gaps in the coverage provided by amateur ground observers of wintering flocks. Many of our birds come from Russia, Iceland or Scandinavia, and so are difficult or impossible to count on their breeding-grounds. But Britain holds an important breeding population of Mallard whose status could easily be investigated by this method.

Methods of Operation

For preliminary work, more flights such as those made by Dr St Joseph, using aircraft and men provided by the R.A.F., could certainly be used. They would have the advantage of being able to use Service airfields, weather forecasting and other facilities. But this is not a satisfactory solution for making regular surveys. The flights would have to fit in with Service requirements, and the same pilot would seldom be available. Moreover, Service training today is such that few pilots are adept at map-reading, an essential proficiency in this type of work.

American work has stressed the importance of the training of individual pilots and observers for aerial survey work, and shown how much more efficient is coverage by an experienced man. If a wide range of inexperienced aircrews had to be used, no reliance could be placed on apparent fluctuations in wildfowl numbers. Because of the much wider sample covered by the aerial observer, individual errors would loom larger in the overall sample, and would not be corrected by cancelling out of tendencies to overestimate or underestimate as is the case when hundreds of ground observers are used. Moreover, the Service pilot (or commercial pilot) would simply be driving the aircraft, and other crew members would be required to tell him where to go, to map read, to identify the birds and do the counting and/or the photography. The obvious solution is for the pilot to be a biologist himself, making aerial survey one of his main researches.

Dr S. K. Eltringham has been appointed to the staff in this capacity. As he was not available until October 1957, a preliminary programme during the winter of 1956–57 was undertaken by members of the existing staff, in a light aircraft provided and flown by Mr J. D. H. Radford. The Trust is very much indebted to Mr Radford for his enthusiastic co-operation. This first season's work was exploratory, with two principal aims: first, to discover what it is reasonable to expect from aerial observations in the conditions of a British winter, and second, to familiarise several observers with the appearance of wildfowl from the air and with the problems of approach and counting.

A total of 82 hours' flying-time was divided between four assignments. First, the aircraft was used in support of the rocket-netting team in October 1956 to locate flocks of Pinkfooted Geese in the Solway, Humber and Wash areas. Second, a short trip in December 1956 was devoted to counting ducks in Somerset. Some experience of conditions on inland reservoirs, on flooded marshes and on the coast was gained, but the weather was bad for flying, and complementary counts from the ground were hampered by the shortage of petrol at that time. Third, between 3 and 12 January 1957, a search was made of the south and east coasts of England from the Exe estuary to Skegness, with particular attention to the numbers of Brent Geese and Mute Swans. A repeat count of Brent Geese on the coast between Skegness and Southend was made on 2 March 1957. The fourth task, taking almost exactly half the total flying-time, was a search of the Hebrides and the west coast of Scotland, chiefly for Barnacle Geese. The results of this search are reported on pp. 42–46.

The expenses of the aerial survey are being met by part of the annual grant made to the Trust by the Nature Conservancy, whose support for the venture is gratefully acknowledged.

BARNACLE GEESE IN WESTERN SCOTLAND, FEBRUARY 1957

by Hugh Boyd and John Radford

THE present status of the Barnacle Goose (*Branta leucopsis*) is of particular interest, because this species, of which a large proportion winter in the British Isles, seems to have decreased seriously in numbers during this century. But it has hitherto been impossible to attempt a census of the wintering population, because this is scattered over a large number of islands off the coasts of Ireland and the west of Scotland, and frequents only a few mainland localities (although the flocks found on the mainland are comparatively large ones). For a census to be reliable it must be complete and accurate. To be complete it must include counts from all the regular wintering places and from many other places which may be visited fairly frequently, and these counts must be as nearly simultaneous as possible. The problems of accuracy in determining the numbers of this species are of two kinds. On most of the islands where the geese occur they are found very close to the shore and their numbers are relatively small—a few hundred at most. In these situations the requirement is that the search should be thorough, the process of counting being uncomplicated, except for the possibility that geese may fly unobserved from one island to another. The second kind of problem arises only in those few places where large flocks, perhaps several thousand strong, occur and are liable to be scattered over a wide area, sometimes a considerable distance inland from the shore. This is the situation on Islay and on the shores of the Solway Firth.

In order to discover whether the use of an aircraft for making a census of the Barnacle Goose was practicable, the writers spent the period 11–24 February 1957 in searching parts of the mainland coast of the west of Scotland and most of the Inner and Outer Hebrides. The areas to be examined were chosen beforehand from all the reports available on the detailed distribution of the species, and included, in addition, many islands which might have held Barnacles although not known to do so. In the event, only one locality known to be a regular wintering place of the species in Scotland could not be visited. The completeness of the 'cover' achieved was a pleasant surprise, in view of the potential hazards of flying in this area in winter. The weather may have been unusually kind.

The map (Fig. 1) shows all the places where Barnacle Geese were found during the trip. The total numbers found in various areas are summarised in Table I and detailed below. This account is not intended to be a full discussion of the historical data on numbers and distribution, although it makes use of earlier published and unpublished information where this seems desirable.

TABLE I

A Summary of the number of Barnacle Geese seen in the West of Scotland, 11–24 February 1957. For those localities visited more than once, the largest daily totals are shown

Area	*Maximum Number Seen*
Solway	430
Argyll (except Islay)	1040
Islay	1720
Islands off Skye and Inverness	550
Islands off Wester Ross	120
Islands off West Sutherland	170
Outer Hebrides	2070
Total	6100

The main sources so used are *The Birds of Scotland*, by Miss E. V. Baxter and Miss L. J. Rintoul (1952), *The Status and Distribution of Wild Geese and Wild Duck in Scotland*, by Dr John Berry (1939), an unpublished report prepared for the Nature Conservancy by Dr J. D. Lockie in 1955, and counts submitted by participants in the Wildfowl Counts scheme.

GEESE SEEN

Localities are listed by counties excepted for the Outer Hebridean islands, which are treated together and from south to north.

CUMBERLAND. *Rockcliffe Marsh:* 130 on 11 February, 33 on 24 February. *Burgh Marsh:* 300 on 11 February, none on 23rd or 24th. *Moricambe Bay:* none 24 February.

DUMFRIES. *Caerlaverock Merse:* None 11 February, 90 on 23rd, none 24th. Searches on the ground on 21 and 24 February, by Mr Alan Walker, yielded only one Barnacle in this area, in a flock of Pinkfeet.

KIRKCUDBRIGHT. *River Nith to River Urr:* None on 11 or 24 February.

The areas mentioned above include all the regular haunts of the Barnacle on the Solway. The highest number reported from the Solway during the winter of 1956–57 was about 800, in late November and late January, largely concentrated in Kirkcudbright on both occasions. In other seasons since the war recorded seasonal maxima have varied between 300 (1950–51) and 1500 (1954–55). It is difficult at present to be sure how far changes in recorded numbers in restricted areas have been due to movements within the Solway area as a whole (as local opinion has it), or whether emigrations and immigrations during the course of the winter may be more frequent than is generally supposed. One hundred and fifty were found (from the ground) in Dumfries on 23 March 1957, despite the apparent exodus in February.

ARGYLL. *East Side of Sound of Jura:* 35 on 12 February. Up to 120 had been seen in this area in the winter of 1955–56, but no other reports for 1956–57 are available.

Islay: 1150 on 12 February, 1720 on the 22nd. On both occasions the largest flocks were to the south of Loch Gruinart (750 and 920 respectively). On the first date geese were found in four other localities, on the second in only three.

These figures are undoubtedly the most controversial obtained during the survey, because they are substantially smaller than expected. In late January 1955, Mr A. B. Duncan and Professor G. A. Swanson saw 8000–10,000 on this island, and had another 2000–4000 reported to them. And though it seems likely that the concentration at the time of their visit was exceptional, the weather on Islay being less severe than in most of their other haunts, it is probable that in most years there are at some time at least 3000. However, it must be remembered that the total recorded by the aerial survey is a count made in the several separated areas within two hours, whereas all other totals known to the writers are compiled from observations spread over several days or, in some cases, several weeks. Since much shifting about occurs and since most recorders seem to have added together maximum counts from the different localities in order to estimate the island population, it is easy for such estimates to be too large. All the recorded localities on the island were examined from the air, and two of the areas where Barnacles were found had not been recorded previously (though presumably known to some local inhabitants).

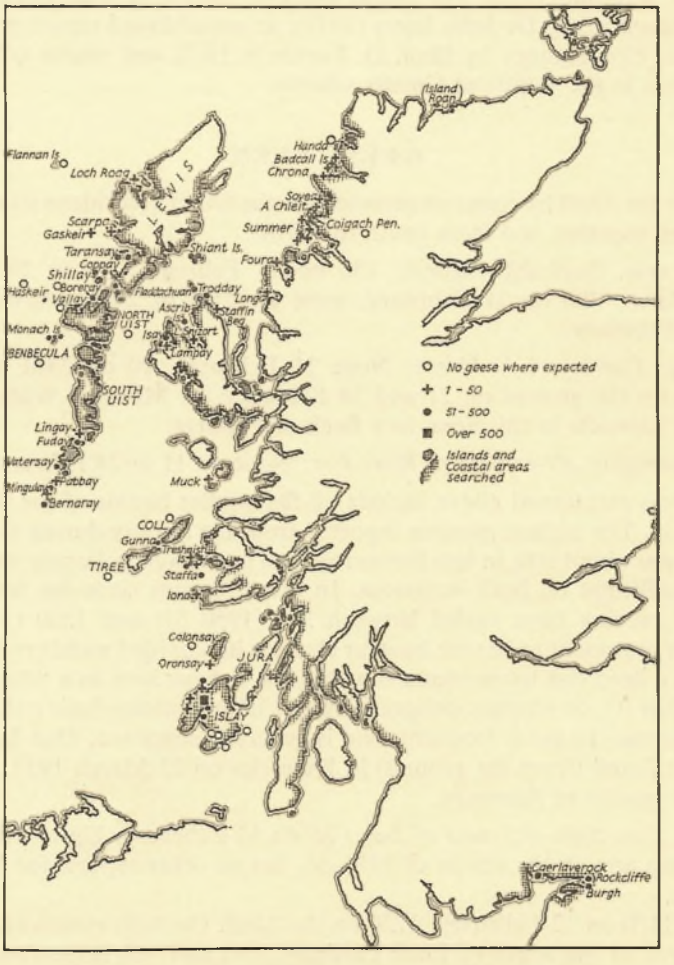


Fig. 1. Distribution of Barnacle Geese in February 1957

Jura: 38, Eilean nan Coinean, 12 February.

Oronsay: 16 on 22 February.

Colonsay: None 22 February. Mr Malcolm Clark had seen up to 76 by the end of December 1956, but could make no counts from the ground in February 1957. On 12 February 1956 the same observer saw 232. The sites suitable for Barnacles on this island are small, and it is unlikely that flocks of over 200 would remain for long.

Iona: Five flying over the cathedral, 22 February. This island is not regarded as a regular haunt of the species.

Staffa: 60 on 22 February.

Treshnish Isles: 106 on 13 February, 257 on 22nd. On the first visit there were 42 on Lunga, 2 on Fladda and 62 on Cairn a'Burgh More. On the second there were 64 on Lunga, 150 on Bac Mor, 38 on Sgeir a Claistich and 5 on Cairn a'Burgh Beg.

Tiree: None on 13 or 21 February. Earlier in the winter a small flock (82 the most seen) was reported roosting on Soa, in Gott Bay, and 5 were present there as late as 3 March 1957 (F/Sgt G. E. Bennett).

Gunna: 300 on 13th, 420 on 21 February. Gunna has been reported as primarily a roost for Barnacles feeding on Coll, but the two aerial inspections were made in the early and late afternoon and each time the geese were feeding on Gunna and Coll was deserted.

INVERNESS. *Muck:* 19, Eilean nan Each, 21 February.

Small islands around Skye: 130, Isay Island, 20 February; 21, Lampay, 20 February; 175, Ascrib Islands, 21 February; 18 on islets in south-east Loch Snizort, 21 February; 37, Staffin Beg, 18 February; 85, Trodday, 18 February; 60 on Fladdachuan, 18 February. Most of the suitable islands seemed to be carrying numbers as high as could be expected if the geese stay there for any considerable period.

ROSS. *Mainland:* None on the Coigach peninsula, where flocks of up to fifty are reported to occur several times a year.

Longa: 38. *Foura:* 21. *Summer Islands:* 95. (All visited 18 February.)

SUTHERLAND. *Islands off west coast:* 173, scattered on seven islands, 18 February. None on Handa, the largest island with suitable grazing for Barnacles, but they may have been recently disturbed.

Island Roan, in the Kyle of Tongue, could not be visited. It is reported to carry a wintering population of 400–500 (D. Murray).

OUTER HEBRIDES. *Berneray:* 85. *Mingulay:* 32. *Pabbay:* 42. *Vatersay:* 64. *Fuday:* 210. *Lingay:* 28. (All visited 21 February.)

South Uist: 200 west of Loch Bee, 21 February. None seen elsewhere, or on *North Uist* or *Benbecula* (14–21 February). The one flock found was on much the most suitable-looking area on any of the three islands.

Monach Islands: 190 on Ceann Iar, 140 on Stockay, 14 February. We were told on Benbecula that there were 'thousands'. 2000–2500 early in 1955 (Colonel H. J. Cator) must have been quite exceptional. The islands are too small to support a population of thousands for any length of time.

Islands in Sound of Harris: 240 on Shillay, 250 on Coppay, 14 February; none on the rest of the group (including Haskeir).

Taransay: 192, 14 February. *Gaskeir:* 41 on 14 February, none on 19th. *Scarpa:* 9 on 14 February.

Shiant Islands: 313, 18 February (78 Garbh Eilean, 125 Eilean an Tighe, 110

Eilean Mhuire). There are many sheep on the islands, and it is unlikely that the group could carry a substantially larger population of geese.

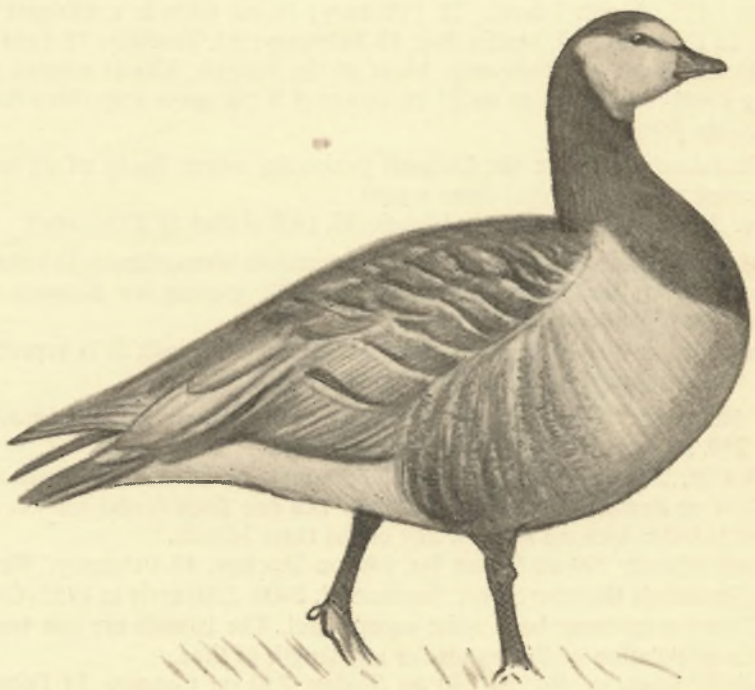
Lewis: 37 on Shiarum Mhor in Loch Roag, 14 February, were the only Barnacles seen. Very few places on the main island offer suitable conditions.

Flannan Island: None, 19 February. The vegetation looked unfavourable, and the islands are so small and exposed that they are unlikely to be a regular haunt.

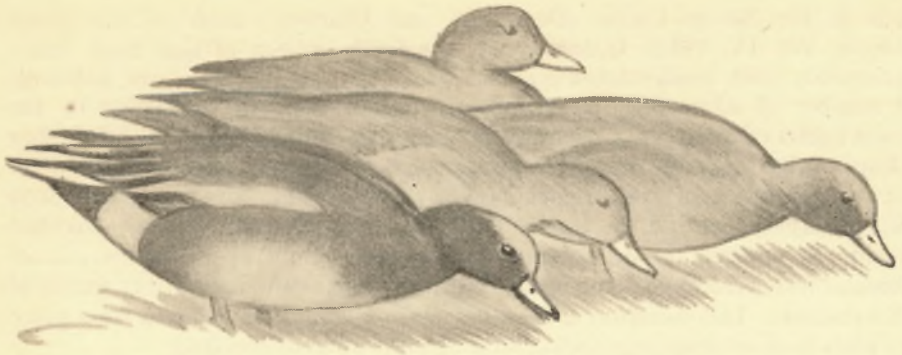
The *St Kilda* group and *North Rona* were not visited. So far as is known they do not support wintering flocks of geese.

CONCLUSION

The nearly complete cover achieved by this survey within the limits set suggests that a census of the total wintering population might be achieved, although the exploration of the islands off the north-west coast of Ireland, an essential part of a census, could only be attempted with safety in very favourable weather. Even with continuous good flying weather a survey of all the important localities in Scotland and Ireland could scarcely be achieved in under ten days. Though this falls short of the ideal of simultaneous counts in all areas, an aerial survey offers much the best prospect of accurately assessing the numbers of Barnacle Geese.



Barnacle Goose



FOOD AND FEEDING HABITS OF WILDFOWL

by P. J. S. Olney

THE increased public interest in wildfowl conservation and restoration heavily underlines the need for dependable information on which to base programmes for the improvement of feeding and breeding areas. The primary essentials are food and cover. Clearly the important animal and plant foods must be known, and consideration be given to their normal distribution and other relevant environmental factors before such programmes can be started with real hopes of success.

At the present time detailed information on the food of the British wildfowl is extremely meagre. It is fair to say that much of the existing information is not only valueless but is often misleading, either because it records an unusual food or feeding habit or, and this is the most common error, it is too vague. It is not enough to know that for a particular species 'pond weeds' or 'grain and grass' are part of the normal diet. Identification must be more precise. That there is a need for a detailed investigation is only too obvious when we study previous work in this field. Apart from J. W. Campbell's pioneer work on the food of various ducks and geese (1936, 1946A, 1946B, 1947), E. O. Höhn's (1948) brief report on the food of the Mallard (*Anas platyrhynchos*) in the London area and Mary Gillham's (1956) useful account of the feeding habits of the Mute Swan (*Cygnus olor*), there is relatively little information available on the foods of British wildfowl in Britain. Most ornithological textbooks, if they mention food at all, merely reiterate the summary information given in *The Handbook of British Birds* (1939). Occasionally there occurs the enthusiast who takes the trouble to have a particular food accurately identified. Thus W. A. Cadman (1953) noted the importance of the roots of the common Cotton-grass (*Eriophorum augustifolium*) in the winter diet of the Greenland White-fronted Goose (*Anser albifrons flavirostris*) on the peat-bogs of Wales. Later on (1956), he found that as the winter proceeded and the Cotton-grass hardened and became less palatable, they eat the shoots of the White Beak-sedge (*Rhynchospora alba*).

European sources are almost as disappointing, though Madsen (1954) has produced a very useful survey of the food habits of diving ducks in Denmark. There is evidence to suggest that valuable work has been carried

out in the Soviet Union (Dementiev and Gladkov, *Birds of the Soviet Union*, Vol. IV, 1952). Unfortunately the food sections of that book suffer grievously from condensation and lack of a bibliography. There are, however, a number of interesting records showing particularly the difference in the food habits of one species over a large area. The Pintail (*Anas acuta*) has been shown to have a predominantly vegetarian diet in the south, and yet in the north at the same time of year animal food is preponderant. It is also shown that Scaup (*Aythya marila*), on their Caspian wintering-grounds in the Lenkoran region, live entirely on the mollusc *Cardium edule*, whilst the mollusc *Mytilastar lineatus* forms the main diet of Scaup a little farther north in the rocky shores of Azerbaizhan. This variation in food habits throughout the year and from place to place is of obvious importance, although it is often overlooked.

It is not until we turn to the American sources that we realise how far behind we are in this field of work. Here a comparatively enormous amount of information has been gathered, not only on the actual foods eaten (Cottam 1939, Kubichek 1933, Mabbott 1920, Martin and Uhler 1939, McAtee 1918, 1922 and 1939), but also on methods of utilisation and propagation of such foods. Fortunately we can learn much from this information, even though the specific foods may be different and conditions and localities will obviously vary.

Above all, a review of available literature shows that for any conservation work in this country we badly need the initial research on the food of our wildfowl.

There are a number of methods for determining the food and feeding habits of birds, most of them admirably summarised by Gibb and Hartley (1957). The methods employed will of necessity vary with the species of bird being studied. The most obvious method and one lending itself to general use is field observation. The importance of field observations should not be underestimated, for only from them can we learn certain aspects of the complete picture. In particular, it is necessary to know how, when and where the food is taken and to what extent the food supply is depleted. This is especially important in determining whether a species is of economic importance, causing damage to crops or whether, for example, the birds are merely gleaning waste grain in stubble. Field observations do, however, need experienced and skilled participants, for inaccurate or careless records can often cause serious and embarrassing mistakes. The fallibility of field observations alone has been demon-

strated many times, and it is only in conjunction with other methods that the full story can be made known. Rarely can all important foods be identified accurately in the field. The only safe guide in ascertaining the food requirements of any species is to find out by stomach analyses what is actually eaten by that species under varying conditions in different localities. For investigation purposes, a bird in the hand is worth at least two in the bush. This often involves difficulties in the specific identification of food fragments, since different materials are digested at different rates (Koersveld 1950), and the foods will therefore not always be in the original proportions as consumed. The problems involved in quantitatively assessing the foods taken will vary from species to species, depending on the type and amount of food taken. Hartley (1948) clearly summarises the various methods of assessment and the inherent problems incurred by each. The primary objection to the extensive use of stomach analysis as a basis for food study in a rare species is the danger of reducing the population by too great an extent. This means that only populations numerically large enough to withstand the loss of an adequate sample of birds can be studied in this way. If a population is not large enough—as, for example, in the Brent Goose (*Branta bernicla*)—other methods must be employed. Faeces and, if present, pellets of undigested material can indicate what is being eaten. Obviously these can only be a guide to what is taken and will not provide the complete diet-sheet. However, their importance should not be underestimated, for in conjunction with stomach analyses field observations and possibly high-speed photography, a fairly complete picture can be constructed.

It is also essential that the completed picture should include a range of different ecological types, and if possible be complete for the whole year. The diet will almost certainly change with time and place. Studies carried out over a long period of time can show long-term changes in diet correlated with altered status and distribution. There are indications that the decline in *Zostera* of the 1930s has caused the diet and distribution of the Brent Goose and Wigeon (*Anas penelope*) to alter. There is some evidence to suggest that the Wigeon has been the more successful in adapting itself to a change in food supply. Where *Zostera* is not available, and their distribution suggests that this may often be the case, Wigeon will take other sources of food. Thus a high proportion of *Ruppia*, *Enteromorpha* and *Ulva* may be taken. Wigeon from north Kent marshes were found to have been grazing on a variety of grasses, including *Puccinellia maritima*, *Festuca ruba* sub. sp. *rubra*, *Poa trivialis*, *Poa annua*, *Glyceria fluitans* and *Agrostis stolonifera* var. *palustris*. Though we know that the total numbers of the Brent Goose have declined in the last thirty years and their distribution has altered, it is difficult to ascertain how far food has been a limiting factor. The main evidence is indirect and the crucial facts are unknown. We do not know the abundance or availability of its chief food or the quantity consumed and, what is equally important in assessing limiting factors, we do not know all the main causes of mortality. These can be particularly important in a species breeding in the far north, where the effects of weather can produce wide fluctuations in numbers. It is therefore really only safe to say that there is a probable association between the decline in Brent numbers and the reduction in *Zostera*. Ornithological journals can provide other examples of the dependence of winter numbers on the available food supply, though most of them are at the anecdotal level and quantitative studies are much needed.

A complete food study should be able to confirm Gause's (1934) contention that no two species of identical ecological requirements can live together. In

birds living in the same region the most obvious differentiation that has been evolved has been in their feeding habits, where each species takes mainly different foods and none compete for the same food (Lack 1944, 1947, 1949, 1954). It has been shown that the various diving ducks (*Somateria, Melanitta, Clangula, Aythya, Bucephala*) compete for food to a lesser extent than might have been expected. Madsen's (1954) survey of the diving ducks of Denmark has shown that the various species occupy ecological niches which, though they overlap, have a number of vital distinctions. Species which feed in the same type of locality dive to different depths and partly select food items (mainly molluscs) with different size limits. Some species are also more dependent on immobile or slow-moving food objects than others.

It is clear that such differences occur, and equally clear that we must know of them if we are to plan any broad conservation programmes in the future. It is hoped that the pioneer survey now being carried out at The Wildfowl Trust will produce some of the answers to the problems. The survey is based primarily on analysis of viscera provided by members of the Kent Wildfowlers' Association. The results of such an analysis combined with field observations, faecal examination and an ecological survey of the feeding area, should provide some indication of the food available and how much is consumed. With this basic knowledge of what a particular species eats, at what time of the year and in what type of locality, we can plan for the future propagation and conservation of our wildfowl.

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FEEDING GROUNDS FOR WILDFOWL

The Provision of Feeding Grounds for Wildfowl on Agricultural Land

by G. V. T. Matthews

IN the European wildfowl system, the British Isles are predominantly wintering grounds—for birds that breed in Iceland, Greenland, Scandinavia and Russia. Apart from a substantial population of Mallard, breeding ducks and geese are rather sparsely scattered or absent. It is doubtful whether attempts to increase the breeding of wildfowl in Britain other than Mallard could produce

a worth-while effect on the European population. The system of wildfowl refuges which is being built up will therefore be concerned primarily, though not exclusively, with providing protection for wintering flocks while they roost and feed.

The Provision of Feeding Grounds

Often suitable inland waters do not have sufficient feeding grounds near them. This limitation particularly applies to reservoirs, especially those with concrete surrounds. The steady increase in the numbers of reservoirs during recent years has been one of the few favourable developments in the wildfowl habitat situation and has yet to be fully exploited. In the absence of contiguous feeding grounds, either the roost will not be used to capacity or an entirely artificial concentration of wildfowl will be achieved which will have to seek its food outside the refuge. American experience has shown that the latter situation may well lead to an increase in the local kill. A similar, if reverse, situation obtains in some inland areas, notably the Fens, where there are ample food supplies but no large undisturbed areas of water to serve as roosts.

In North America difficulties like these have been resolved by purchasing tracts of farmland and deliberately degrading them back to marshland. This policy was aimed not only at the conservation of wildfowl but at reversing the over-enthusiastic land drainage that had led to the creation of barren 'dust-bowls'. It is not possible to advance such radical arguments for the re-creation of marshland in Britain. Most of the land suitable for such treatment is in productive cultivation and would be very expensive to buy. Moreover, the government and local authorities concerned are committed to maintain a high level of agricultural production throughout the country. The 'wildfowl harvest' doctrine has not yet been spread widely enough for them to consider wildfowl an orthodox 'crop' whose production and maintenance justifies the setting aside of land primarily for these purposes. The supplementary measures adopted in America, planting food crops solely for the use of wildfowl and cultivating aquatic plants as duck food, would likewise find little favour in this country. A compromise solution which does not take land out of agricultural usage is therefore suggested.

It is well established that several species of ducks congregate and feed, as well as roost, on sheets of recent, shallow fresh-water floods over grassland. Berry (1935) investigated the effect on the contained plankton in river water slowly passed over longish grass. He found that in the first few days of flooding almost all the insects and Entomostraca were strained out and 'marsh and wading birds swarm over the meadows and feed royally'. After a short time the plankton stranded on the meadows begin to breed and the meadows become a veritable 'food nursery'. This effect was not confined to small plankton, a surprising crop of *Gammarus* being recorded in one case. If the flood remains out for more than a few weeks, the birds may transfer their attentions elsewhere. It is therefore suggested that areas of grassland should be artificially flooded for short periods in a rotational succession throughout the winter months.

Water-meadows

Deliberate winter flooding of grassland has been an established agricultural practice in Britain since at least the seventeenth century. The permanent 'water-meadows' were to be found particularly in south and south-western England, but also in eastern England and southern Scotland. The most popular

method of construction for irrigation was the ridge-and-furrow, or bedwork, system. The catch-water system practised in hilly areas, although much cheaper, does not produce standing sheets of water, and so it is of little use for our particular purpose. Full descriptions of these methods are given by Wright (1808), Carrier (1936) and Moon and Green (1940), while a more up-to-date assessment of their value is given by Stamp (1950). Essentially, water is passed along ridges whose tops are grooved along their length, with a gently falling gradient. Water overflows into the furrows, which are graded in the opposite sense and thence to an outlet channel. By this system a thin sheet of slowly moving water can be passed over the meadow or the ground quickly drained as and when required. The sequence of flooding and drying varies considerably from place to place. Typically, the meadows would be flooded for two or three weeks at a time, with similar intervals of drying, during October, November, December and January. Shorter flooding periods were used during February, and the grass was available for grazing by mid-March.

This periodical flooding has the following advantages: (1) Fresh mineral salts, etc., are deposited, particularly during the early autumn flooding. (2) There is less dependence on rainfall. (3) The slow movement of the water (vertical as well as horizontal) keeps the soil well aerated. (4) The water used is of a higher temperature than the soil water, and so provides protection against frost and encourages early growth.

No recent data are available to indicate the yield obtainable from water-meadows. Peel (1938) gives the following comparative figures:

Type of Pasture	Protein Equivalent (%)			Starch Equivalent (%)		
	Spring	Summer	Autumn	Spring	Summer	Autumn
Good water-meadows	17	14	17	68	65	68
Intensively treated pasture	16	12	14	68	63	66
Good permanent pasture	13	11	13	64	62	64
Temporary ley	13	10	12	64	57	63

These must be treated with reserve, since recent improvements in grassland management will probably have led to increased values for the pastures and ley. But certainly water-meadows did not produce poor-quality grass. No comparative data on the overall annual production are available. Stamp (1950) states that thirty ewes and their lambs per acre could be carried through the spring. It was the production of the early 'bite' and the early lambing which it permitted that gave water-meadows their economic importance. In addition to the spring grazing, a crop of hay was taken in the summer when further grazing by sheep was not advocated owing to 'foot-rot'. At the end of the eighteenth century the production from a water-meadow totalled £12 per annum against £5 from ordinary meadows. The construction cost, of £4 to £6 per acre, was thus recovered in one season.

In view of the advantages of winter irrigation, it may be asked why the system is falling into disuse in England. Undoubtedly the factors causing this decline have been: (1) The sharply increased cost of materials and labour (particularly the latter) needed for their maintenance. (2) The availability of relatively cheap imported feeding-stuffs for use in the spring. (3) A general change-over to dairying from the barley-arable-sheep farming. (4) The development of refined

methods of grassland improvement, use of artificial fertilisers, better seed mixtures, etc. (5) The increased difficulty of securing co-operation between neighbours when large estates are broken up. (6) The increased value of fishing rights and objection of owners to the interference caused by the weirs and to the possible loss of fish spawn.

In Italy, with its poorer economy and cheaper labour, a system of water-meadows, known as *marcita*, is still extensively used in the Po Valley.

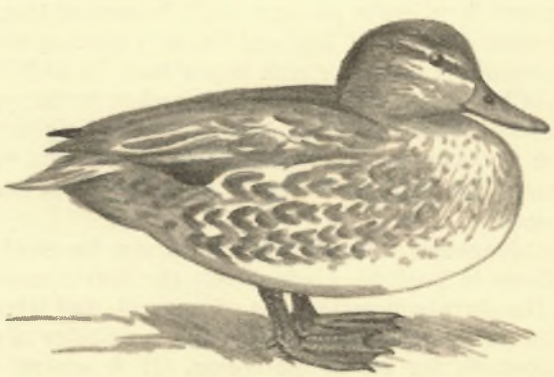
Sewage farming, which is essentially a variant of the water-meadow technique, is also declining in Britain in favour of modern chemical methods of sewage disposal. However, in the west of the U.S.A. more and more 'sewage lagoons' are being constructed for small townships, and are proving highly attractive to waterfowl (Van Heuvelen 1952).

Other Types of Winter Flooding

There is an historical example of the effects of rough-and-ready winter flooding in the alluvial meadows at Oxford (Baker 1937). These have flooded regularly, and until comparatively recently there was no control over the flood period, which could last up to six months. But Port Meadow, 400 acres, has been *continuously* pastured by horse and cattle since A.D. 1085. The Yarton, Oxey and Pixey Meads, 270 acres, have likewise been mown for hay each year for centuries. A stable and yet productive sward has been established without especial efforts at cultivation. Those species of grasses which are best adapted to the conditions become predominant in the sward. Lists of species are given by Fream (1888) and Stapledon (1925), showing an emphasis on moisture-loving grasses of tall habit.

The practice of 'warping' may also be mentioned. This is deliberate autumnal flooding to obtain a deposit of silt brought down from the upper reaches of the river. Warping is thus largely confined to estuarine areas, such as round the Humber in England and the Elbe and Ems in Germany. Again there is a tendency for the practice to become obsolete owing to the availability of other fertilisers, although its basic value is not disputed.

Experiments have been made with a view to determining more precisely the effects of flooding on different types of swards. Davis and Martin (1949) placed a series of turfs in tanks connected with a water supply. Turfs from each seed mixture were subjected to four depths of flooding, to a high water-table and to stagnant water.



Teal ♀

Most of the mixtures were not adversely affected by four weeks of flooding. Timothy, *Agropyron*, *Agrostis* and meadow fescue formed fairly dense swards after ten weeks of flooding. Resistance was greater when at least the tips of the plants were above water and when the water was moving. Davies (1953) and Roberts (1955) report on a field experiment in which strips of different grass mixtures (including clover) were sown down on a slope. The whole area was subject to severe flooding to a depth of 10 feet two or three times a winter for from two to six weeks at a time. The upper part of the slope drained quickly after flooding, the lower part remained water-logged for long periods. After two winters the following analysis was made:

Mixture	Percentage Ground covered by Grass (i.e. not including Clover)	
	On and Off Flooding	Prolonged Flooding
S.23 Perennial Ryegrass	48	13
S.48 Timothy	47	34
S.50 Timothy	36	15
S.215 Meadow Fescue	35	19
S.59 Red Fescue	43	4
Rough-stalk Meadow Grass	23	6
Agrostis tenuis	19	4
Weeds and Weed Grasses (average for all plots)	12	36

These figures demonstrate very clearly the comparative harmlessness of on-and-off flooding as compared with prolonged flooding and water-logging. The varying resistance of the different seed mixtures is also obvious, S.48 Timothy giving the best all-round performance. The sown seeds were still surviving in the upper part of the slope seven years after sowing. Other tests with clover mixtures indicated that Strawberry Clover was outstanding in resisting flooding, with Kentish Wild White a good second best.

Experience in New Zealand (Bell 1935) confirms the flood-resistant properties of Timothy, *Agrostis* and White Clover. But in swamp pastures there three introduced swamp grasses have proved very useful, productive and palatable to stock. *Glyceria aquatia* (Reed Sweet Grass) is a high producer—15 tons of green matter per acre—and is little affected by frost. Although a perennial it seeds vigorously, an additional source of food for ducks. *Paspalum distichum* (Mercer Grass) has an even higher production. Both are dormant in winter but produce a dense sward a few weeks after the recession of flood waters, and both compete successfully with rushes. *Glyceria fluitans* (Floating Sweet Grass) grows in slightly shallower water, has floating stems and is not dormant in winter. Armstrong (1945) also suggested that further use should be made of this species and of *aquatica* on land subject to flooding.

Suggested Procedure

From consideration of the published evidence and after discussion with a number of grassland experts, it is concluded that rotational winter flooding may be applied to established grassland with a marginal quality sward without causing deterioration. Indeed, some beneficial effects can be confidently expected.

High-quality sward intensively fertilised and cultivated would undoubtedly suffer some deterioration through flooding. If land of this type, or arable land, became available, it should be resown with flood-resistant seed mixtures. These should be based on S.48 Timothy and Strawberry Clover, or on the swamp grasses. A good permanent sward will then be formed, though it is acknowledged that production will be less than under intensive cultivation. Whether natural methods of cultivation may not have qualitative advantages is too big a question to go into here, but is one that is attracting increasing attention as 'metabolic disorders' of indeterminate causes increase in domestic livestock.

It will not be necessary to create 'water-meadows' in their full complexity of interdigitating canals. This elaborate construction was aimed at facilitating rapid flooding and drainage. Berry (1935) describes a variant of the system—'sheet-watering'—developed in Dorset with the particular purpose of preventing the loss of fish on the meadows. The field is slightly saucer-shaped and is flooded and drained from the same channel, the water being allowed to stand for a time in between. Very skilful adjustment of levels is called for, and this has prevented general adoption of the method. However, this difficulty could be overcome by the use of efficient, portable diesel pumps of the Petter type. Modern excavating machinery would throw up the perimeter ridges needed rapidly and cheaply. Such ridges on a level site would not need to exceed 18 inches in height, as flooding is required to only a few inches in depth.

Since it is found that a prolonged period of drying-out between short-term floods is not needed, the feeding grounds need consist of only perhaps three areas of grassland of an equal size. A minimal flood of about 10 acres would seem the requirement if large numbers of ducks are to be attracted, making a total area to be set aside of 30 acres.

We live in an age that favours short, easily remembered 'code names' for projects of every sort. In deference to this tendency, we would suggest these artificial feeding areas be known as Grassland Areas Rotationally Flooded (GARF). Since garths are areas of greensward within a cloistered sanctuary, the punning relation is unobjectionable.

It will obviously simplify the water-supply problem if the areas to be flooded are adjacent to the body of water providing the roost. In the case of reservoirs, the seasonal fluctuations of level incidental to their operation could, following the suggestion of Berry (1955), be used to provide winter feeding grounds. At present the summer 'draw-down' results in the exposure of water vegetation which dies off. An unsightly and unhealthy band of mud and decaying vegetation is left, often containing pools in which mosquitoes breed. If the area between maximum and minimum water-levels were planted with flood-resistant grasses, this unpleasant effect would be avoided, and short-term flooding with its positive benefits to wildfowl populations would have been achieved without further effort.

The immediate need is to carry out pilot experiments on suitable land near a wildfowl refuge. It is hoped that this exposition of the probable effects of rotational winter flooding will encourage some landowners to give the scheme a trial. The Trust will be only too pleased to assist in any way they can.

ACKNOWLEDGMENTS

Research rather far outside the normal ornithological field could only be successful if guided by experts, and sincere thanks are owed to Miss S. B.

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THE ISOLATION OF ASPERGILLUS FUMIGATUS FROM WILD PINK-FOOTED GEESE IN ENGLAND AND SCOTLAND

by J. V. Beer

The survey reported here forms part of the wider investigation into Aspergillosis which Mr Beer has been conducting since 1954, while working for a Ph.D. at the University of Bristol as the holder of the Bristol, Clifton and West of England Zoological Society's Scholarship.

SUMMARY

A SWAB was devised that could be used on a large scale in the field to determine if the wild Pinkfoot carried spores or mycelium of *Aspergillus fumigatus* internally. A selective growth medium based on Czapek-Dox broth allowed the fungus to grow freely with little or no competition from other micro-organisms. Swabbing of the mouth and pharynx of 1188 apparently healthy Pinkfeet over three seasons produced 86 (7·2%) positive cultures of *A. fumigatus*. Controls showed that the technique used was adequate despite the relatively primitive field conditions. No significant difference was found between the three seasons nor between adults and juveniles. However, male Pinkfeet are more likely to harbour the fungus than females. The percentage of positives increased as the season progressed, and there was some evidence to suggest an east–west gradient across the country.

The fungus found was probably derived from the soil and vegetation rather than the internal organs of the birds.

The fungus disease, *Avian Aspergillosis*, is at times fairly common in captive birds, but little is known of its form or occurrence in wild birds. Ainsworth and Rewell (1949) described the disease in captive birds, while among wild birds Ainsworth and Austwick (1955) noted it in a Rook, a Jackdaw and four Woodpigeons; Poulding (1952) in the Herring Gull and the Lesser Black-backed Gull; Quortrup and Shillinger (1941) in 43 (1·4%) wildfowl during the examination of 3000 dead birds for botulism and lead poisoning in the Western Lake areas of the U.S.A., and Venn (1955) in a White-fronted Goose found on the Dumbles at Slimbridge. The disease is caused by the fungus *Aspergillus fumigatus*. Diagnosis is difficult or impossible in the living bird, and a post-mortem examination generally has to be made to show the presence of the disease. The question of the occurrence of the fungus in the healthy wild bird is of primary importance to any study of the disease, and the best that can be done in the field at present is to study the fungus flora of the oro-pharynx.

As early as 1914, Heald and Studhalter found that birds could be carriers of a fungus, and in particular that causing chestnut blight. Sladen (1952 and 1954) examined Penguins, Kelp Geese and Steamer Duck in the wild, but found no evidence of *A. fumigatus*. Tiffany, Gilman and Murphy (1955), while studying Oak Wilt, isolated 16 cultures of the genus *Aspergillus*, comprising some 11 species, including *A. fumigatus*, from Woodpeckers and other birds trapped in the region of the diseased trees. Sladen and Austwick (1955) studied the mycoflora of 317 wild Pinkfeet in Iceland and Britain, but did not isolate any cultures of *A. fumigatus* from these birds. As the technique they used resulted in the isolation of many other fungi, this negative result suggests that *A. fumigatus* is comparatively rare. The work of Tiffany *et al.* (1955) bears this out, as only a few of the 442 isolates were *A. fumigatus*.

If *A. fumigatus* is present in the Pinkfoot, means must be devised to increase the chance of detection. This can be done in four ways:

(1) Sample a larger number of birds.
(2) Improve the swabbing technique.
(3) Provide a selective medium to prevent the possible overgrowth of the fungus being isolated.
(4) Incubate plates at 40° C.

Various improvements were proposed by Sladen and Austwick (1955) along these lines, and the following technique, independently evolved and briefly described in an earlier note (Beer 1955), included several of the suggestions.

METHODS

Source of Material

Pinkfeet were swabbed after trapping in rocket-nets during three seasons in England and Scotland (October and November 1954, October 1955 and October 1956). 1118 birds were examined, in 18 groups varying from 26 to 159 in number. Many controls, samples of soil and of vegetation were taken to obtain some idea of the chances of contamination giving false positives and of the quantity of *A. fumigatus* in the environment of the geese.

The Swab

In previous studies workers have used a cotton-wool swab on a stick stored in a plugged sterile tube. Experiments with ducks showed that it was not easy to swab the oro-pharynx, as the cotton-wool caught on villi at the back of the tongue. Streaking of this type of swab on to media at a later stage does not utilise the maximum amount of inoculum available, and may allow other micro-organisms, particularly bacteria, to overgrow the small amount of *A. fumigatus* present. Ideally, soluble-wool swabs should be used in conjunction with a selective medium, but the former are not easy to use in the field.

To overcome some of the disadvantages of previous swabs, one was made of rubber tubing and springy wire. Tubing, $\frac{5}{32}$ inch $\times$ 3 inches, was attached to a hooked length of inert nichrome resistance wire (Fig. 1), and four or five of

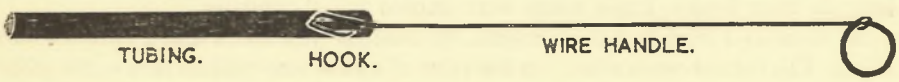

Fig. 1. The Swab

these swabs were placed in a test-tube with a glass cap and a cotton-wool sleeve (Fig. 2). The units were steam sterilised and stored in sterile tins.

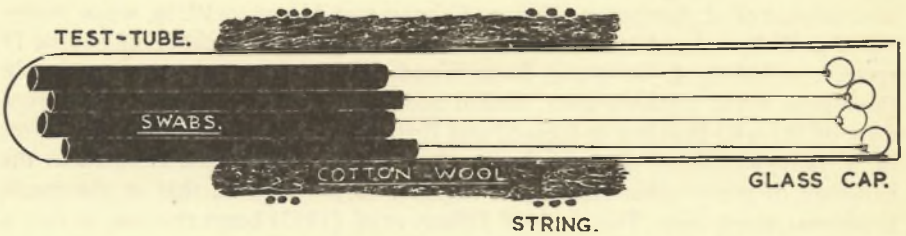

Fig. 2. Storage of Swabs

Medium

The media used by previous workers have not been particularly selective, for *A. fumigatus* and growth of other organisms may well cover up the few colonies present or, even worse, inhibit the growth of the fungus altogether. It is also important that the sample be placed at once into the selective medium to suppress growth of contaminants. A suitable medium consists of a modified Czapek-Dox broth, containing sugar, mineral salts, aureomycin (a wide spectrum antibiotic) and hydrochloric acid to produce a high acidity. Experiments showed that the fungus was capable of rapid growth on this medium. Incubation of this medium at body temperature allows very few other micro-organisms to grow on a culture plate. In the first season a less selective medium was used. Experiments showed that *A. fumigatus* was readily isolated on both media, but the Czapek-Dox grew fewer contaminants and was latterly used in preference to the earlier type. For use in the field, the broth was dispensed in small 2-drachm bijou screw-cap bottles in 4-millilitre amounts and sterilised. The bottles were kept in sterile tins.

Incubation

A. fumigatus grows readily at temperatures between 20° C. and 50° C., with an optimum around 40° C., which coincides with the body temperature of geese. 40° C. was used for incubation. At this temperature most fungi and many bacteria are inhibited, while *A. fumigatus* grows profusely. Prior to incubation, all samples were kept at a low temperature (near 4° C., if possible) to reduce growth of the micro-organisms between collection and culture of the sample.

Collection of Samples

Ringing of the birds was carried out upwind of the rocket-nets, and generally it was possible to arrange the area used for swabbing so that contamination by dust from vegetation, birds, etc., was reduced to a minimum. A clean cloth-covered area of a vehicle comprised the work-bench. Four or five of the bijou bottles of medium were opened and placed on or close to the work area to sample the air during the whole of the operation, which lasted at times for as long as three hours. These tubes were known as air controls.

As soon as a bird had been ringed, its number was noted and a throat swab taken. The cotton-wool sleeve on the tube of swabs was pushed down, the glass cap removed and a swab taken out. Contamination of the remaining swabs

was prevented by immediately replacing the glass cap on the test-tube. The bill of the bird was held open by the fingers, and the swab was rubbed over the back of the mouth and over the entrance of the trachea (photograph, *Eighth Annual Report*, p. 119). Care was taken not to contaminate the swab by any external source, and if there was any suggestion of contamination in any way, the swabs or tubes were discarded. Having obtained the sample from the throat, the swab was washed vigorously in sterile broth contained in the bijou bottles. The rubber tubing buckled up, and it was possible to wash the whole of the tubing in the broth. A proportion of the swabs were waved around in the air, and then washed in the broth to check the probability of contamination of the swab during the time that it was in use.

Soil and vegetation samples were collected in sterile bottles for examination, and all samples were sent by post to Slimbridge and stored at about 4° C. until they could be examined.

Examination of Samples

The tubes of broth were plated out with a similar but solid medium, and incubated for seven days at 40° C. The presence or absence of *A. fumigatus* was noted (large green colonies with certain microscopic characteristics), and pure cultures were made of a large proportion of these isolates. Most plates were sterile, while a few grew other fungi and bacteria, but in no case was the growth of any contaminant so great as to overgrow *A. fumigatus*.

RESULTS

The picture obtained from the swabbing showed that a small proportion of the birds carried the fungus in the oro-pharynx. Some 86 cultures were obtained from 1188 birds, a percentage of 7·2. The results of three seasons are given in Table I.

TABLE I

Year	Total Swabbed	*A. fumigatus* Present	Percentage of Total with *A. fumigatus*
1954	348	31	8·9
1955	289	15	5·2
1956	551	40	7·3
	1188	86	7·2

Although the percentage varies between 5·2% and 8·9%, an analysis of the figures shows that the proportion of birds carrying the fungus is much the same from year to year.

A note was made of the age of the bird—either adult or juvenile. The age of some adult birds was known accurately, but as so few were involved no age analysis was attempted on a yearly basis. These birds were lumped together with the other adults. Table II gives the breakdown of the results in terms of age.

TABLE II

	Total Swabbed		*A. fumigatus* Present		Percentage of Total with *A. fumigatus*	
Year	Adults	Juveniles	Adults	Juveniles	Adults	Juveniles
1954	237	111	20	11	8·4	9·0
1955	211	78	9	6	4·3	7·7
1956	254	97	36	4	7·9	4·3
	902	286	65	21	7·2	7·3

Analysis shows that there is no significant difference between the two age-groups.

In 1954 most of the birds were sexed; the results are in Table III.

TABLE III

Sex	Total Swabbed	*A. fumigatus* Present	Percentage of Total with *A. fumigatus*
Male ..	142	21	14·3
Female ..	129	8	6·1

On analysis this difference is found to be greater than would be likely to occur by chance, and suggests that males are more likely to harbour the fungus than females.

It had been hoped that a large number of suitable recaptures would be available for repeat swabbing. In practice only nine birds were swabbed twice, and in each case the fungus was not isolated. To obtain any useful results from recaptures, a very much larger sample would have to be taken.

As the percentage of positives is quite small, the results obtained from the controls are quite important. To begin with, some 85% of the plates were completely sterile, which indicates that at least gross contamination by organisms capable of growing under the provided selective conditions has not occurred. The results from various controls are given in Table IV.

TABLE IV

Year	Air Samples	+ ves	Swabs Samples	+ ves	Fingers Samples	+ ves	Feathers Samples	+ ves	Net Samples	+ ves
1954	11	0	10‡	0	12	0	1	0	2	0
1955	18	0*	2	0	—	—	—	—	—	—
1956	31	1†	40	0	—	—	—	—	—	—
Totals	60	1	52	0	12	0	1	0	2	0

* Two tubes produced a mucor-type fungus.
† Tube exposed for 3 hours. One colony of the fungus produced.
‡ Unused swabs examined after the trip.

The lack of positive cultures in all the controls except one air tube indicates that the technique was adequate for the purpose, i.e. the swabs and sample tubes were not exposed to too great a risk of contamination. The single positive tube was exposed for some 3 hours. It seems reasonable to conclude that the chances of a swab, exposed for no more than a minute, becoming contaminated are very small. The only other contaminated tubes were exposed for 1–2 hours and grew mucoraceous fungi.

Samples of soil and vegetation were collected in sterile bottles from the fields where catches were made. On culture, the following picture was obtained:

TABLE V

Year	Total Samples	Samples with *A. fumigatus*
1954	28	13
1955	17	17
1956	47	10

The variation is quite large, and some fields did not produce any cultures of the fungus. In 1955 all samples from all fields were positive.

DISCUSSION

The Technique

The failure of other workers to isolate *A. fumigatus*, except incidentally in the Oak Wilt survey by Tiffany *et al.* (1955), may be due to a variety of reasons, which are implied in the four suggested improvements in the introduction and are now discussed in the light of the results.

The number of birds harbouring the fungus as evaluated by the technique described in this paper is small (7%). Sladen and Austwick (1955) swabbed 40 Pinkfeet caught on stubble-fields and the expected number of positives would be 2 or 3 on the above basis. However, with a sample of this size it is quite likely that no positives would be obtained. Thus the sample size should be increased considerably. A similar argument can be applied to the 254 Iceland birds. Here the sample size should be even larger, as the concentration of spores in central Iceland is probably smaller due to a lower ambient temperature than in Britain, resulting in a lower infection rate of the birds. Thus in any one season it is advisable to swab several hundred birds in Britain and over a thousand in Iceland. Samples of this size with a control swab rate of 1 in 10 or 1 in 5 allow useful statistical analyses to be made. The present study approximated to these figures. With the present level of 7% positives, a total sample of less than 100 is not worth considering except in an initial study.

The swab that was used was easy to prepare and to handle. Rubber tubing slides in and out of the throat very easily and picks up a fair quantity of mucus. This is readily washed off by broth in bijou bottles. There was a tendency for the rubber tubes to stick together or become weak after several sterilisations, and they had then to be discarded.

The use of selective growth conditions increased the chance of detection of the fungus. The medium based on Czapek-Dox agar rather than Sabouraud's provided these conditions, 85% of the plates being sterile. Incubation at 40° C. is near the optimum for *A. fumigatus* and well above the optima of many other

fungi and bacteria, and allows the fungus to grow readily. The selective conditions could be further improved by the use of chloromycetin in place of aureomycin and by the addition of 4–7% sodium chloride.

Discussion of Results

This study has shown that a small proportion (7%) of the wild Pinkfeet in Britain do at times carry *A. fumigatus* in the throat, but it was not possible to show that these birds consistently carried the fungus, as the sample of suitable recaptures was far too small. Sladen and Austwick (1955) have pointed out that the flora of the throat is a reflection of the flora of the stubble-field, and as presumably all the birds in a catch are exposed to the same degree of infection, we would expect to find no difference in the incidence of the fungus between adults and juveniles and between the sexes in any one group of birds. This was the case for the former but not for the latter, and no reasonable explanation can be given for this sex difference. On this evidence and since many of the soil and vegetation samples contained *A. fumigatus*, it is fair to assume that fields are the source of the fungus. This is supported by the fact that cases of Aspergillosis in the birds are rare, and that the nature of the disease is such that transfer of spores from one bird to another is unlikely. Similarly, air samples taken by many workers indicate that the whole genus *Aspergillus* is uncommon in the atmosphere, again pointing to the soil and vegetation as the main source of the fungus.

Although some Pinkfeet can consistently be found carrying *A. fumigatus* internally during October and November, differences and trends can be detected in the samples. The sex difference has already been pointed out though not explained. As the season progresses the incidence of positives increases. The following percentages are calculated from the three years' results, leaving out one small sample of only 26 with 1 positive.

Period ...	... 7–10 Oct.	13–17 Oct.	18–24 Oct.	23–26 Nov.
Per cent positives	3·4	8·8	9·2	10·5

This trend on analysis proves to be significant, but cannot be explained in terms of ambient temperature as the temperature is decreasing during the season, which means that there will be less growth of *A. fumigatus* and, consequently, fewer positives. An increasing humidity coupled with a moderate temperature during the season may allow the fungus to grow more readily on straw and the like, thereby increasing the number of positives. It may also be that a bird takes time to come across and pick up the fungus and, because of the probable transient nature of the infection, the maximum number of positives may take a little while to develop.

If the results are grouped on a regional basis, there is some, but not very convincing, evidence of an east–west gradient but not a north–south gradient. Kinross and the Wash on the east side produced averages of 3·6% and 2·9% positives respectively, and the Solway on the west coast, 12·6%. A low figure for Kinross could be explained by the early sample date. The Humber and Perthshire samples are intermediate, with 9·1% and 6·1% respectively. The trend is significant, but a Southport catch would be most useful to provide a sample from a second west-coast area. This trend could be explained by the warm, damp weather on the west coast and the dry, cool weather on the east coast.

Further Studies

This survey could be extended to confirm or refute the results to date, but to make a fourth sampling worth while a complete season's catch (1500) would have to be utilised. It would be particularly interesting to confirm the seasonal and regional variations. The field technique could be further improved in many small details to reduce further the risk of contamination.

For the present it is proposed to discontinue the swabbing survey, to assume that the results will be much the same in another year, and to study the concentrations of spores in the environment in which the geese live. In particular, regional and seasonal variations will be studied.

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PARASITES OF THE ANATIDAE

by G. Lapage

At a conference on 16 March 1956, between Dr Matthews, Mr Jennings and Dr Soulsby of the Department of Animal Pathology, Cambridge, and myself, it was decided that my time should be given in the first instance to the compilation of a check list of parasites recorded from the Anatidae, and that Dr Soulsby should continue to examine dead birds for helminths.

Because bibliographical research could only be done in a centre provided with good zoological and veterinary literature, it was decided that this work should be done at Cambridge and that experimental work should be deferred for the present.

It soon became evident that the compilation of an adequate check list was a considerable task and would take up all my time. The system adopted uses Copeland-Chatterson cards. The entries on these cards have been written by hand, this being quicker and more convenient. Later the cards can be typed, particularly if the list is to be published.

The cards have been designed to give the following information:

1. The names of the authors of the papers recorded.
2. The titles of the papers and the references to the journals or books in which they are published. When a paper is not in English a note is made as to whether an English summary is included. A note is also made as to whether it is illustrated.
3. The Class to which the parasites belong, i.e. Protozoa, Cestoda, Trematoda, Nematoda, Acanthocephala, Arthropoda, Hirudinea.
4. The generic and specific names of the parasites found.
5. Taxonomy of families, genera, species, etc., of parasites where discussed.
6. Whether the parasite species recorded is new; if so, whether it is described and figured.
7. The generic and specific names of the birds infected and the localities in which the birds were found. These notes on the localities may help in future studies of the geographical distribution of parasites and in the correlation of the incidence of parasites with the migrations of the birds. The names used are those given in *Key to the Wildfowl of the World*, by Peter Scott.

In some instances it has not been possible to refer the bird-host to particular species mentioned in the *Key*. In these instances the possible alternatives have been entered on the cards. The locality helps also in its exact identification. Further consultation of the literature will clear up many of these doubtful identifications. In some instances the authors have merely given 'duck' or 'goose' or 'domestic duck or goose' or 'swan', and there seems to be no certain means of identifying the bird-hosts, although it is almost certain that they were *Anas platyrynchos*, *Anser anser* and *Cygnus olor*.

8. The site occupied in the bird-host by the parasite, e.g. gizzard, intestine, oviduct, blood, etc.
9. The names of any intermediate hosts.
10. Pathology of the infection.
11. Chemotherapy of the infection.
12. Whether the bird-hosts were infected experimentally.
13. Details of any other losses incurred.
14. Any other useful information.

Holes in the cards will eventually be punched for each of the above items, Species of parasites and hosts have not yet been allocated holes in the cards. and probably they will not be needed.

A detailed discussion of the information already accumulated is premature, because a great many references remain to be entered on cards, but the following notes will indicate the amount of knowledge we already have and the scope of the information:

Cards completed	603
References noted for further consultation or not yet consulted. . . .	427
Total references	1030

To these must be added a number of reprints, host-lists in textbooks and similar sources of information yet to be combed. Progress is necessarily slow. Much help has been given by various friends or by correspondents. *Helminthological Abstracts*, Vols. I–XV, have been a most valuable source, and the earlier *Bibliography of Helminthology* has also been combed. I am putting aside my own reprints, and others sent, as the nucleus for a reference collection at Slimbridge.

Number of genera of parasites recorded on the cards so far .	130
Number of species of parasites recorded	419
(of these 190 belong to the single tapeworm genus *Hymenolepis*)	
Number of unidentified species of parasites	32

Only 4 genera of Protozoa and 7 of Arthropoda have been recorded. The dearth of information about external parasites is probably due to the fact that most examinations have been of dead birds, which external parasites will have left. Most work on the external parasites and the protozoa requires the catching and handling of wild birds, which presents considerable difficulties.

Parasites belonging to one or more genera and one or more species have been recorded from all save 10 of the 40 genera of Anatidae.

Provisional List of the more Dangerous Genera of Parasites

All parasites cause damage of some kind and, although some not on this list usually do relatively little harm, the condition of the host-bird may be such that relatively harmless parasites have a decisive effect on the bird's health. Also, we know as yet far too little about the pathogenic effects of many species recorded, and less about the combined effects of several species infecting the same individual bird. Much more work is needed on the effects of many species.

Acuaria
Amidostomum
Apatemon
Capillaria
Catatropis
Choanotaenia
Cittotaenia
Cotylurus
Cyathostoma
Davainea
Dermanyssus
Dicrocoelium
Diphyllobothrium
Drepanidotaenia
Echidnophaga
Echinoparyphium
Echinorhynchus
Echinuria
Echinostoma
Eimeria
Filicollis
Heterakis
Hymenolepis
Hypoderaeum
Hystrichis
Leucocytozoon
Liponyssus
Menopon
Metorchis
Microfilariae
Ornithobilharzia
Ornithofilaria
Parastrigea

Plasmodium	*Raillietina*	*Trichobilharzia*
Polymorphus	*Schistogonimus*	*Trichostrongylus*
Prosthogoniumus	*Strigea*	*Typhlocoelum*
Pseudamidostomum	*Syngamus*	*Tyzzeria*
Pseudobilharziella	*Tetrameres*	*Zygocotyle*

Examination of Blood Smears from Pink-footed Geese

In October 1956 some 200 blood smears from Pink-footed geese caught by rocket-nets in northern Britain were sent to me for examination. Glassware, stains and reagents for dealing with these were supplied by the Cambridge School of Veterinary Medicine, through Dr Morgan, Lecturer in Veterinary Parasitology. The parasites to be looked for in these films are *Plasmodium* and *Haemoproteus* in the red blood cells, *Leucocytozoon* in the white blood cells and microfilarial larvae in the plasma. All of these should be readily seen. So far, however, no parasites at all have been found in these films. Each film is being examined for about ten minutes with an oil immersion lens. Using this method, Levine and Hanson (1953, *J. Wildlife Management*, **17**, 185) found in the blood smears of 353 Canada Geese, *Leucocytozoon simondi* in 31 (9·1%), *Haemoproteus* sp. in 5, *Plasmodium* sp. in 1 and microfilariae in 4.

It is therefore not to be expected that many of the films from the Pinkfooted Geese will show parasites, especially as only one film was taken from each bird. The incidence of these parasites in their blood is conditioned by the birds' contact with the vectors of the parasites: mosquitoes for Plasmodium and blackflies (Simuliidae) for the others. There is little information about the time during which these parasites persist in the blood. Examination of a further batch of films taken in 1957 is now proceeding.

VISCERAL PARASITES IN WILDFOWL

by E. J. L. Soulsby

Department of Animal Pathology, University of Cambridge

This paper was first published in the Bulletin of the British Ornithologists Club, **78** (2) : 21–22 (*February*, 1958)

DURING the 1956–57 season 46 viscera were examined in order to ascertain the type and degree of parasitism which occurs under natural conditions. Ten species of wildfowl were represented in the samples, the distribution being as follows: Shoveler 3, Mallard 3, Teal 15, Wigeon 12, Greylag Goose 1, Velvet Scoter 3, Common Scoter 4, Goldeneye 1, Shelduck 3, Tufted Duck 1. With the exception of three viscera which were sent by Mr J. L. Hirst of Morecambe, the rest were sent by the Kent Wildfowlers' Association. The author is extremely grateful to the gentlemen concerned who have helped with this survey.

Parasites found

Nematodes (Roundworms):

Amidostomum anseris
Tetrameres fissispina
Echinuria horrida

Acanthocephala (Thorny-headed worms):
Polymorphus minutus
Trematodes (Flukes):
Catatropis verrucosa
Psilochasmus oxyrus
Echinostoma revolutum
Cotylurus cornuatus
Paramonostomum alveatum
Maritrema subdolum
Himasthla elongata
Hyptiasmus arcuatus
Cestodes (Tapeworms):
Paricterotaenia borealis
Hymenolepis gracilis
Echinocotyle rosseteri
Hymenolepis sp.

Observations on the parasites found

Amidostomum anseris is a very common parasite of ducks and geese. It was found in a Greylag Goose and in two Common Scoters. It affects the gizzard and causes marked erosions. It also occurs in domestic ducks and geese, sometimes causing severe disease.

Tetrameres fissispina was previously thought to be uncommon in this country but was found in Scoters and a Teal. It may cause serious damage to the proventriculus.

Polymorphus minutus was found in extremely large numbers in Common Scoters and in a Velvet Scoter. Despite gross infection the birds appeared to be healthy.

Paramonostomum alveatum and *Maritrema subdolum* were found in extremely large numbers in a Shelduck which was found dead and also suffered from gross tuberculosis. In addition, this bird had a massive infection with *Hymenolepis gracilis*.

Paricterotaenia borealis and *Echinostoma revolutum* were found in large numbers in a Shelduck and a Tufted Duck respectively.

Other parasites were found in small numbers only.

The purposes of this survey are twofold: firstly, to obtain information regarding the species of parasites which occur in wildfowl in this country. We do not know which are the indigenous parasites and which are introduced by migratory species of wildfowl. Secondly, to obtain information regarding the parasitic burden of apparently healthy wildfowl. We do not know at present what levels of parasitism to expect in the natural state, but it would appear from the few viscera examined so far that generally a low level of parasitism obtains, but apparently heavy burdens can occur with impunity. Nevertheless, such burdens may be of importance in so far that they can be a potential menace to the health of the bird if its food supply is curtailed or if other diseases are acquired.

It is only by an extensive and prolonged survey of the parasite fauna of such birds that the importance of parasitism can become apparent. This must be accompanied by other observations on such things as the food supply, abnormal behaviour in migration or use of feeding grounds, or abnormal plumage, which only the man in the field, the wildfowler or bird-watcher can provide.

TUBERCULOSIS IN WILDFOWL

Tuberculosis in a Wigeon and a Shelduck from Britain

by Dr Jeffery G. Harrison

IT is remarkable how little appears to be known about the natural causes of death in wildfowl in this country. Fortunately we do not see outbreaks of botulism or lead poisoning in this country, which might have focused attention on the general subject of disease, but that is the object of this article.

Any sick or dead duck found in the close season is sure to be interesting. They are not often found, but in the past two years I have obtained two. The first, an adult drake Wigeon (1), was swimming on a loch on South Ronaldsay in the Orkneys on 3 June 1955, a very wasted and sick bird, which was killed and found to be suffering from advanced avian tuberculosis in both lungs, both shoulder joints and the air sacs. The tubercule organism was cultured and found to be a typical smooth avian strain, sensitive to streptomycin.

On 20 April 1957 my dog found a freshly dead first-summer female Shelduck (2) on the fresh marsh on the Isle of Sheppey, Kent. It had been killed by having its head largely chewed off by some animal, but at the same time it was felt to be extremely thin. The possibility that it had been killed in its weakened state by some predator and then not eaten came to mind, as I had once found a Short-eared Owl, which had been killed by some animal and left, and this was found to have tuberculosis (3).

The same proved true of the Shelduck, which had a gross tuberculous peritonitis and the right lung heavily infected. The organism was cultured and proved to be a typical avian strain. While doing the post-mortem, a heavy infestation of intestinal worms was noted and the viscera were sent to Dr E. J. L. Soulsby at the School of Veterinary Medicine at Cambridge, who identified no fewer than four different species of Trematodes and two of Cestodes. He commented that this was the most varied parasitic fauna he had seen in any bird. It is interesting to speculate whether the bird's resistance was lowered by its heavy parasitic burden, so that it subsequently developed tuberculosis.

The lesions of tuberculosis in birds are characterised by being greyish-white or yellow nodules of varying size, ranging from a pin's head to a pigeon's egg, and are hard. Fortunately, humans are not susceptible to the avian type, so that there is probably little danger if an infected bird is overlooked and cooked for food.

These two appear to be the only proved cases in wild ducks in Europe. Tuberculosis has been recorded in an American Wigeon, shot in British Columbia; while a probable case in a Grey Teal has been reported from New South Wales. Major-General C. B. Wainwright found a dead Wigeon in Essex in 1950 which almost certainly had the disease, but unfortunately the culture became lost at the laboratory to which it was sent. So far no cases have been found in wild geese, but Dr E. Hindle has told me of an epidemic in Mute Swans on Possil Marsh near Glasgow in 1936. Large numbers died, and two were examined and found to be tuberculous. This is a remarkable outbreak, although the Mute Swan is perhaps more of a semi-domestic than a genuinely wild fowl, and it sounds as if there may well have been an over-populated marsh. In captivity a wide range of wildfowl have been infected, and probably no species is immune.

It is not difficult to speculate how both the Wigeon and the Shelduck could become infected. In my opinion this is most likely to occur when they are grazing the fresh marshes on infected ground. The most frequent site of infection is in the alimentary tract (4). The organisms are passed in the droppings of an infected bird and can remain alive for from two to six months in a sunless, damp climate such as Britain. Tuberculosis has been recorded in such marsh-loving species as the Green Plover (in Orkney) and Starling (in Kent), while Poulding has recently examined a series of 97 gulls found dead or dying in the west of England, and of these, one Herring Gull and nine Black-headed Gulls showed advanced tuberculosis (5).

It seems likely that avian tuberculosis will be found to be a far commoner disease than has been thought in the past. I doubt if these two cases in wild duck in this country give a true picture of the rarity of the disease, and it is to be hoped that all freshly dead wildfowl found in the close season will be submitted for examination, particularly those which are thin and wasted. It is perhaps noteworthy that the plumage of both of these was normal, for a darkening and an abnormal feather structure has been seen in tuberculous Wood Pigeon (6, 7), particularly when the adrenal glands are involved, a condition somewhat similar to Addison's Disease in humans. Plumage changes are therefore worth watching for.

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AROUND THE WORLD IN 103 DAYS

by Peter Scott

THIS account of our travels has been divided into a preliminary description of the whole journey followed by a more detailed description of the various species of Anatidae we encountered, told largely by direct quotation from diaries written at the time. For this Annual Report it seemed more appropriate to group these extracts from the diaries under the headings of the species concerned, which will also make them easier for reference than a chronological presentation.

This, then, is the story. Last winter my wife and I set out on a journey round the world which had a threefold objective. In my capacity as President of the International Yacht Racing Union I was required to attend the Olympic Games at Melbourne and to be Chairman of the International Jury for the Yachting events. Such a journey obviously presented an excellent opportunity of seeing and filming the wild life of Australia, and those other countries which lay on our route, for presentation on television; and finally here was a chance to see a number of species of ducks which I had never seen before.

When I left England I had never seen alive 17 of the 116 full species of Anatidae which are known to science, and when I got back only 9 remained to be seen (of which 2 are in any case almost certainly extinct).[1]

Accompanying us on our journey was the brilliant young cinematographer, Charles Lagus—cameraman of the Zoo Quest television series. His films, together with some of mine, were later shown on B.B.C. television under the title 'Faraway Look'. The three of us travelled almost entirely by air and were seldom more than two or three days in the same place. We flew by way of Amsterdam, Rome, Basrah, Karachi, Rangoon, Bangkok and Singapore to Darwin, Australia.

AUSTRALIA

Near Darwin we were, for a week, in the hands of Harry Frith, a biologist working for the Commonwealth Scientific and Industrial Research Organisa-

[1] Crested or Korean Shelduck and Auckland Island Merganser are probably extinct; the remaining seven species are: Freckled Duck of Australia, Bernier's Teal of Madagascar, Stellers and Spectacled Eiders from Arctic breeding grounds (both to be seen in Alaska), Chinese and Brazilian Mergansers, and the Masked Duck of the West Indies and tropical South America.

tion on the Magpie Goose with particular reference to its conflict with rice-growing interests. Harry had been to Slimbridge, and later accompanied us on a rocket-netting trip in Scotland two years before.

You will read in the diary about the Magpie Goose and the various ducks we found there, including the enchanting Green Pygmy Goose. Besides these we saw a great profusion of tropical birds from the Brolga or Native Companion Crane downwards; there were storks, ibises, herons, egrets, spoonbills, the bustard or Plains Turkey, cockatoos both black and white, parakeets of great brilliance, White-breasted Sea Eagles, Kookaburras, roller, bee-eater, the cuckoo which is called the 'Swamp Pheasant', the Pee-wee or Magpie Lark, which is neither a lark nor a magpie, nor for that matter a peewit, but is related to the wood-shrikes. We identified 62 species of birds in five days, and in addition we saw buffalos and dingos (both probably introduced by primitive man), wallabies, flying foxes, magnificent reptiles—including a fine big monitor called a Race-horse Goanna, which was common, and the superb Frilly Lizard, *Chlamydosaurus kingi*, 2½ feet long, which runs on its hind legs only and spreads a huge orange and black frill to discourage its enemies. There were fascinating smaller animals—mud-skippers, frogs, spiders and insects—'doo-doos' we called them, using the East African word.

Frilly Lizard (*Chlamydosaurus kingi*)

From Darwin we flew to Perth, where our plans were laid by Vincent Serventy mainly around two excursions to see ducks, one before and one after a lecture engagement in the city. It was here that we saw five new species of ducks, four of them on one day within half an hour: Musk Duck, Blue-bill, Australian White-eye and Australian Shoveler. The fifth, the Pink-eared Duck, we saw during a delightful trip in which we camped under a huge gum tree on a sand spit beside the Dumbleyung River.

From Melbourne we went to various places which were within reach during the week-ends of the Olympic Games period. One was spent, with Harry Frith again, on an ambitious journey to the interior of New South Wales. We flew to Canberra and then motored past Wagga-Wagga to Griffith. The object here was to get better films and make closer study of the Pink-eared Duck and to see the amazing Mallee Fowl. In the event we saw the Pink-ears well, including our first newly hatched ducklings of this species, the downy pattern, of

Male Mallee Hen (*Leipoa ocellata*)

course, being of great significance in the evolutionary relationships of ducks.

The Mallee Hen is one of the Megapodes which incubate their eggs in mounds of sand and rotting vegetation. For four years Harry Frith has been making a study of this species. In a square mile of mallee (eucalyptus scrub) he had recorded 58 nests, of which about 17 were in use each year. He had used special instruments for recording nest temperatures and had watched and filmed the birds. The Mallee Hen's year consists of a short period of courtship and nest building (usually on an existing mound). The male does all the building, then digs a hole in the top into which the female lays one egg which is covered up and, in the early part of the season, incubated by the heat of the decaying organic matter. A week later she lays another egg, and so on throughout the winter and early spring, until more than 20 eggs have been laid. Apart from laying the eggs she has nothing further to do with the nest or the young. The male alone controls the temperature, thrusting his head into the nest and probably using his tongue as a thermometer. According to his findings he either heaps sand on to the 10-foot diameter nest mound or scratches it off. There is an intricate interaction between the heat of the decaying mallee leaves and twigs and the heat of the sun. Towards the end of six months' laying season almost all the heat is derived from the sun, as the vegetable heat is expended and the midsummer sun is so hot. The chicks hatch in mid-heap and somehow or other fight their way to the surface. They are entirely independent and neither parent pays any attention to them. They have to rear themselves separately, as only one hatches each week. The principal enemy of the Mallee Hen is the European Fox, reputedly introduced into Australia for fox-hunting, and now immensely numerous. It digs up and eats the eggs. In the course of studying the Mallee Hen Harry had found a bird, Joe, which was exceptionally tame and confiding. He took us to its nest and, sure enough, there was Joe, a much larger bird than I had expected—as big as a female turkey. Harry sat on the edge of the nest throwing sand up into the air. The red dust floated down in cascades which were too much for Joe. He advanced to the nest, looked over the edge of the hole which Harry had dug, turned his back and started to throw the sand back in again. He was 5 feet away from Harry as he worked; I was 10 feet away and in full view as I filmed. Charles Lagus was 30 feet away, also filming, and my wife was taking stills. Nothing seemed to upset Joe.

It was at Griffith that we saw wild budgerigars (amongst seven species of parrots and parrakeets), Red and Blue Kangaroos, a Blue-tongued Skink, and the very numerous Shingle-back or Bob-tailed Skink (*Trachysaurus rugosus*).

On another week-end we went to Flinders Island in the Bass Strait between Tasmania and Australia. Here, as the guests of Dr Dom Serventy, we stayed on tiny Fisher Island, headquarters of the nine-year-old research into the biology

of the Mutton Bird or Short-tailed Shearwater, *Puffinus tenuirostris*. One of the principal objects of this visit was to see Cape Barren (Cereopsis) Geese in their native haunts. We also saw Musk Ducks living at sea—an unexpected habitat. Besides, there were nesting Fairy Penguins, White-faced Petrels, Caspian Terns, Black Oyster-catchers, Silver and Pacific Gulls and passing Australian Pelicans; and we caught and filmed a fair-sized octopus.

Koala

From Melbourne we also went to Philip Island, which lies about 70 miles south of the city, in order to see wild Koala Bears, with which the eucalyptus trees were full. I climbed up beside one female with baby and she allowed me to stroke her and scratch her head. On the same evening at dusk we watched the Little Blue Penguins filing up a special track from the beach to their nesting burrows in the sand dunes. The little birds march up in a sort of procession watched by 50 or 60 people every night standing behind a special fence and shining torches on them, to which the penguins pay practically no attention.

When the Olympic Games were over we flew to Sydney, where Sir Edward Hallstrom showed us the Taronga Park Zoo and made plans for us to visit his properties in New Guinea. Dr Alan Keast took us to the National Park to see and film the Satin Bower Bird at its bower.

NEW GUINEA

On 12 December we flew northward to New Guinea, where we spent a week in the Wahgi Valley as Sir Edward Hallstrom's guests. We were most hospitably entertained by Mr and Mrs Frank Pemble-Smith, and spent much of our time with the distinguished zoologist and animal collector, Fred Shaw-Mayer, who probably knows more about New Guinea's fauna than any other living man. In the Fauna Section at Nodugl—half zoo, half sanctuary—of which he is in charge, we saw an incomparable collection of Birds of Paradise and the rare Salvadori's Ducks which have been successfully bred in captivity there. Unfortunately, though we spent several days hunting, we never saw the ducks in the

wild state. They were 'the ones which got away'. But we did see the New Guinea race of the Grey Teal, *Anas gibberifrons gibberifrons*, which has only once before been recorded from that area. Commoner were Australian Black Ducks, *Anas superciliosa.*

Because the natives kill great quantities of birds to supply feathers for their magnificent head-dresses, Birds of Paradise are not common, although we had a good view of a wild male Salvadori's Red Bird, *Paradisa apoda salvadorii.*

Tree Kangaroos and Phalangers and the rare Wild Dog were the most attractive of the New Guinea mammals we saw. The lizards, frogs, spiders and insects were as remarkable as I had always imagined they might be in this naturalist's paradise.

Western civilisation only reached the Wahgi Valley about twenty years ago, and the impressive development of villages and towns has been achieved with only two lines of communication with the outside world—radio and aircraft—although a temperamental road, subject to frequent landslides, has just been built. Our departure was delayed by an unsuccessful and alarming attempt to fly over a range of mountains enveloped in a cumulo-nimbus cloud system of vast proportions. However, we got through next morning, returning the same day by way of Lae and Port Moresby to Cairns in Queensland.

THE BARRIER REEF

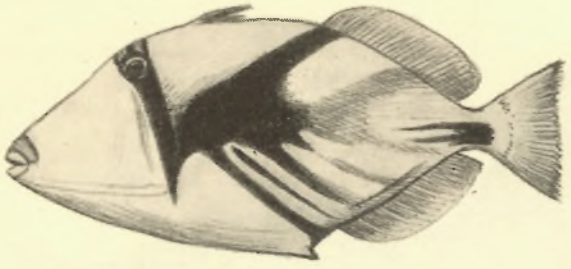
We had only three days in which to see something of the Barrier Reef. On each of those days we swam for long periods with mask and snorkel, which neither Philippa nor I had ever done before. In my diary at the time I wrote:

'23–25 December. For part of these three days I have been in a new world. Nothing I have done in Natural History in all my life has stirred me quite so sharply as my first experience of skin-diving on a coral reef. Konrad Lorenz said when I saw him in Bavaria in September that this was one thing I must do before I died—and now I have done it, or rather started to do it. The dramatic threshold which is crossed as soon as one puts one's face-mask below the surface is, to a naturalist, nothing less than staggering in its impact. Much has been written already about the scarcely explored new continent of the ocean; I have read these descriptions in the books of Cousteau and Diolé, and yet I was unprepared for the visionary revelation when I first saw the real thing.

'I must try and describe it chronologically and in detail, but the effect on my mind is still rather kaleidoscopic and bewildering. First it should be explained that the adventure falls into four chapters and an appendix—and, by the way, I have no hesitation in using the word adventure, for this type of swimming cannot fail to be high adventure, nothing less, for any naturalist; indeed for any imaginative person who has never done it before. The four chapters were four separate dives, two on the first day and one on each of the next two. The appendix is two visits to the Underwater Observatory on Green Island. As befits such a sequence, each chapter was a little bit more exciting and more moving than the one before. The final effect was overwhelming, so that in spite of trials and tribulations with ill-designed equipment, and intense discomforts arising therefrom, I cannot see how I can escape from its lure. I am already an addict and I have not yet used an aqualung.'

From then on the diary is full of drawings of fish, although a part of Christmas Eve was spent among the huge colony of Noddy, Sooty and Crested Terns at a

small coral island called Michaelmas Cay. Christmas Day was spent mostly in the water at Green Island discovering the common fish of the corals, the glorious little bright blue damsel fish which rejoice in the generic name of *Abudefduf* and the black and white *Dascyllus*, the pompous-looking Pig-snout Trigger Fish with his complicated pattern of black and white and orange and bright blue, the superb Anemone Fish of the genus *Amphiprion* (there were three species here and the commonest was also the most brilliant—*A. percula*, a goldfish with pale blue bands), the ridiculous Razorfish which always swim standing on their heads and are always in pairs, and many species of Butterfly Fish of the genus *Chaetodon*. The numbers and diversity of the animal life in these supremely beautiful coral gardens was perpetually breathtaking. It was a day of enchantment.

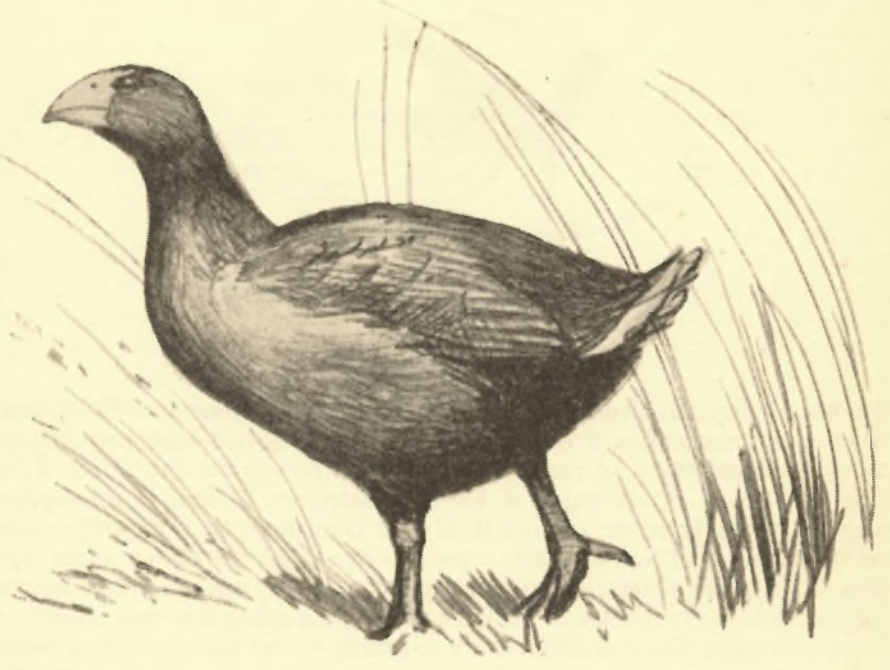


Pig-snout Trigger Fish (*Ballistapus aculeatus*)

NEW ZEALAND

On Boxing Day we flew to Sydney and next day in a jet stream to New Zealand. There a comprehensive if rather exhausting itinerary had been prepared for us by the Department of the Interior. We went first to the South Island and saw the colony of six pairs of Royal Albatrosses, *Diomedea epomophora sanfordi*, which breed on Taiaroa Head near Dunedin. This is the only colony on the mainland of New Zealand; it began with a single nest about twenty years ago. It has taken a long time to build up, because only one egg is laid and the young takes eleven months to leave the nest, so the adults can only breed once every two years. These albatrosses are so greatly valued that the colony, which is surrounded by a barbed-wire fence, is protected by a special Act of Parliament. Stan Sharpe, the warden, took Charles Lagus and me to one nest, which I described thus in my diary: '. . . The cart track ran horizontally round the steep face of the hill, and slap in the middle of it, in a clearing of the tall summer grass, sat an Albatross (unexpectedly huge if one has not seen albatrosses at close quarters before). It was a male and it looked slightly embarassed; it snapped its bill with a resonant rattle and a little grunt. Stan took its egg from under it, we looked at it (very small for the size of the bird), and he put it back again. The bird was quite extraordinarily steady and did not seem to be at all resentful of us. So close were we that we could see the feather lice wandering among the feathers of the head. We filmed him extensively, including large close-ups of his friendly eye and tube nostrils, and fetched the tape-recorder to record his rattle. . . . Stan Sharpe had been looking after the colony for six years. He knew a very great deal about his albatrosses. He told us that a large part of the diet is squids, which have been identified by the eye lenses cast up in pellets by the birds round the nest. . . .'

On the following day I was taken to see the Takahe (*Notornis mantelli*) by Dr Gordon Williams, biologist of the Department of the Interior, who is studying it, and who had visited Slimbridge to show us films of it a few years before. We flew into Takahe Valley in a Grumman Wigeon amphibian piloted by Jim Monk, and landed on Lake Orbell (named after the ornithologist who rediscovered it about ten years ago after a long search). It was pouring with rain, and continued to do so almost without stopping for the whole of the four hours we were there. We were soaked through and excessively cold, but we saw one Takahe among the tussocks of Snow Grass, heard two more and found the hatched nest containing the eggshell and membrane. I also saw my first Blue Ducks (described on p. 104).



Takahe (*Notornis mantelli*)

Permission for this excursion had only been granted as a very special favour at the last moment, and in return for such advice on Takahe conservation as I might be able to give. Unfortunately neither my wife nor Charles Lagus were permitted to go with me. This was sad, though the reluctance of the authorities to allow visitors into this last stronghold of the great flightless moorhen is fully understood, and I was grateful indeed that I was allowed to go at all. There are possibly not many more than 60 Takahe now living. Higher estimates are considered to have been over-optimistic. The habitat is strictly limited, so no great increase can be expected, except perhaps by artificial means in captivity.

At Lake Ellesmere, near Christchurch, with Gordon Williams and Ken Myers, we saw huge flocks of Australian Black Swans, an introduced bird which has been even more successful in New Zealand than in its native land. On one day we saw more than 20,000, which may have been as little as a quarter of the

Black Swans

population of this fifteen-mile-long lagoon. We also saw a flock of between 3000 and 4000 moulting Canada Geese (and some New Zealand Shovelers).

The converted wartime Harbour Defence M.L., now the Motor Yacht *Alert*, was put at our disposal in the Cook Strait (between the North and South Islands of New Zealand) by its owner, Alex Black, and with us for a two-day cruise were a party of half a dozen, including that distinguished ornithologist, Dr Bob Falla of the Dominion Museum, Wellington. On a small island, one of the Trios, we found almost every Blue Penguin or Shearwater burrow occupied by a Tuatara (*Sphenodon punctatus*). These reptiles are not related to any of the living forms of lizard, and form a sort of living link with the Dinosaurs (the Coelocanth fish is analogous). The largest we found, sharing a burrow with a moulting adult Penguin, was about 2½ feet long. They are sturdy greenish grey animals with a fringe of soft white spines, vertical pupils to their eyes like a cat and a breakable tail which regenerates. Apparently they breed, and grow, very slowly, but nevertheless there must have been several thousands on this island. They survive only on this and a small number of other islands round New Zealand, but nowhere on the mainland. On the Trios, too, were some huge crickets, *Hemideina thoracica*, known by the Maori name Weta. The females were 4 inches long, glossy yellowish brown, and the males slightly smaller with a head nearly an inch long and 5-inch antennae.

From the *Alert* we landed at Kapiti Island and saw the rare parrot known as the Kaka, *Nestor meridionalis*. Here in the evening I gave a lecture to an 'ornithological camp' which was interrupted by the call of a wild Kiwi nearby.

At this camp we met Dr Graham Turbott (then Director of the Auckland Museum), an old friend who has visited Slimbridge, and who was to show us Brown Ducks at Waipu in the North Island, and Archie Blackburn, who was to take us to see and to film Blue Ducks near Gisborne, also in the North Island. How we saw these two species is described on pp. 104–112. Graham Turbott and Roy Cavanagh of the Department of the Interior (who was later to send us a fine selection of live New Zealand Ducks for the Trust) were with us

Tuatara (*Sphenodon punctatus*)

on an excursion to Cape Kidnappers to see the fine Gannet colony there, and took us to Rotorua, where we saw 'Black Teal' (the New Zealand Scaup) and were shown the hot springs by guide Rangi. At Waipu, on a sand-bar at the mouth of the river, we found three newly hatched young of the New Zealand Dotterel, *Charadrius obscurus*, attended by their parents, one of whom performed a spectacular distraction display. This is one of the world's rare birds—a pale-coloured sand plover—of which probably only 300 exist.

Kaka (*Nestor meridionalis*)

FIJI

From Auckland we flew north across the Pacific to Fiji. For a week we stayed in one place—a unique hotel at Korolevu on the south coast of the main island, Viti Levu. My diary for Thursday 17 January begins: 'We went out before breakfast to bathe, 25 yards from our thatched burré, and as soon as I put my mask under the water I realised that our week would be a success. There were hosts of little fish of all shapes and sizes and colours. The brilliant blue one in which the male has orange fins which I had seen at Michaelmas Cay was quite common; there were multi-coloured Wrasse everywhere; it was a scene of amazing beauty and diversity. At breakfast I drew all the different fish I could remember seeing and it came to 22 species. Once more, as on the Barrier Reef, I had the sudden joy of revelation. This new world, which can so easily be seen just by putting on a mask and dipping one's eyes below the surface, is a paradise for anyone with an interest in Natural History. Immediately I began to see the discoveries in the fields of animal behaviour, of speciation, of genetics, which are so obviously there for the taking—offering themselves to the observant fish-watcher. It would be interesting enough without the beauty, but to an artist the colour and form and movement were breathtaking, so that my cup was full. . . .'

We swam for about five hours each day and were able to distinguish 108 different species of fish, to say nothing of the crabs, shrimps, molluscs, sea urchins, starfish, worms, sea cucumbers, anemones and corals. One night after dinner I swam with a waterproof torch and found that all the fish were quite different. The common fishes of the daylight were nowhere to be seen, but a number of nocturnal species had taken their place. The Fijians of Korolevu sang 'Isa Lei' for us when we left after an enchanted week.

HAWAII

We left Fiji on the evening of Wednesday 23 January and flew for 13 hours, arriving in Honolulu on the morning of Wednesday 23 January, a peculiar phenomenon associated with the crossing of the International Date-line. Our main object while in Hawaii was to make contact with those responsible for the future of the Ne-ne (Hawaiian Goose). In Honolulu we were looked after by Paul Breese, Director of the excellent Zoo and Chairman of an Advisory Committee which keeps watch over the status of the bird. We saw some of the yearling Ne-ne which he then had at the Zoo. Then we flew 200 miles to Hilo, on the big island of Hawaii, to be the guests of Mr Herbert Shipman, who perhaps more than any other man is responsible for the turn in the tide of the Ne-ne population. We visited Pohakuloa, where Ne-ne have been bred in captivity in covered pens ever since the Trust sent its Curator, John Yealland, to Hawaii to rear the first goslings there in 1950. The birds are now in the care of Dave Woodside, and we saw several broods of goslings with white Muscovy Duck foster-mothers. We drew up a list of the Ne-ne known to be alive at that date—26 January 1957. The total was 103.[1]

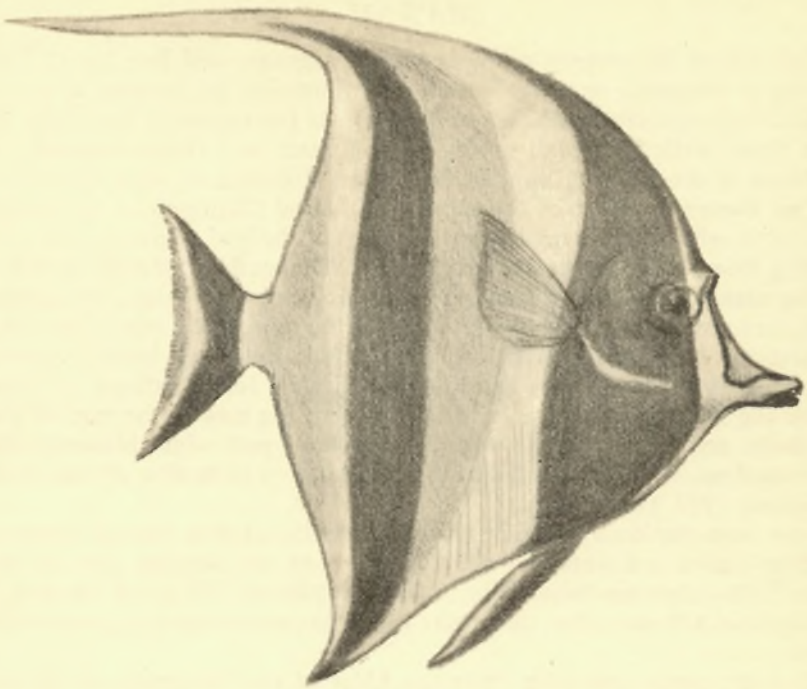
There were further eggs being incubated at Pohakuloa, and of course the breeding season in Europe was still to come. (As this account goes to press, 1 May 1958—there are believed to be between 140 and 150 living Ne-ne in the world, about 100 more than there were when the species was at its lowest ebb in 1949.)

We spent much time with Professor Elder of the University of Missouri, who was in the middle of an intensive study of the Ne-ne. Bill Elder was an old friend whom I had first met at Delta in Canada, and who subsequently brought his fluoroscope equipment to Europe and did important work with it during the rocket-netting season of 1953. Bill took us on a strenuous day walking across the *a-a*, a particularly rough and jagged type of lava which covers the slopes of the great volcano Mauna Loa, in an area where he had found Ne-ne nesting. He showed us a recently hatched nest of a pair he had been studying, under a fallen tree bole in a *kipuka*—an island of vegetation in the surrounding sea of

Yellow Tang (*Zebrasoma flavescens*)

a-a. Although we did not succeed in seeing a wild Ne-ne, we did see an Iiwi, and two other species of the native bird family, the Drepanidae.

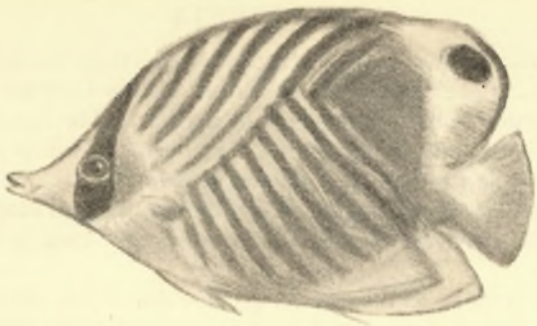
[1] A more up-to-date table, drawn up in September 1957, appears on p. 113.



Moorish Idol (*Zanclus canescens*)

While in Hawaii we had a chance to swim with masks and flippers on the Kona coast, where the fishes were as beautiful and varied as they had been in Fiji though the water was much colder. Many of the species were the same, but some of the most numerous were new to us and the relative abundance of the familiar ones was quite different. In Kealakakua Bay, beneath the monument which marks the spot where Captain Cook was killed, Charles and Phil and I met a very large grouper (probably *Epinephelus thompsoni*) which we reckoned was almost exactly the same length as Phil and probably weighed about 250 lb. He was curious and swam up round me in quite a friendly fashion.

But even more exciting to me were the great shoals of slightly apologetic yellow Tang, *Zebrasoma flavescens*, like little yellow plates on edge, the gaudy Moorish Idols, *Zanclus canescens*, black and white and yellow and pale blue and looking vaguely like big Angel Fish, the complacent, even pontifical-looking Trigger Fishes, *Melichthys buniva* and *Ballistes vidua*, which progress by purposefully waving their dorsal and anal fins, the slightly deprecating Convict Tang, *Acanthurus sandvicensis*, and his near relative, *Acanthurus olivaceus*, with a great flash of orange outlined in black on his flanks. And the Box Fish, and the Parrot Fish, and the little Wrasse, and above all the great variety of Butterfly Fish (Chaetodonts), which are mostly yellow and always go about in pairs. We found more than a dozen species of the genus *Chaetodon* in Hawaii, all apparently living in the same kind of habitat, on the same kind of food, and at the same depth; in fact in the same ecological niche. For a while I puzzled over the evolutionary origin of this, and then I thought that it could



Chaetodon setifer

all be explained by some large-scale disaster such as a glacial period which had overtaken the ancestral *Chaetodon*. In various isolated and sheltered spots fishes had survived and varied over a long period to form a number of species. Then conditions had improved and the different species had been able to spread themselves once more through the warm seas. But, being full species by now, they had remained distinct. The patterns which differentiate the species are striking and conspicuous, and the fishes are evidently monogamous and form devoted pairs. And so, on one small patch of coral you may see pairs of half-a-dozen species of Butterfly Fish.

I wrote in my diary of that day: '. . . I had been in the water 40 minutes the first time and 50 minutes the second, which with 40 minutes or so in Kailua harbour in the morning made 2 hours and 10 minutes of swimming—and what swimming! Now that some of the fishes are becoming quite familiar—old friends almost—one is inclined to glance at them almost without noticing them; at least this would be so if I did not find myself returning to the amazing beauty of the underwater scene. And so it remains unbelievable, out-of-this-world, a unique and glorious experience of which I could never tire. I find myself still echoing Konrad Lorenz's injunction to me in Bavaria, "This you must do before you die". Every naturalist, every zoologist—but more than that every single person with an eye for beauty and an inquiring mind should—no, must—look down through a face-mask at a tropical coral reef. . . .'

Back in Honolulu, Paul Breese arranged for us to meet Dr Vernon Brock, head of the Fish and Wildlife Service of the Territory. We had an interesting discussion over lunch, at which we were joined by Dick Woodworth, who is responsible for the Pohakuloa Project at headquarters in Honolulu. One of the great problems is how to release hand-reared birds successfully into the wild range, and I outlined my scheme for a Ne-ne Park, a large vermin-proof enclosure in which pinioned Ne-ne could be kept, instead of the covered pens at Pohakuloa (which is outside the wild range and in unsuitable country). It is only by allowing pinioned parents to raise full-winged young that I believe the wild population can be successfully reinforced.

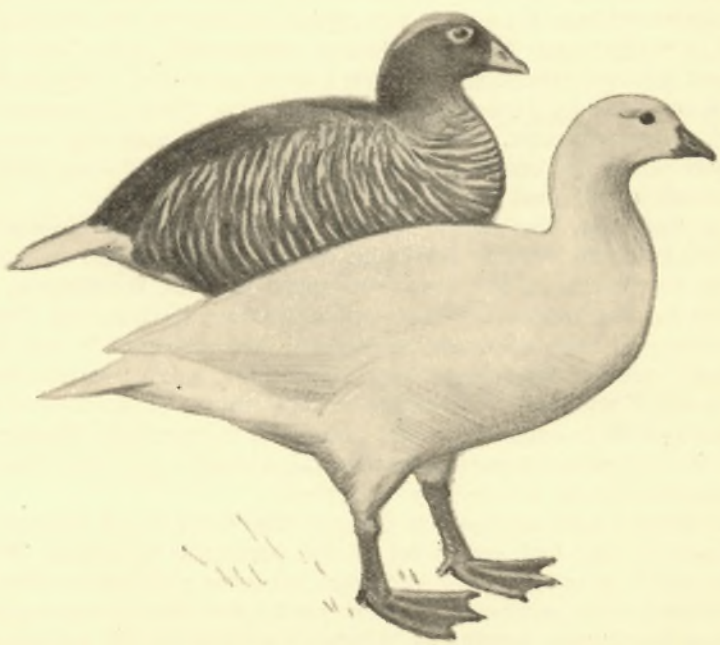
Vernon Brock's main interest is in fish, and after lunch we all went swimming with aqualungs—my first experience of this admirable invention. We dived in a fairly shallow pool just off the Aquarium, but it was sufficient to demonstrate the possibilities of the equipment. Vernon was kind enough to spend some time in the Aquarium Library helping me to identify some of the fish we had seen on the Barrier Reef and in Fiji and on the Kona Coast of Hawaii.

CALIFORNIA

On Sunday 3 February we arrived at Los Angeles from Honolulu to spend a few days with our old friend Jean Delacour, who is Director of the County Museum. The garden of his home is most beautiful and he has some delightful aviaries. He took us to see Bill Parsonson's aviaries in which he has a pair of Kelp Geese which he has kept in good health for more than a year, although there are long periods when the grass is dry and brown and inedible to a goose. He also had three Peruvian Ruddy Ducks—the only ones in captivity in the world.

Jean Delacour took us to the San Diego Zoo which was crammed with wild Pintails, and on the way there and back we passed a bay with Black Brant, 300 strong, feeding on the mud close to the road. He took us to the fabulous Marineland where the tame Dolphins play with such evident enjoyment, and he accompanied us to Merced in the San Joachim Valley, where Dave Marshall (whose article on the Pacific Flyway appears on p. 128) had come south from the Malheur Refuge especially to show us the Ross's Geese which he had been studying during the previous year. In the winter of 1955–56 there had been an estimated world population of 12,000 Ross's Geese, but this winter of 1956–57 had only disclosed a maximum of 8000. Dave was not sure whether he had lost a significant flock somewhere or whether the population had fallen by that amount. In view of the bad summer in the Arctic in 1956 it seems not unlikely that the Ross's numbers had sharply fallen, especially as, in spite of the complete protection afforded to them, several thousand Ross's are known to be shot annually in error for Lesser Snow Geese, which are not protected.

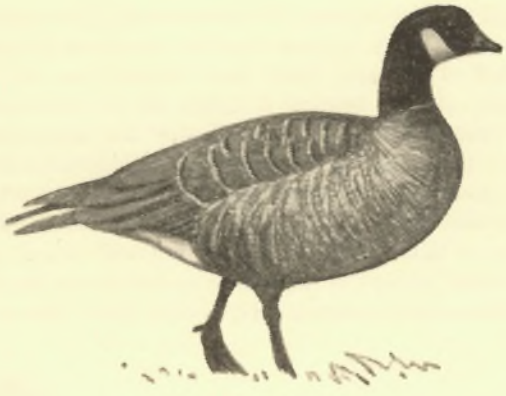
We saw 1100 Ross's Geese in one flock and 400 in another; we saw a great concourse of 6000 geese of which the majority were Cackling, but there were



Kelp Goose (*Chloephaga h. hybrida*)

also Taverner's Canada Geese, White-fronts, Lesser Snow and Ross's Geese; and we confirmed what I already knew, that for profusion and variety of Anatidae there can be few places in the world to equal the Sacramento and San Joachim Valleys of California in midwinter.

And so to New York for a lecture under the auspices of the Audubon Society, and then back home again on 14 February after 103 days of travel.



Cackling Goose (*B. c. minima*)

NOTES ON ANATIDAE SEEN ON WORLD TOUR

by Peter Scott

MAGPIE GEESE (*Anseranas semipalmata*)
GREEN PYGMY GEESE (*Nettapus pulchellus*)

(Near Darwin, Northern Territory of Australia)

From Darwin our destination was a forty-mile drive south towards Alice Springs, then twenty miles east to the floodplain of the Adelaide River.

Friday 9 November 1956

WE drove through mile upon mile of sparse eucalyptus forest with occasional Kites visible above the trees. At last over the corrugated road we came to the original homestead of Humpty Doo. Just beyond was the Government rice project, and a mile or two beyond it again the private enterprise project of Territory Rice Limited. But we forked off after the homestead in order to go down by a track which would show us our first Magpie Geese. The eucalyptus woods gradually gave way to Pandanus palms and then we were at the edge of a great open plain, with black, cultivated earth in the foreground and lush grass beyond. A couple of miles away was a low hill with scrub and trees on and around it, and various groups of trees were dotted about the plain. Just beyond the 'sea-wall', which encompassed the rice-fields, was a line of black-and-white

Magpie Goose (*Anseranas semipalmata*)

birds nearly half a mile away—our first Magpies—and in the tree where we stopped the land-rover were about a dozen white cockatoos—Little Corellas. Hanging on stakes around the small rice paddy were a Magpie Goose and half-a-dozen cockatoos which the crows were busily eating. Geese and cockatoos and finches are all pests to the rice-grower.

After lunch at the Territory Rice headquarters, we went again to the rice-fields. Here, Harry and Stephen[1] had put down bait for the geese, but the cockatoos were the only birds which had found it. We walked across the black, crumbling earth behind the flood-bank in order to get near to a group of 200 geese which were still close outside it. We took some film and some stills. Among the geese I could hear the chatter of Radjah Shelducks, familiar from the Orchard at Slimbridge. Here they are always called Burdekin Ducks, and there were three of them, two females and a male. The geese were not very wild but would not sit at less than about a hundred yards. Further on there were more geese, mostly a few hundred yards away. There was quite a large flock—known in Australia as a mob—which we later estimated at about 1000 and counted as 1002. Some of the geese were flighting over the flood-bank to feed in the back fields, but only a small number, under 50. Nevertheless, the geese and their setting and movements were vaguely reminiscent of the Pinkfeet on the Wash—perhaps particularly at Terrington in the old days when they fed on the saltings.

We had been there for an hour or so, enjoying so many new birds, when suddenly the whole mob of geese rose and swirled in the air. Some of them came right over us and there were astonishing aerobatics. Whether an eagle was the cause we do not know, but it was a most exciting moment when they flew close overhead in a tight mass.

Later, Harry took us to another part of the river plain. This was unspoiled by the new rice-growing projects—so far. Here again was a great mob of Magpie Geese, perhaps 1500. Most of them were feeding in a black swamp close to the Pandanus jungle, across a sort of bay in the open plain. Hitherto we had been very much inclined to believe that these birds were, in fact, geese. So much of their behaviour seemed characteristically goose-like; their flock reactions, the way they 'decoyed' in and settled just like Pinkfeet, the V-formations in flight, the alarm notes in their language—everything seemed to indicate that *Anseranas* was a goose; not a screamer, nor a crane, nor a stork, but a goose. But now here was a new feature of its behaviour. The birds were still arriving at the feeding swamp, flighting in parties from a temporary roost in the *tops of the eucalyptus trees*. Several hundreds were still perched there on the topmost branches. We wondered particularly about this behaviour when, a few minutes later, we saw a dingo coming along the edge of the forest. Here was a reason for the tree roosting, but then the dingo was introduced by humans (or so it is believed), no doubt thousands of years ago. But could the tree habit be of such recent origin? And then I remembered the newly hatched gosling which had gripped my finger with its long prehensile toes two months ago at Slimbridge. The tree habit is evidently of very long standing. But I still think that *Anseranas* is more of a goose than anything else—albeit an extremely aberrant one.

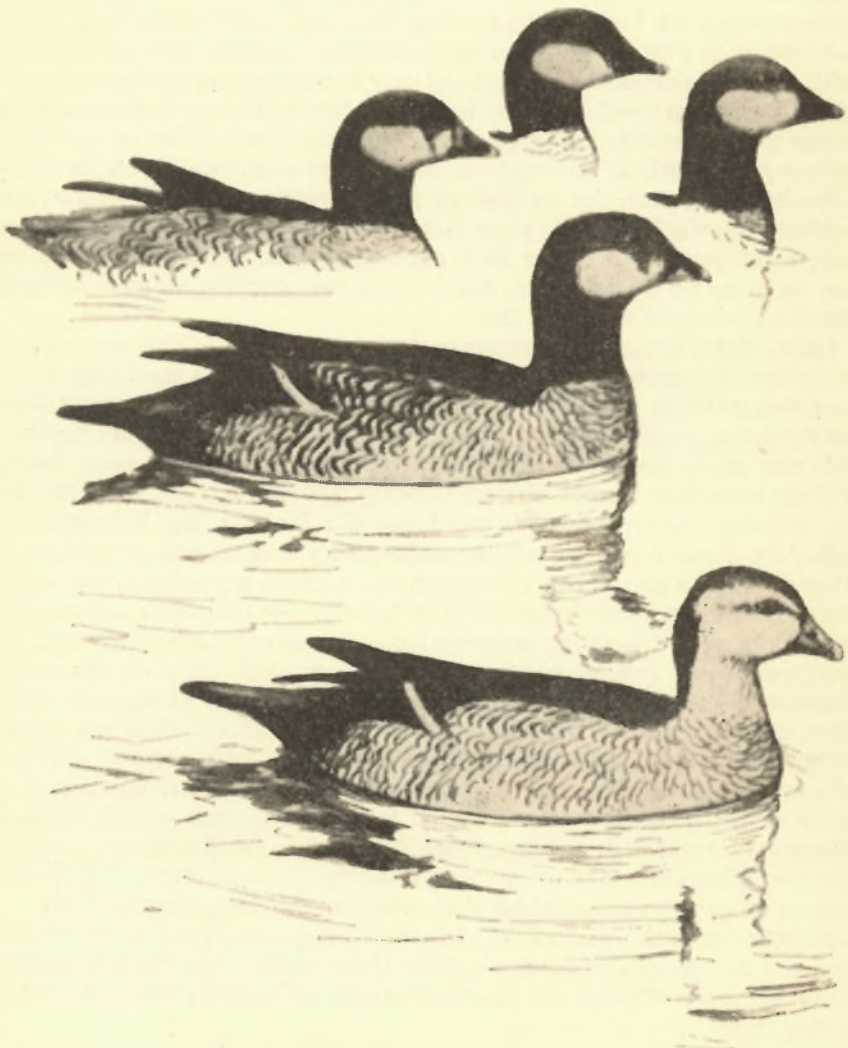
Farther out in this part of the plain were many more geese at the edge of a lagoon near a prominent dead tree. Here, Harry told us, was where he had made his record catch of geese with his 'boom trap'—350-odd at one shot—in order to ring them.

[1] Harry Frith, in charge of a special study of the Magpie Goose undertaken by the Commonwealth Scientific and Industrial Research Organisation, and his assistant, Stephen Davies.

Saturday 10 November

. . . After breakfast we set off on an excursion to a special creek, or billabong, on which Harry Frith promised we should find Green Pygmy Geese. It was a longish drive across a part of the plain which becomes impassable after a rainstorm. . . . For me this drive was enhanced by frequent views of a fine monitor which is known as a Goanna (clearly a corrupted form of Iguana). They were astonishingly swift over quite long distances, often 100 yards or more to the nearest cover. As we reached the creek there on the first patch of open water was a trio of Pygmy Geese. The first distant view of this little bird was disappointing. They sat alert and motionless watching our clattering approach in the landrover. The male looked exactly like a minute Richardson's Goose.

We worked our way along the creek which was in most parts about 20 yards



Green Pygmy Goose (*Nettapus pulchellus*)

wide. There were a few geese at various points and three groups of 9 Pygmy Geese. In one part, sitting in the trees, were Cattle Egrets in full plumage with dark buff heads and backs. Four Spoonbills with black bills were feeding in the creek. After about three-quarters of a mile the creek gradually dried up. In the last major pool were 50 to 60 Magpie Geese, 9 Pygmy Geese and a pair of Australian Black Duck (*Anas superciliosa rogersi*). This was our first positive identification of Blacks. They were rather stained and looked very dark among the green floating leaves. The birds left this pool and we decided to build a hide at the foot of a bamboo bush by the water's edge. When it was complete, Phil and I climbed into it. Harry waded out in the black mud (in spite of alleged crocodile risks) to see how well we were hidden from the water.

Then began a tremendously exciting hour. The Magpie Geese came back, but failed to settle and went away on up the creek. Some of the Pygmy Geese settled short about 60 yards from us, but some spread on to us and even passed us and then swam back to our pool. At first they were nervous, but gradually they got used to the camera noise and settled down. They were in pairs mostly, some trios. They displayed continuously, the females tipping their heads like Tufted Ducks, the males less intensively doing the same. Males made little rushes at approaching pairs and were counter-attacked. There was a short display flight of about 6 feet performed by the male only. The female's chin-lifting was done while following the drake, and is clearly analogous to the sideways 'sicking' of Mallard and Goldeneye. The little birds spent more than half an hour within 50 feet, which meant that one or two filled the screen with a 6-in. lens. I saw a curious wing opening movement rather like the one in *Dendrocygna* which must be associated with heat and ventilation of the body. Finally Harry came and put them up and they flew off up the creek, turned and came back past us again. In flight they have a very prominent white patch on the secondaries. They are then very reminiscent of Goldeneyes. As they fly there is a delightful little high whistle which sounds most attractive as the flock goes by. We had a chance to observe the individual variations in bill colour and plumage. The bill is black with a pink nail, but some, if not all, have pink lower mandibles, and in one male the pink spread up half-way along the upper mandible. The top of the head is dark brownish-black and it is only the neck and back and wings that are bottle-green. The grey breast and flanks are disclosed at close range as superbly marked in bold vermiculations, making an almost marbled pattern. The flank feathers rise surprisingly high over the back; in one case a detached tongue of feathers *above* the speculum. The white of the belly encroaches on the breast and flanks in some individuals of both sexes.

One curious feature is the prominence of the wing-tips when folded. They cross to an extreme degree and give a most characteristic appearance. The face pattern of the males is variable, some having an entire white cheek to the bill, others (more common) having a dark line downward and slightly forward from the eye; and one had nothing but a small lozenge of white on the cheek, just like a Canada Goose.

At close range one could no longer be disappointed by these lovely little birds. They were as beautiful as their scientific name suggests.

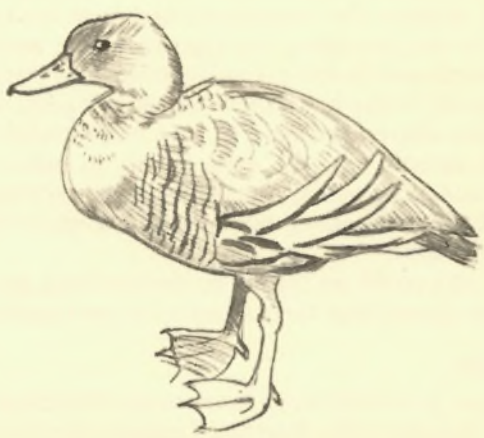
Sunday 11 November

. . . Our plan was to go farther afield to try to see Whistling Ducks. There was a lagoon beyond Beatrice Hill—Beatrice Lagoon—lying farther north where a mob of *Dendrocygna arcuata*, the Wandering Tree Duck, might be expected

to be found. . . . This was the hottest day since our arrival and by now it was noon. We had driven past some of the geese and now we came to an arm of the lagoon which had a fine concentration of birds. . . . Beyond and among the geese were some ducks; lots of Burdekins, a few Blacks and some Tree Ducks which we took to be Wandering, but they were distant and the heat-haze shimmered. There were also many Stilts, and in one place a Glossy Ibis. Eventually Stephen put up the main lot of the geese, 1500 in the air at once. . . . After lunch under a shady tree, we had another look at the ducks which had accumulated in the lagoon, and I found a small party of Grey Teal (*A. gibberifrons*) which were at once identifiable when one saw them with Black Ducks in company. There were also 36 Burdekin Ducks. Further up the lagoon were a lot more Blacks and Grey Teal. In silhouette the Grey Teal looked like little Pintails, and even the Blacks looked lean and pointed of tail so that I thought for a moment I had found some Pintails. . . . On the way back to Humpty Doo we drove into Pandanus jungle so thick that we had no choice but to retrace our track, and finally we decided to go back all the way by the track we had come out on. 'Who knows,' we said, 'maybe we shall see something nice on the way!' And so it was—for we came to a small lagoon which somehow we had missed on the way out. It was covered with geese which were feeding on both banks, but down at the water's edge there were lots of Tree Ducks: so far from being the expected Wandering, they were all Plumed. I counted 130 and there were more in dead ground. Harry said this was unexpected, although he had once seen *eytoni* there before. For a while we watched them from a couple of hundred yards, and then decided to go down and build an impromptu 'humpy' (Australian for hide). So we walked behind the truck as it went down to a small tree at the edge of the billabong. Here we broke down enough branches to hide Charles Lagus and me, climbed inside and let the truck drive away. An hour later we emerged with what should be some adequate film of these decorative birds.

Monday 12 November

We had spent the night in Darwin so as to fly in a chartered 'plane early next morning to locate and count the geese and to visit the famous Mission Station at Oen Pelli.



Plumed Whistling Duck (*Dendrocygna eytoni*)

Wandering Whistling Duck
(*Dendrocygna arcuata*)

. . . At 7.15 we were at the airport and soon after were boarding a De Haviland Dragon. I swung the props for the pilot, and we were off. The plan was to fly low over certain parts of four or more rivers and estimate the numbers and distribution of the Magpie Geese, and then fly on to Oen Pelli (the beautiful lagoon) for lunch, and return by way of other known goose concentrations, particularly one called Goose Camp.

The low flying was immensely interesting and enjoyable. The goose flocks looked wonderful rising below us in the sunlight. The buffaloes sniffed at us with laid-back horns and we could identify every reasonable-sized bird we had seen during the previous days, and saw several more, including Black and White Pelicans, a Red-backed Sea Eagle and Black Cockatoos. We saw the Bustard, which is called the Plains Turkey—in one case a pair with a striking difference in size. We saw the White Torres Strait Pigeon with black wings and tail tips, the White Ibises, the Straw-necked Ibises looking like geese, and even two lots of Glossy Ibis. And everywhere we saw Magpie Geese and buffaloes.

Of the ducks, we saw lots of Burdekins, Blacks, a few Grey Teal, occasional Green Pygmy Geese, and at various times Tree Ducks which looked dark enough to be Wandering. In some of the swamps grew a scarlet duck-weed, which made bright splashes of colour down below.

Suddenly we came to steep hills with rugged cliffs, and nestling at the edge of them was the Mission Station beside its 'beautiful lagoon'. As we came in to land, a large flock of geese rose from the lagoon in company with undoubted Wandering Tree Ducks. It was very hot indeed when we emerged from the 'plane to meet the missionary and his wife, Mr and Mrs Ash. From their new house overlooking the lagoon I discovered that the surface was dotted with Green Pygmy Geese among the water-lilies—there were perhaps 200 on the whole lagoon. Besides these, there were several groups of Magpie Geese, perhaps 300 all told, feeding on the banks or up-ending among the weeds, and there was a tight bunch of several hundred Wandering Tree Ducks diving for food just opposite us on the far side of the lagoon. . . .

From a dug-out canoe on the lagoon I was able to film some of the birds. . . . I found that we could get quite close to the geese and even closer to the Pygmy Geese, but that the Tree Ducks were much wilder. . . . We had to leave after only 3½ hours at Oen Pelli, as we had to avoid thunderstorm risks. We flew round the edge of the hills to another beautiful secluded lake called Red Lily Lake, but it had very few geese on it. From there we went to an area known as Goose Camp—being where the geese are in the habit of camping or con-

centrating. The most we had seen in one mob on the outward flight in the morning had been what I called 10,000 and Harry called 8000, but this group of lakes contained four or five times that number. On one smallish, round lake there cannot have been less than 20,000 and in the whole system, say, an area of about 5 miles square, there were at least 50,000. In some places they rose in clouds from dense concentrations round the lake shores. Flying at between 50 and 100 feet we saw them marvellously well. . . .

MUSK DUCK (*Biziura lobata*)
AUSTRALIAN WHITE-EYE (*Aythya australis*)
AUSTRALIAN SHOVELER (*Anas rhynchotis rhynchotis*)
BLUE-BILL (*Oxyura australis*)

(Near Perth,Western Australia)

Thursday. 15 November. ***Musk Duck***

. . . Our first destination was a suburban pool called Butler's Swamp, more recently re-named Claremont. This was perhaps 40 acres of water with many dead trees entirely surrounded by houses, rubbish tips, ruined and half-flooded buildings and roads. And yet in the space of less than an hour we had seen four new species of Anatidae which I had never before seen alive. These were Musk Duck, Blue-bill (Stifftail), White-eye, and finally, Australian Shoveler. There were also Grey Teal, Black Duck and Black Swan. The rest of the list was as follows: Dabchick, Coot, Moorhen, Porphyrio, Pelican, White-fronted Heron, Banded Plover, Silver Gull, Stilt, Little Black Cormorant.

It was really astonishing to find so many new birds on such a small and unpromising-looking lake. But of course the star turn was to have seen four new ducks. I cannot remember the last time when such a thing could have happened—perhaps on my first visit to Walcot Hall or my first visit to California—anyway, not less than twenty years ago.

The most peculiar of the four was the Musk Duck (*Biziura lobata*). This is a huge Stifftail in which the males are half as big again as the females with a large pendulous lobe under the bill, perhaps twice the diameter of a half-crown. The female has no lobe, or only a very small one. Those we saw with half- and

Musk Duck (*Biziura lobata*)

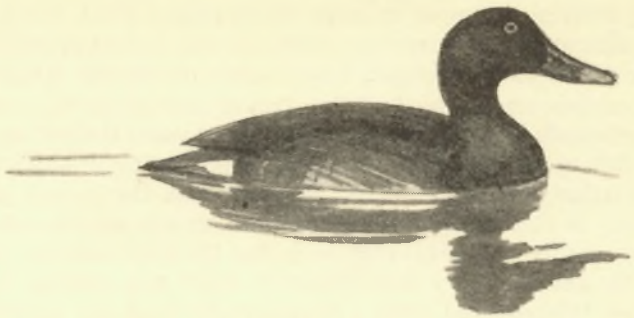
quarter-sized lobes were almost certainly young males. Musk Ducks were very common on almost all the waters we visited; we had a good opportunity to see them, and in one case (at Mongers Lake) watch the display which is accompanied by a curious single whistle. It is a typical Stifftail display, using the tail and characteristically complicated, with a splash of water thrown up, I thought, by the foot, although apparently some people hold that it is done with the wings. The effect is rather like the Goldeneye display. Musk Ducks look more or less black and only at close range with binoculars can one see the paler spotting. They have an untidy and dishevelled look, but the most striking impression I gained was the extraordinary resemblance in shape and position in the water to the African Whitebacked Duck (*Thalassornis*). Even the feathering of the head and neck was immediately reminiscent, and the position of the head, held slightly back with the bill pointing slightly up, was strikingly similar. A young Musk in silhouette was almost indistinguishable from a Whiteback if the scale was not apparent, and its extremely aquatic habits—swimming very low in the water, always diving—virtually never flying except to move from waters which are drying out—all indicated a close similarity. Of course it may be a case of convergence and there may be no close relationship, but on the other hand the impression of resemblance was so strong that I am inclined to think there must be a not-too-distant common ancestry.

Blue-bill (*Oxyura australis*)

Blue-bill

The next species we saw was the Blue-bill, the Australian Ruddy Duck. This looks exactly like the Maccoa or the two South American species, but it has a complicated display quite unlike the North American and very amusing. I have so far only seen it once and the first part of it a second time. The first part consists of slightly raising the body in the water and pointing the bill down the breast as if trying to preen neck feathers. On one occasion this was immediately followed by a dive. I am not quite sure how this fits on to the second half, which consists of bringing the tail over the back, submerging the head and flopping the wings in the water as if the bird were *in extremis* and about to drown. At some stage in this a jet of water is thrown up by the foot. I hope to see and perhaps film this display at a later stage.[1] The female is much more heavily marked than in the North American Ruddy Duck.

[1] Unfortunately neither opportunity materialised.



Australian White-eye (*Aythya australis*)

Australian White-eye

The third new duck we saw was the White-eye. The pale tip to the bill in the male is the most striking feature. When one comes to look at this species critically, both the male and female, it seems evident that it is more closely related to the Southern Pochard than to the White-eyed Pochard. It is a sort of link between the two. This was confirmed at Bibra Lake on the following day when I had an opportunity of seeing a brood of five- or six-day-old ducklings. These looked exactly like young Southern Pochard and not at all unlike Red-crested Pochard or Rosy-bills. This bird may be more of a *Netta* than an *Aythya* in spite of its white eyes and the male's white belly. Near a rubbish tip I crept quite close to a pair of White-eyes sitting on a log. When the drake jumped off into the water he displayed with a bulging of the throat, and I also saw a head-throwing-back as in *vallisneria* (Canvasback) and *ferina* (European Pochard), indicating that it is still related to *Aythya*. I think it may prove to be quite close to *baeri* (Baer's Pochard).

Australian Shoveler

The fourth new duck we saw was a pair of Shovelers. These flew near us and then pitched, and we had a good opportunity to look at them, but the drake was in full eclipse and could not have looked more like the female. There was no sign of the white crescent, but as this was the latter half of the breeding season his dull plumage was not surprising.

Australian Shoveler (*Anas r. rhynchotis*)

Pink-eared Duck

THE PINK-EARED DUCK (*Malacorhynchus membranaceus*)

MOUNTAIN DUCK or AUSTRALIAN SHELDUCK (*Tadorna tadornoides*)

(Near Perth, Western Australia)

John Warham gives an account of his observations on nests of the Pink-eared Duck on pp. 118–127 *of this Report.*

Our first encounter with the Pink-ear was on a river leading down into Dumbleyung Lake.

Saturday 17 November

. . . We travelled down river in a boat with an outboard-motor among flooded bushes and tree stumps. The river was stagnant—a creek which in many places was spanned from bank to bank by dead bushes and trees. Grey Teal and some Black Duck kept flying in front of us, occasionally breaking back where the river curved round. The commonest water birds were Coots. A few Musk Ducks dived in front of us. Black Swans swam ahead and two pairs had small downy young. We had been going for more than half an hour and I was beginning to think that maybe we weren't going to find any Pink-eared Ducks, which had been promised in good numbers on the river, when we came round a corner and there at once were some among the Teal. There was hardly time to look at them as we sped on with the outboard-motor, getting quite close to a few which seemed to be flightless but were probably well-grown young. One was evidently adult and flew a few yards at a time, apparently intending to lead us away. Some others had by this time taken off. Round the next corner, however, in a big lagoon were more or the same ones again. There were a party of four or five and a pair. We stopped the motor and tried to approach silently, but they would have none of us. However, I had a chance to look at them. The impression was that they looked surprisingly like what I had expected, and the illustration in *Phillips' Ducks* (which is by Louis Fuertes) is quite good, especially the distant one. This time when they flew I heard for the first time the little plaintive clicking whistle which is so characteristic of them.

Also in this open bay of the river were Mountain Ducks (*tadornoides*);

many of them young ones in a surprisingly dull and nondescript plumage, so much so that for quite a while I gazed at one in the fond hope that it was a Freckled Duck.[1]

On the far shore of the lagoon were some Wood Ducks (Maned Geese) and a couple of Greenshanks. We turned back from here, having much trouble with the outboard-motor, and we found the Pink-ear doing a distraction display in the same place. We also found two well-grown young Pink-ears diving and swimming away low in the water like water-rats.

Sunday 18 November

After attempting unsuccessfully to film Pink-ears from a humpy, we again set out in the boat down the river towards the lake. . . . Almost at once we came upon small parties of Pink-ears, but then there was a long narrow stretch of river with nothing much but Black Swans. Towards the mouth of the river among the dead timber were crowds of Teal, many of them flightless, some flightless Black Ducks, and several flightless Mountain Ducks. There were also flightless Black Swans, but the only Pink-ears we saw which were unable to fly were apparently juveniles. We turned back just before we got to the open water of Lake Dumbleyung, and then on the way back we explored a lagoon lying to the south-west of the lake in which there were 20 to 30 Black Swans, and about the same number of Shelducks. Among these was a strange bird with a white head and neck. It was obviously a Shelduck. We wondered if it could be a stray female Paradise Duck from New Zealand or a hybrid with a Burdekin (Radjah Shelduck). We approached under oars and we came eventually to the conclusion that it was a schizochromic Mountain Duck, possibly a very old female in which the white round the eye had spread to the whole head and neck. This raises a rather interesting point. Certain females of other duck species (not necessarily exceptionally old, though usually at least several years old, I believe, unless artificially castrated) assume parts of the drake plumage. But in the Shelducks the female plumage is the brighter—at least in the '*Casarca*' species. This is most marked in the Paradise, in which the female even has an eclipse, but it is evidently true of the Australian, South African, and Ruddy also, in which the first plumage of the young is like the male and the white markings on the head (or the whole head in the Paradise) are acquired later. Now the point is, what would happen to the plumage of a castrated or cockish hen? Would it become like a male or would it develop even more ornate female plumage, even to the extent of an all-white head in the Mountain Duck? It would be interesting to castrate female Mountain and Paradise Ducks and see which happens.

On our return journey to Perth we were to stop at Lake Gundearing which was reputed to have a flock of 300 Pink-ears. At the first part of the lake, or rather an independent pool across which ran a causeway carrying a railway line, we found several hundred ducks, but nearly all Teal with a few Mountain Ducks and a few Black Ducks. On the shores of the main lake, however, we found some Pink-ears, and it was here that a bunch of about a dozen gave us our most interesting view—including some display. This was an upward tilting of the bill which is slightly open. It seems to be to some extent an aggressive affair, or perhaps rather a triumph movement after successful aggression. It

[1] The Freckled Duck (*Stictonetta naevosa*) appears to be the rarest of Australia's ducks. This and the white Australian Pygmy Goose (*Nettapus coromandelianus albipennis*) are the only two Australian ducks which I have still never seen alive.

was performed several times by birds who had successfully displaced another bird from a particular spot on a log on which the whole party was preparing to roost. When their heads were finally tucked away I noticed an extremely superficial resemblance to a sleeping Hawaiian Goose caused by the head pattern. This party of Pink-ears was very wild, like all the other ducks on this lake, and our attempts to get close enough to film them were completely unsuccessful. Thus we had not yet seen Pink-ears close enough to see the pink 'ear'. The characters of colour and plumage which were visible were the black head marking, the striped flanks, the white forehead and a warm buff on the under-tail coverts. Above this is a noticeable white line passing over the base of the tail. In flight as the bird comes towards you the white front is conspicuous; as it goes away, the white trailing edge to the secondaries and the rather narrow white transverse line across the rump. As a Pink-ear flies past, the most noticeable feature of its appearance is the raised head and slightly down-pointing bill. Just before we left we had one last view of some more Pink-ears with which one Shoveler was swimming. The comparison was most interesting. The head and bill were almost exactly the same size, but the body of the Pink-ear was a good deal shorter.

(Griffith, N.S.W.)

Saturday 24 November

We made our way to a place called Gum Crick where Harry (Frith) had a study area marked out with wire-netting fences. We spent a good deal of that day and the next trying to film Pink-ears on this lagoon. It was flood water from the Murrumbidgee River about ten miles away. The floods had come up originally nearly a year ago and had remained fluctuating for many months, with hundreds of ducks—indeed thousands—breeding all over the area. Here there was thick tall grass and other vegetation, hayfield height, round most of the water; frequent trees, most of them eucalypts but some pines, and a lot of the trees dead and standing, grey and barkless, in the water. Many of these trees were hollow, and it was in these that the ducks had been nesting six weeks ago. The bulk of the ducks—perhaps a thousand altogether—were Grey Teal, but there were probably two or three hundred Pink-ears, a few Blacks (one of them a flightless adult), a few Shovelers, a pair of Chestnut Teal, four Wood Duck (Maned Geese), two Musk Ducks and a family of Black Swans.

The following day, *Sunday 25 November*, was bright and sunny but there was a horribly cold wind blowing early in the morning. After breakfast beside Gum Crick we built a humpy, using an axe and some string and cutting branches

Display of Pink-eared Duck

from a neighbouring tree. A plant called roly-poly with adhesive seeds formed the principal cover. Charles and I both sat in the hide. With wet feet and a whistling wind we were perished sitting in the shade of the humpy. At first the Teal and a few Pink-ears only returned to an island about 60 yards away. But later, with Harry and Phil hovering about on the far side of the flood, a small group swam up to less than 20 yards, feeding away at great speed and practically without pause. They are much more rapid feeders, covering much more ground than the Grey Teal. The Pink-ears were aggressive to the Teal and once to a Wood Duck (*Chenonetta jubata*) which was sleeping inoffensively. The moment when the Pink-ears—five of them—swam their closest to our hide was immensely exciting. Charles and I, who had been very cold two minutes before, found we had quite forgotten the discomforts when we were filming. The birds were close for only a very short time, but Charles's 12-in. lens and even my 6-in. should have recorded satisfactory pictures. At last, too, we had positively seen the pink 'ear'—a carmine patch which appears to be hidden frequently by neighbouring feathers, and perhaps only shown by the bird at will.

Nearby was the house of some delightful people called Coppard, who had asked us to lunch. They had hatched some baby Pink-ears under a bantam and this was our first sight of the downy duckling. It was more or less the same colour as a Marbled Teal duckling, and was not at all so different from either Marbled or Cape Teal as I had been led to believe. The eye stripe was rather dark and markedly down-curved. Harry Frith said they were not as heavily marked as the first ones he had seen and described.[1] This brood consisted of five, and they seemed fairly healthy except for one which looked a bit small. (We have heard since from Harry that all five died within the following week.)

CAPE BARREN GOOSE (*Cereopsis novae-hollandiae*)

(Islands of the Furneaux Group in the Bass Strait, Tasmania)

We were staying with Dr D. Serventy on Fisher Island, headquarters for his research on the Mutton Bird (*Short-tailed Shearwater*, P. tenuirostris).

Saturday 1 December

3.30 a.m. . . . It was already almost daylight and there was a weird croaking coming from the burrows. The Shearwaters were making much more noise than they had made in the evening. Later when we got up for breakfast it was sunny

[1] The downy young of this species was unknown to science until collected by H. J. Frith in 1953.

and quite calm. The sea was like glass, a very rare kind of day for the Bass Strait. Charles and I filmed the Cormorant and the pair of Black Oystercatchers.

After breakfast Trooper Lou Bailey brought the police cutter to take us to the islands. She was a fine boat—thirty-seven years old—with a good cabin, a large cockpit, a mainsail bent on the spars but not used, and an auxiliary. We transferred the gear by dinghy and set off at once for the islands to the west.

It was on the westernmost end of Big Dog Island that we saw our first Cape Barren Geese. There were three pairs widely scattered on the rocky shoulders of the island. The pairs stood close together and often on a rocky eminence. They looked huge and majestic and somehow supremely appropriate to their setting. On the next island there were three more pairs, and finally we came to Little Woody Island where we were to land. Here were several geese on the crest of the central ridge watching us. Charles and Phil and I were landed and crept up the island, getting some long shots of geese as we advanced, but they were very spry and mostly moved off to Big Woody Island or to a small reef in between. We found one hatched nest full of down and the pile of droppings where the gander had stood. We saw several other such piles but were not sure if these also indicated nests or were just favourite roosting places.

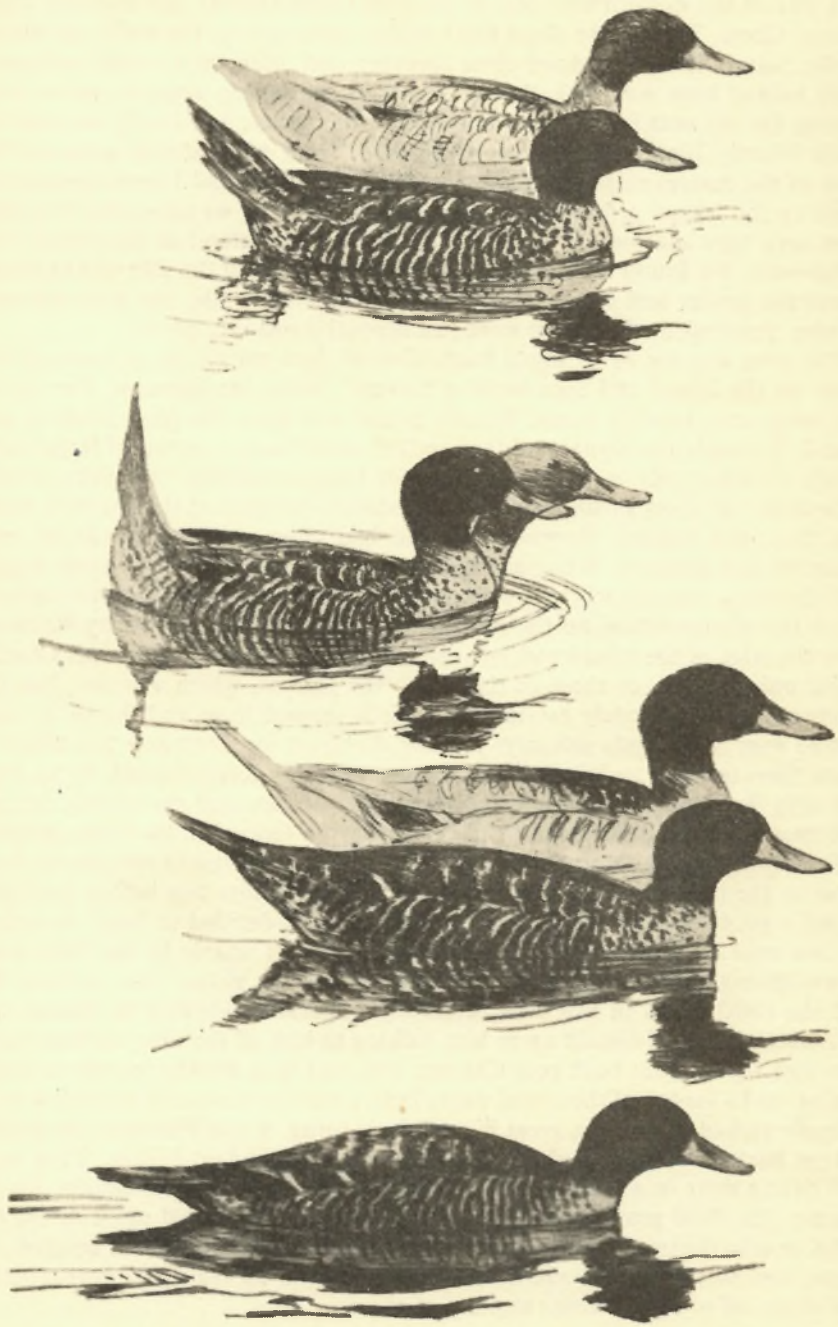
The plan was for us to signal back after we had got all the pictures of the geese on the island and then build a 'humpy'. When we signalled, the rest of the party were to walk round Woody Island and drive the geese back to our island. We made our signal and then settled ourselves in a group of large rocks which provided only moderate facilities for humpy-building. We planted rows of branches of a low shrub, fixed between stones, but were at the end of it much less than well hidden. However, the sun had come out and it was all very beautiful and pleasant. We could see the 'beaters' walking over Woody Island and the geese moving in front of them. Not many came our way until at last, when the accumulation on the reef was disturbed, a flock of nearly 40 swept over the edge of the island and low over our heads. With the 6-in. lens Charles could only get two or three of them into the picture, which was sad, but the moment was enormously exciting. The birds seemed huge and floppy as they passed over with heads sideways looking down on us. They saw too much to allow them to settle and went away, ultimately to Tin Kettle Island. So we were left with the strange grunting calls ringing in our ears and the feeling that we had been properly introduced to the Cape Barren Goose on his home ground. Before building the humpy we had seen a family of five geese running in front of us to the far end of the island. We decided to explore this before leaving. I found a goose skeleton with a perfect skull which I decided to keep. A minute or two later up jumped three full-sized goslings still unable to fly. They went down among some big jumbled rocks just above the shore; two of them hid but the third stood in full view, evidently undecided whether he should run or crouch. I walked almost up to him, talking to him all the time, circled round him and walked him back past Charles, who had been filming the whole thing, and up on to the top of the island where both I and the bird increased speed until I finally picked him up—a great big gander gosling. While Phil held the gander I went back to the place where the other two goslings had hidden. They were still sitting there in a rock pool. I persuaded them both out and caught one—a female. The third gosling had reached the sea before we could catch it. We decided to take the two goslings back to the boat so that they could be banded. . . .

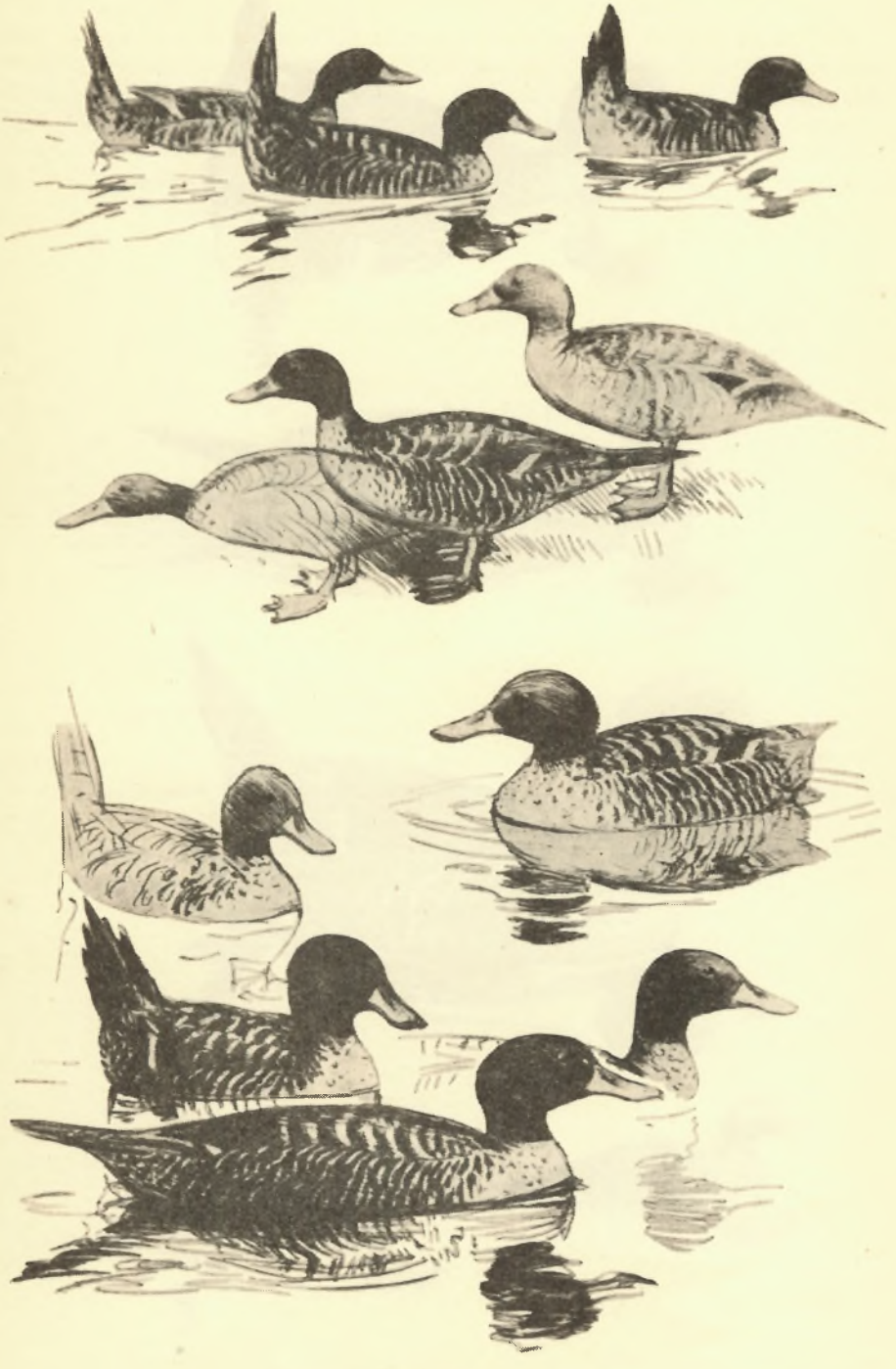
Later, with another gosling which had been caught near the boat, they were released and swam off to their parents waiting off-shore.

SALVADORI'S DUCK (*Anas waigiuensis*)

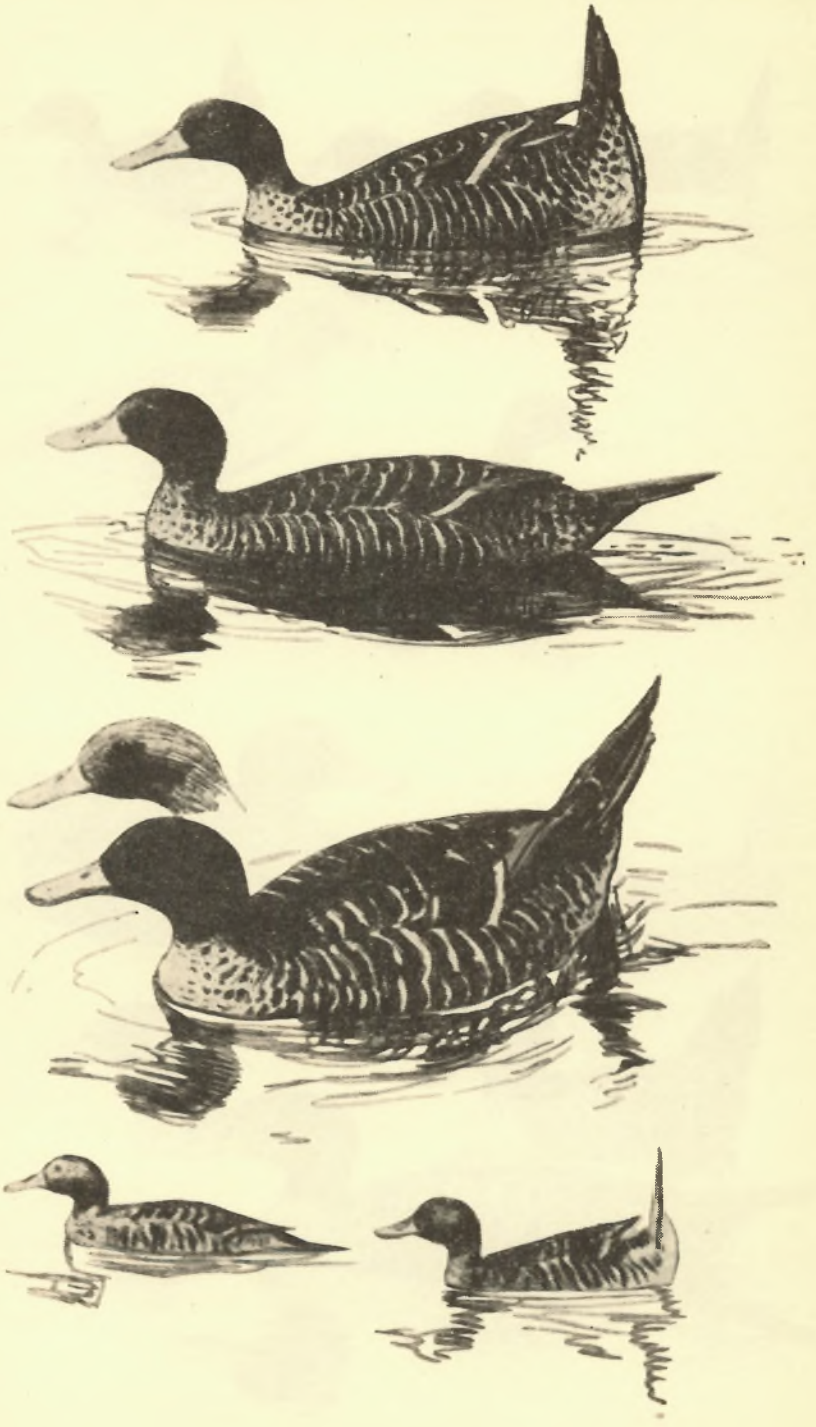
(New Guinea)

We saw Salvadori's Duck in the zoo belonging to Sir Edward Hallstrom and kept by Fred Shaw Mayer at Nondugl, in the valley of the Wahgi River in Central New Guinea.





Salvadori's Duck (*Anas waigiuensis*)



Friday 14 December

The zoo, or should it better be called a sanctuary, covers ten acres. It consists of three ponds formed by dams across a shallow cleft. Around these are lawns and flower-beds and flowering shrubs and bamboos, and dotted about are eight or nine aviaries, beautifully planted up and somehow fitting most appropriately into the whole landscape. The collection consists of about 200 Birds of Paradise, some Bower Birds, Parrots, 3 Cassowaries and 20 Salvadori's Ducks, and a dozen or more Tree Kangaroos of three different kinds.

It was not unnatural perhaps that we could hardly wait to see the Salvadori's Ducks—Fred took us into the enclosure round the top pond and there at once was a pair of them about 15 yards away, at the edge of some sedges. The bird was more striking than I had expected. The yellowish flesh-coloured bill with no black tip was prominent and there was quite a sharp dividing line between the dark-brown head and the pale pinky-yellow ground colour of the spotted breast. The barring of back and flanks however was less precise and neat than I had painted in my illustrations for *The Waterfowl of the World.* Nevertheless it was quite a handsome bird. More surprising were its movements. It swam with a rapid jerky backwards-and-forwards movement of the head, caused apparently by nervousness or watchfulness, and the tail—which is very long—was carried at times almost vertically. After a while we saw the display. It was the only true courtship display behaviour we saw, though later we saw 'dashing and diving'. The male's head is stretched up and moved only slightly, in unison with a whistle. The whole of this is reminiscent of the Shelducks. The female meanwhile pumps her head up and down violently, emitting a series of croaking barks which are clearly analogous to the Mallard's quack.

In the next few days we had ample opportunity to become familiar with the bird. In feeding it frequently up-ended like any other dabbling duck, but it dived more readily and went under from a low-in-the-water posture, without making a ripple. It is obviously a very accomplished diver. It is also of skulking habit and largely nocturnal, as Fred told us of various occasions when he had seen them about the pens at night. Later I had a chance to handle three live birds, two males and a female. The female's head was much paler on the crown and forehead and more streaked. The wings are quite short but the speculum is very well marked, though the green is only on the inner half. The line of the white tips of the secondaries is extended to the tips of the inner primaries.

From all that we saw of the bird I have no doubt that it is a dabbling duck and should correctly be in the tribe Anatini, though whether it should be in the genus *Anas* is more doubtful. It is certainly not just another teal like the Cape Teal or Chile Teal. It is quite highly specialised for living in mountain streams, and the long tail and the jerky head movements are reminiscent of *Merganetta* (Torrent Ducks). The eye is rather farther forward than in most dabbling ducks, suggesting the requirement for increased binocular vision in order to catch living prey. Fred thinks that tadpoles form the basis of their diet in the wild state. He feeds tadpoles to his during most of the year, but in the wet season when they are harder to get he augments this with meat, sometimes tripe.

We failed to find any of these ducks in the wild state although we searched a high mountain stream and the slower waters of the Wahgi River. Time did not permit us to visit some mountain lakes to the north, where they were perhaps feeding at this time of the year (the wet season) when the streams are fast rushing torrents.

BLUE or MOUNTAIN DUCK (*Hymenolaimus malacorhynchos*)

(Lake Orbell, Takahe Valley, South Island, New Zealand)

The first Blue Ducks I saw were a family party in the Takahe Valley. We had just been searching in the pouring rain for the Takahe and were on our way back to the small hut for some sandwiches.

Sunday 30 December

Suddenly we came to the river and there was a family party of Blue Ducks. It was very sudden and unexpected and to me *very* exciting. I could see at once

Blue Duck

that there were four or five birds at least and the nearest were about 25 yards away. We afterwards found that there were five well-grown young, fully feathered, with their parents. The only differences in the young were that their bills were blue-grey instead of whitish-flesh colour, and their breasts were not spotted with chestnut colour as in the adults. They were also, of course, a trifle smaller. The drake sat on a rock in mid-stream and the duck was on the shore with the young making nervous head movements surprisingly reminiscent of both Torrent Ducks and Salvadori's. I managed to take a lot of film of the drake, getting as close to him as 30 feet. The bill was pinker, less yellow than I had expected in the adults. The tail was long but not quite so prominent as in Salvadori's or Torrent Ducks; the yellow eye was sharply contrasted with the blue-grey plumage. Although none of the birds flew, I noticed that both parents had full-length primaries at a time when one might have expected them to be flightless. The complete lack of speculum is a most puzzling feature. I heard the call which is a loud, rather rasping, whistle—not unlike a Wigeon drake—and which gives the bird its Maori name Whio, pronounced Few; there is also a croak which the male made frequently when I was at my closest. It would scarcely have been possible to imagine a more confiding or co-operative group of wild birds than these seven Blue Ducks.

(Near Owhena (pronounced Ofenner) on the Ruatahunga River, North Island)

Wednesday 9 January

One of the best days we have had in New Zealand. We set off at 9.30 by car 5 or 6 miles up the valley of the Waitahaia, past a junction above which the river changes its name to Ruatahunga, to the last station. Here a cavalcade of 14 horses had been assembled, one a pack-horse for the camera gear.

We started down the steep slope from the farm leading the horses. It must have been at least 1000 feet down to the river, perhaps more. There was a rough path which in places went down incredibly steeply, and frequently went along the edges of near-vertical hill faces. One had to put much faith in the sure-footedness of the animals, but it was not misplaced. We came to the river near a junction, and from here up-stream it was expected that we should find Blue Ducks. Instead we found at once a single Grey Duck in this unusual setting. It flew down the valley, then turned and went up it again out of sight. We crossed the river and rode up the far side. As we rode up the steep valley I heard ahead the call of a drake Paradise Duck above the noise of the river. I was rather pleased with this identification, which was doubted by all around me until the bird flew up from the slope ahead. Later he was joined by the female and they flew up and down the narrow valley. It was a most exciting and romantic setting for the birds. But as we rode on we began to doubt whether we were in fact going to find any Blue Ducks. We came at last to another river junction, and here Fred Maxwell (our host at Owhena, who had ridden ahead to locate the birds for us) met us with the news that he had been several miles up the main river without seeing a sign of a Blue Duck. We should stop here and brew up tea while he and Jim Douglas went up the little side stream on foot.

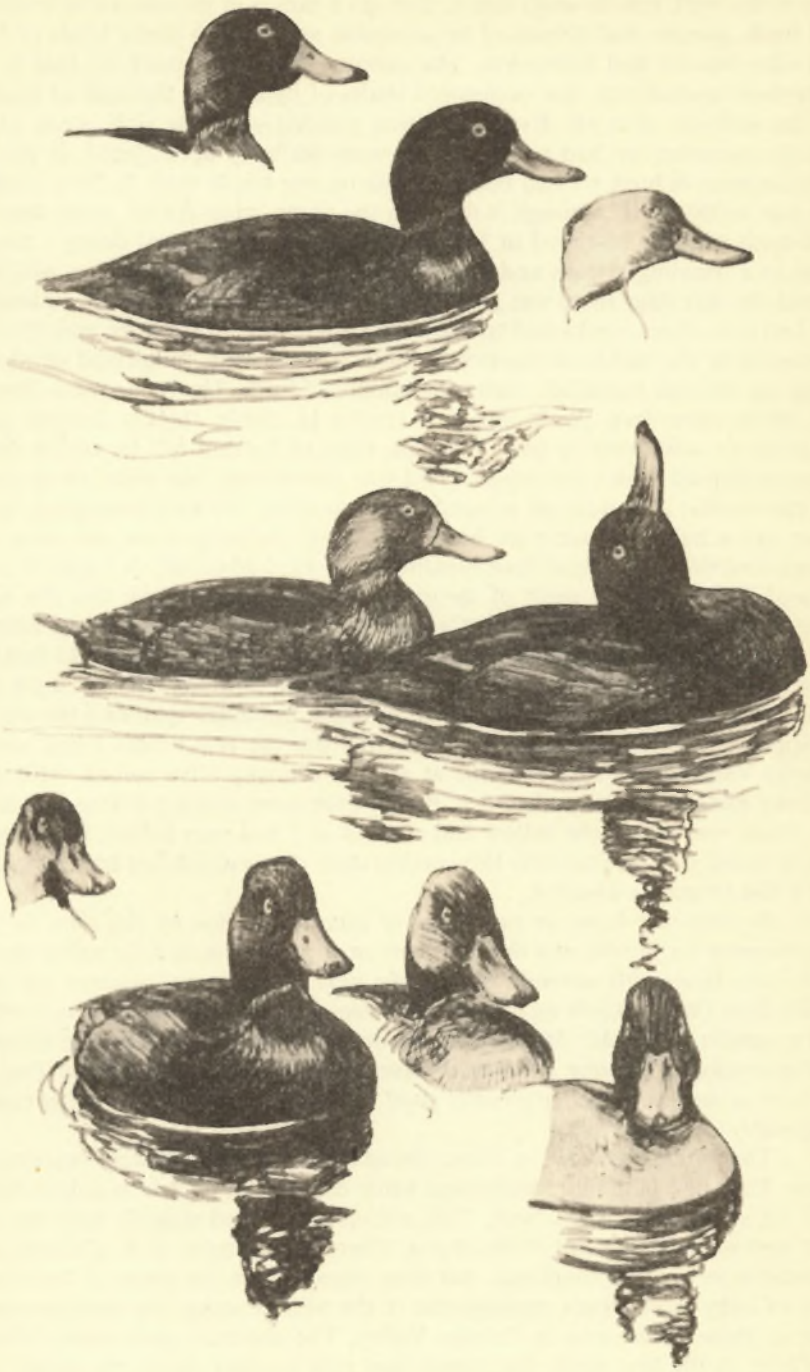
As we finished our meal Fred reappeared and walked down, leaving his horse tethered at the junction, which was a good omen, and when he reached us he told us of finding a single Blue Duck about two-thirds of a mile up the little brook—locally a creek! This we afterwards found was an underestimate. We immediately decided to go up, taking cameras and tape recorder. The first

Blue Duck (*Hymenolaimus malacorhynchos*)

part of the walk was through forest, through a tangle of moss-covered branches and bush, mosses and lichens of innumerable species and many kinds of ferns and club mosses and liverworts. The canopy above was thick so that it was quite dark underneath, but occasional shafts of light came through to illuminate the softness of it all. Everything was padded with the rich green plants and the branches we had to climb over were perfectly upholstered. It was the most impressive bush we had been through on our whole tour. In New Zealand it is just called 'bush', though it deserves the name 'moss forest' more than the high bush which is so-called in New Guinea. Then we plunged down a tangled bank to a trickling stream and down it until it joined our brook, up which we turned. At this stage there was nothing for it but to abandon all hope of keeping our feet dry; shoes, socks and trousers were immersed to the knee and above as we waded up the middle of the stream itself. It was a long, tough and wearisome climb up through waterfalls under the tangles of bush. The rocks were slippery, and there were deep pools, big tree trunks to climb, thickly knitted fallen branches to walk over or push through, piles of flotsam left by earlier floods which collapsed under our weight. Phil was marvellous. She went up as fast as the rest so that they were all amazed at her stamina. We had been going for an hour and a half (and were six hours out from Owhena) when we came to a recent landslide which had been mentioned by Fred Maxwell. A hundred yards beyond it was a small cairn of stones, and immediately above this the single Blue Duck was said to be. Roy Cavanagh came back to say he had heard it whistle. We advanced cautiously and suddenly there it was, within 15 feet, but very nervous and moving quite rapidly up-stream. It eventually sat on a rock about 20 yards away, but half hidden by fallen branches spanning the stream. In appearance it was remarkably different from the two adults I had seen in Takahe Valley. It was hardly blue at all, but a dusky olive colour, with quite a strong metallic green on the back. Perhaps the most striking difference was the iris which was not bright yellow and startled as I had seen before, but a dusky, almost hazel yellow. Evidently this was the dark phase which has been described, but I had forgotten about it. . . .

On the long ride home we saw a pair of Blue Ducks, but by this time the light was too poor for filming and the party was so strung out across the valley that the birds were thoroughly nervous. And so the next day a second attempt was made to film Blue Ducks. Again we rode out on horses, but this time direct from Owhena, and a smaller party. Mr Maxwell's assistant had been out since before dawn and had succeeded in locating a family of Blue Ducks, so that after another long ride we were at last able to have a really good view of these birds in good light and at reasonably close quarters.

. . . The young were still in down, though the first feathers were beginning to show. They had blue bills, prominent white cheeks and a curious golden-brown spot on either side of the back. This colour contrasted sharply with the dark grey and white of the rest of the down. There was a vague look of Carolina or Mandarin in the face markings, but also, especially in the shape of the head, a look of baby Goldeneyes, perhaps due to the white cheeks. The parents were as blue as those I had seen in Takahe Valley. The chestnut spots were different, however, in the two birds; the female had pale orangey spots; the male's were more maroon, almost chocolate. As before, the female was more nervy than the male, but they settled down well in various different pools—and we got some excellent film.



NEW ZEALAND SCAUP (*Aythya novae-zeelandiae*)
(*In New Zealand the Scaup is known as the Black Teal*)
(Hamurana, Rotorua)

Friday 11 January

. . . We were taken to the mouth of a beautiful clear river which is part of the grounds of a holiday hotel. It is called Hamurana and it is very imaginatively laid out. The river is about 20 yards wide, crystal clear and smoothly flowing with beds of brilliant green weed. On it were groups of Black Teal and a few Grey Ducks, one with a brood. There were also some Pukeko (the swamp hen —Blue Gallinule).

On a stretch of 50 yards of river on which there were also boats we saw perhaps 25 little Scaup. In one place, though alas in the shade, a group of them was displaying. This display and the call which went with it were extremely like the display and the call of the Redhead, and quite unlike anything done by Tufted Ducks. The head was thrown over the back, though not so far as in the Canvasback, and when the call—a soft whirring whistle—was made by the drake, his chin was enlarged—a thing which I noticed in the Australian White-eye and which is so typical of Redhead and Pochard. Just as the Ringneck is not so close to the Tufted as might be supposed, so I believe the New Zealand Black Teal is not very close either. How strange it is that characters of this kind seem to be interlaced among the species, suggesting affinities between those which at first sight do not appear to be closely related, and showing new differences between those that do.

Brown Duck habitat

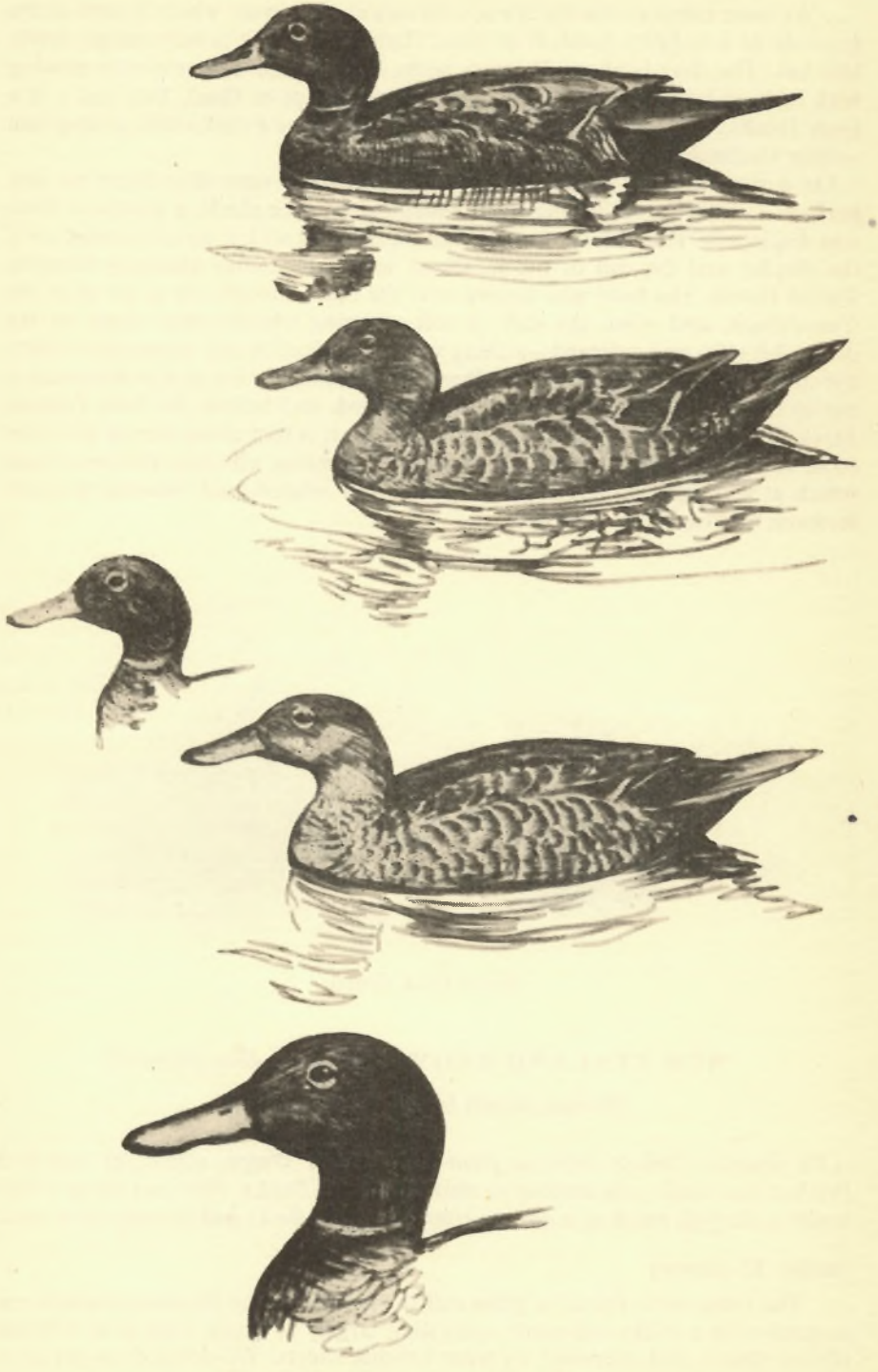
NEW ZEALAND BROWN DUCK (*Anas chlorotis*)

(Waipu, North Island, New Zealand)

Dr Graham Turbott drove us from Auckland to Waipu, where Mr and Mrs Prickett had made preparations to show us Brown Ducks. They had set up a hide beside a sluggish reach of a narrow river where the ducks had recently been seen.

Sunday 13 January

. . . The fields were full of a grass called Paspallum, the flowers of which are covered with a sticky substance consisting largely of ergot. This is so bad for clothes that it was necessary to wear bathing shorts. We decided to put up a second hide, at the next corner down-stream, and then for some of the party



New Zealand Brown Duck (*Anas chlorotis*)

to try to drive Brown Ducks up towards us. Four of them had recently been seen down there. But they are crepuscular or nocturnal creatures and much given to hiding in the rushes or overhanging bushes by day, so that when Charles Lagus and I had been there for nearly an hour the drivers—including Phil—arrived, having seen nothing. So it was a case of 'up sticks' and away to a place called, I think, Ryans, where a pair of Brown Ducks had been seen sitting on a willow branch beside a bridge two days before. This seemed a pretty long shot, but twenty minutes later Phil and I were tip-toeing up to the bridge with Prickett just behind. Nothing was in view, but suddenly ripples came from under a thick tangle of willow scrub on the far bank. Surely it would be a Pukeko, but no! Out swam two little Brown Ducks. They were exactly the same and, though no doubt a pair, I could see nothing in plumage to distinguish the sexes. The male, judged on behaviour and slightly larger size, had a split upper mandible at the tip. Almost at once the pair disappeared into cover again. They were only 10 yards away and made no attempt to fly. Prickett went quickly above them and they turned down and went under the bridge. Then Charles arrived with his camera. There was much to-ing and fro-ing before the little ducks were finally held in a state of equilibrium in a patch of willows on a little island. Charles and I then fixed up our cameras overlooking a small patch of sunlight, and Phil most skilfully manoeuvred the birds into it and took stills of them at the same time. After half an hour they came to tell us that five birds had been located a little farther down-stream. The river was very thickly grown with willows and we walked in the brilliant evening sunshine through a hay-field newly cut. Almost at once I caught a glimpse of a pair, but it was far too fleeting and too dark for photography. Stationed in the centre of a sharp bend in the river under the dark trees we waited, and in due course five Brown Ducks appeared. These were far more nervous than the first pair, and fairly useless for photography, though I shot a little film. The most important thing was that one of the males was in fairly bright colour, and a slanting white line on the sides of the tail forward of the black undertail-coverts was quite conspicuous. On the way back across the paddock Charles took some shots to establish the habitat. Then we piled into the cars, fairly well satisfied. As we drove back to town we passed over a river bridge not a quarter of a mile from our hotel. Here the earlier cars had stopped, and at once we saw the reason. Out on the open river swam three Brown Ducks. To be sure, they went off down-stream when the crowd spewed out of the various cars, but Sibson, who had joined us, went down one side and Cavanagh went down the other. We saw a brief aggressive rush by the brightly coloured male against the third bird, which thereafter disappeared. The pair, however, swam back up-stream. I filmed them, and then when Charles got out the 12-in. lens I crossed to the far bank to move them out into what was left of the setting sunlight. They were under a bush, and I walked right up to it and could see them looking up at me with apparent nonchalance. There was an old landing-net lying on the bank and I picked it up to persuade them to swim out. I could quite easily have caught at least one had I been so minded.

As it was they swam quietly out and I had a grand view of them. The male's head was very dark with a green sheen, but what interested me most was a sharply defined jet-black area on the back of the head, just where it is black in the drake Pintail. The whitish neck-ring (narrower than in the Mallard) is turned up at the back to what seems to be the beginning of a Pintail's white vertical neck-streak. The bird looked in shape surprisingly like a Kerguelen Pintail. Suddenly I felt that this was not at all the degenerate Mallard which we

had supposed it to be, but a bird with many Pintail characters. Thinking about it afterwards, I am convinced that this is still very near to 'the original duck'—that is to say that it is descended, and perhaps not very much altered by selective pressure, from a basic *Anas* which was common ancestor to Mallard and Pintail. This seemed to me to be a moment of truth, and perhaps one of the most valuable conclusions to be drawn from the whole of the tour. To me, what is most fascinating about the study of evolution is to be able, by looking at a branch, to judge just how high up the trunk it branched off in those far-away times. So the Brown Duck is a primitive and not a degenerate. The Chestnut Teal has varied more, no doubt under heavier selective pressure in Australia.

So we filmed the pair of Brown Duck in the evening light and found that they had kept an excellent dinner for us at the hotel.

NE-NE IN HAWAII

Preliminary Report on the Ne-ne in Hawaii

by William H. Elder

Dr Elder, who is Professor of Zoology at the University of Missouri, has just completed a year's survey of the Ne-ne in Hawaii. His past contributions to this Report (7th Annual Report, *pp. 123–132*) *followed a season during which he accompanied the rocket-netting team to Scotland and Northern England, and worked for a period at Slimbridge.*

JUST eight years ago the world's population of the Ne-ne had reached an all-time low. But thirteen birds remained in all the aviaries of the world—all in the Hawaiian Islands. Except two lone birds, all were in the flock of Herbert C. Shipman, long their protector. Little was known of their status in the wild. That they were scarce, all agreed. In the five years since Paul Baldwin's (1945) study, Ne-ne had been seen less than half a dozen times. The Schwartzes (1949) had failed to find any birds in the wild during their two years of intensive field work in the islands. Smith (1952) estimated their numbers in the wild as less than 30.

Since then two significant events occurred in the Ne-ne world. One morning in July 1955, 24 birds passed an observation-point manned by Big Island biologist, Dave Woodside (1956). Did this indicate a real increase or a seasonal concentration of all the remaining birds? No one knew. Secondly, captive birds were supplied through the generosity of Herbert Shipman to start the Board of Forestry and Agriculture's Ne-ne farm at Pohakuloa and to the Wildfowl Trust. Now their aggregate numbers exceed those of birds remaining in the wild (Table I).

TABLE I

Ne-ne known to be alive 1 September 1957

In Hawaii	
In the wild	at least 35
Honolulu Zoo	2
Mr Shipman's ranch at Ainahou ..	9
Pohakuloa project	34
Outside Hawaii	
Wildfowl Trust, England	40
Leckford, England	3
Clères, France	2
Rotterdam, Holland	2
Litchfield, Conn., U.S.A.	2
Total	129

Thus, it was hoped that a restocking programme could soon be started to repopulate some of the former range of the Ne-ne on the island of Hawaii.

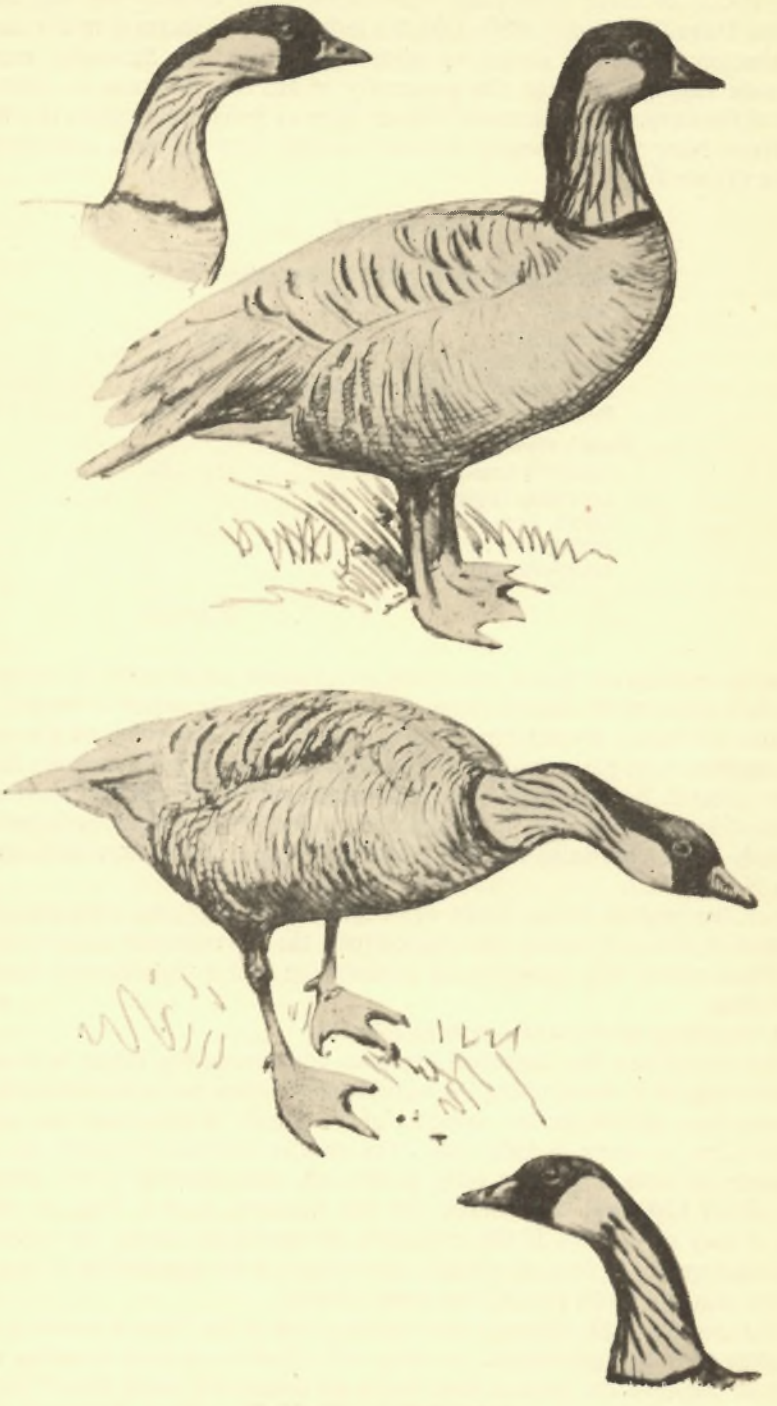
Success of such a project hinges upon a better understanding of the causes of the decline of the Ne-ne and knowledge by which the current mortality factors can be reduced. For any species to survive, the rate of production must equal the rate of losses, or *natality* must equal *mortality*. If the balance is tipped ever so slightly, so that mortality exceeds, a species declines. This is what has happened to the Ne-ne.

Hence the present Ne-ne study was begun under the joint auspices of the Hawaiian Board of Forestry and Agriculture, the International Committee for Bird Preservation, the Guggenheim Foundation and a Yale-Bishop Museum Fellowship.

The objectives of the study were as follows:

1. To re-examine the historical evidence concerning the Ne-ne in a search for clues helpful in interpreting the significance of changes in land-use patterns that may have altered the life equation of the species. If Henshaw was entirely correct when he wrote in 1902 that: 'The greater number, probably all, leave the upper grounds beginning early in the fall, and resort to lower altitudes, from about 1200 feet downwards' for the breeding season, then we should know if they still do so. If the expansion of cane-fields nearly up to the fern forest has forced the Ne-ne to remain above this belt for the nesting season, it is possible that the bird's fertility has been affected.

2. To discover what changes have taken place in the former breeding areas not taken over by agriculture. Are they still suitable, or have invading exotic plants so changed the habitat that Ne-ne no longer will come there? Such an area was recently visited with Mr William Meinecke in Kau. Where he found young Ne-ne in open country at the turn of the century, there is now little but



Ne-Ne (*Branta sandvicensis*)

brushland grown up to the exotic plants Lantana, Christmas berry and Apple of Sodom.

3. To discern, if possible, the seasonal food limitations of the summer ranges —5000 to 7500 feet—during the breeding season and ensuing winter period. If birds are now forced to stay higher than formerly, are they subject to impoverished diets or are there plenty of foods for them to shift to after the end of the berry season?

4. To learn the significance of standing water for Ne-ne. This species, sometimes called 'lava goose', certainly frequents dry habitats by choice through much of the year. Is open water, even in small pools, essential for the breeding season? Some species of geese in captivity lay only sterile eggs when no pool is available in which they can mate.

5. To appraise the role of predators as a limiting factor upon the Ne-ne. When pueo and io were once abundant, so were Ne-ne; so the native Hawaiian predators, the owl and the hawk, cannot be implicated in any way in the decline of the goose. One even wonders if the introduced predators of such long standing as the rats and pigs could have been of great importance. But the spread of the mongoose is more closely timed with the period of rapid Ne-ne decline. And feral cats and dogs surely increased with the rise in human populations. Perhaps no one of these alone can ever be said to be the limiting factor; but all may have contributed.

6. The last objective of this current Ne-ne study was to learn some of the details of their behavior for comparison with detailed studies that have been made of the pairing, nesting, incubating and brooding activities of the Canada Goose—most likely the nearest of kin to Ne-ne. This may shed new light on the origin of the island species, so long isolated from its mainland progenitors. We may also learn whether hand-reared birds should be liberated in pairs or as families when the time comes to release captive-reared stock in the wild.

Nearly all Ne-ne sightings in the past decade have been on Mauna Loa, Mauna Kea and Hualalai. These mountain slopes between 5000 and 8000 feet are sparsely vegetated with gnarled open-grown koas, stunted ohia trees and such fruit-bearing shrubs as pukeawe, ohelo and the creeping kukainene with its beautiful glistening black berries. All these, along with the unique golden, native strawberry, provide food for the Ne-ne. But their preference, we found, is for greens, especially the succulent leaves, stems and buds of two native yellow flowers: pualele (*Sonchus oleraceus*) and gosmore (*Hypochaeris radicata*). To these the Ne-ne adds seeds stripped from the heads of grasses and sedges. His water comes from fog drip, the dew which forms on all vegetation and hangs from it nearly every afternoon in this particular band around the mountains.

It was here that my first few months in the islands were spent, looking, listening, hoping for signs of these rare and elusive birds. Five thousand miles by jeep, days on horse and mule, and seemingly endless miles on foot over vast, rough lava fields of jagged aa' (and a new pair of boots every month), finally paid off. With Territorial Biologist, Dave Woodside, we not only found the first nest of a Ne-ne seen for many years but were able to get what we believe are the first photos ever made of a wild Ne-ne nest with eggs and of babies not a day old.

News of the find was withheld for many weeks to protect the young from disturbance by sightseers or others who might be accompanied by dogs. The

nest came to naught, for the single gosling that hatched vanished the next day. I trapped a mongoose just twenty feet away.

Within the next few weeks we found five more Ne-ne pairs within a mile of the nest and each with a brood of downy young (Table II). Each day a hundred hazardous pitfalls must have been negotiated as they scrambled over the loose lava until their feet—larger proportionately than those of Canada Geese and only half webbed—grew tough and their legs strong. Only then, when five weeks of age, did their feathers begin to show above the long, fuzzy grey down that covered their fast-growing bodies. Not until another seven weeks had passed and the young had reached the age of three months were their wing feathers fully hardened so they could fly.

TABLE II

Ne-ne families observed in the wild on Mauna Loa, 1957

1	pair	with	..	..	..	0	young
1	„	„	..	..	..	1	„
2	„	„	..	..	..	2	„
1	„	„	..	..	..	3	„
1	„	„	..	..	..	4	„
	Total young reared in the wild					10	

Geese that raise their young in the far north see them grow twice as fast, and thus escape the hazards of ground-running predators in half the time. But the Ne-ne can't match them because days are so much shorter in the tropics than in Canada or Iceland. Then, too, the Ne-ne nests in November, December and January, when days are shorter than at any other time of the year. This means many fewer hours in which to find food—no wonder the Hawaiian Goose grows at half the rate of his northern cousins!

How this reversal in nesting season came about is one of the great mysteries still to be solved. Ignorance of this fact of winter-time nesting contributed heavily to the decline of the species, for the hunting season was set in mid-winter, just as it was in North America, thus legalising the shooting of helpless young and flightless parents. (Like other members of the family of ducks, geese and swans, Ne-ne lose all large wing feathers at one time and are grounded until new ones grow.) No wonder the largest and finest of Hawaiian land birds nearly vanished from the earth before restoration measures were started.

As the year's study comes to an end, some preliminary conclusions become clear:

1. No longer does the Ne-ne nest at low elevations. What land is unsuitable for sugar-cane is now in close-cropped pasture or grown up in a tangle of exotic shrubs and vines. But there is little evidence that these lower altitudes were ever abundantly used for nesting.

2. At altitudes now frequented by Ne-ne, 5000 to 8000 feet, there is no evidence of food shortage at any season. Grasses and other greens, making up most of their diet, are never scarce in this zone of nearly daily rain and fog-drip, and frosts are very infrequent.

3. This moisture on all vegetation precludes the possibility of any shortage in drinking water. Despite the fact that copulation among captives has frequently been observed on land, Ne-ne do seek ponds and water-tanks at the onset of the breeding season—perhaps they prefer to perform the precopulatory display in the water.

4. Mongooses and dogs are probably the most significant predators, but the innate tameness and curiosity of the Ne-ne make them extremely vulnerable to poaching and very dubious as a game or sporting species.

It is a universal human weakness that we fail to cherish a thing of beauty until it is taken from us. Many a lovely flower is nurtured with greatest care far from its normal habitat, yet ignored at home merely because it is common. Thus few men thought about the Ne-ne or its future while thousands still roamed the slopes in Kau, Kona and Kohala. But today every effort is being made to rescue this native Hawaiian species from the brink of eternity.

In the past year many important administrative steps have been taken by the Board of Forestry and Agriculture. As soon as our findings were made available, the summering grounds of the birds were closed to all hunters for six months of each year. A co-operative agreement has been made with C. Brewer and Co., lessees of the ranch known as Keauhou. The upper end of this ranch contains the nesting area, where we found the six pairs that bred last year in the wild. This nesting area is to be posted, patrolled and the predators poisoned. And at the last meeting of the Territorial Legislature, the Ne-ne was declared the official bird of the islands. Thus the people of Hawaii have voluntarily taken on a new obligation for its perpetuation.

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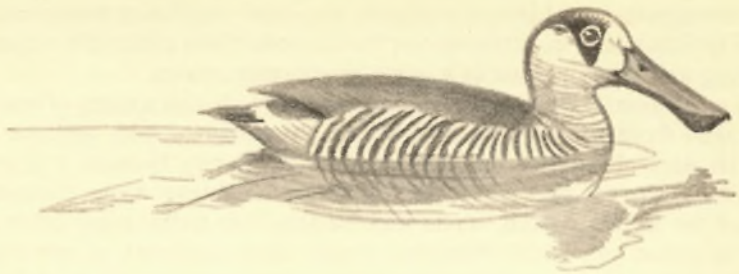

THE NESTING OF THE PINK-EARED DUCK

by John Warham

SUMMARY

1. An account is given of the nesting of the Pink-eared Duck (*Malacorhynchus membranaceus*) in a swamp at Moora, Western Australia, during 1956.

2. Nests were in holes or crotches in trees and lined solely with down, which is unusually oily, clings to itself and appears to be a most efficient insulator.

3. Both sexes swim to the nesting site at the beginning of an incubation spell, but it is unknown whether both incubate.

4. The birds perch readily and climb sloping limbs without difficulty.

5. Adults use three calls: a disyllabic whistle serves as a flight note and alarm; a rattling cry is associated with success after territorial disputes; a soft purring note used on approaching the nest and at the time of hatching probably serves as an integration note once the chicks are on the water.

6. Distress and contentment notes are given by the newly hatched chick.

7. After hatching, the young are induced to descend by the calls of both parent birds circling in the water below the nest site.

8. During inter- and intra-specific threat displays neck and head are stretched along the surface towards the antagonist and the beak opened and closed. The presumed female is very aggressive at the time of hatching.

ACKNOWLEDGMENTS

I am grateful to Mr P. T. Sandland of Burrabidgy, near Moora, for introducing me to the breeding-grounds of this species of duck, and to Mr and Mrs Cook of Lake View, Moora, both for ready access to their property and for other favours received during my stay there.

The Pink-eared Duck is one of the most peculiar of the Anatidae and one whose relationships to other ducks are still somewhat obscure. Only scattered references to the bird occur in the literature, the most recent observations on its general behaviour and nesting being those of H. J. Frith, incorporated in Vol. II of Delacour's *The Waterfowl of the World* (1956).

Malacorhynchus membranaceus is a smaller and rather handsome teal-like duck with brown wings and back and fine bars of creamy-white and blackish on underparts, flanks and throat; a dark brown triangle encloses the eye behind which lies a small patch of pink feathers justifying the vernacular name. The bill is very long, spatulate, and the edges of the upper mandible extend down-

wards as a curtain of skin which broadens towards the tip to form a membraneous flap. The sexes are alike. In contrast to young Shovelers, Pink-eared ducklings also possess spatulate bills with their attendant curtains. Food of both adults and young is believed to be wholly of an animal nature.

In Western Australia the bird is commonest in inland salt lakes, where estherids and allied animals are abundant, and it appears to favour warm, shallow waters rather than deep ones. In the south of the state nesting takes place from August to November, the birds often being rather late breeders, but in the tropical Kimberley Division they apparently nest in and during the summer wet season. According to Shilling (1948), they are numerous in the Liveringa swamps in the wet, and young birds were seen there in April 1947.

The Pink-ear is tamer than most Australian ducks, and Campbell (1900) refers to a pair in Victoria that attacked a man on horseback by diving at his head!

The present observations were made on the property of Mr G. Cook of Moora during November 1956, observation hides being sited in a swamp overlooking two of the three occupied nests discovered there. The birds were quite tame and readily accepted hides erected gradually over several days, so that close observations were supplemented by a good series of photographs in black and white and in colour. Unfortunately the study period coincided with a run of heavy thunderstorms which broke on three consecutive afternoons, and these hindered observations since it was necessary to leave the hides beforehand in order to ensure that eggs or young were not unattended during the subsequent downpours.

THE BREEDING GROUND

The Moora swamps consist of a group of shallow, saline lakes that are generally filled by winter rains falling between May and August. These lakes lie in the coastal plain of Western Australia and are about fifty miles from the sea. Some of them are interconnected after good rains, but by the end of the summer many have dried out completely. Several have no surrounding cover, being edged only with a few dead trees; but Marada swamp, where the present observations were made, is fringed with thickets of tall *Kunzia* trees and tangles of 'bottlebrushes' (*Leptospermum*), while in the water grow numerous paper-barks (*Melaleuca*) and a few casuarinas, some of which grow to a height of about 50 feet.

In November 1956 this lake was approximately circular, about 400 yards in diameter and about 4½ feet deep towards the centre. Although the bottom was covered with a layer of mud from 2 to 4 inches deep, wading was easy. Vegetation in the water was very limited and consisted mostly of a growth of green algae. There were no reeds, lilies or similar plants. Great quantities of small Cladocerans were seen in the water and these were believed to form the principal food of the Pink-eared Ducks at the time.

Coot (*Fulica atra*) were by far the most abundant birds here, and there were upwards of 50 nests of this species dotted about the shallows or on snags in deeper water. Breeding had nearly ended for them, only two nests being seen with eggs, but their young were being fed everywhere. While paddling quietly around in a rubber dinghy, we would see groups of two or three Pink-eared Ducks and these would allow close approach. Such birds were probably nesting, whereas flocks of up to 400 duck present, many of which were Pink-ears,

were doubtless there simply to rest and feed, and, in contrast to the smaller groups, these left the lake completely if flushed.

A Whistling Eagle (*Haliastur sphenurus*) was nesting high in a paper-bark, Grey Teal (*Anas gibberifrons*) and Black Duck (*Anas superciliosa*) came in to feed, as did occasional Straw-necked Ibis (*Threskiornis spinicollis*), White-faced Herons (*Notophoyx novae-hollandiae*) and many Black-winged Stilts (*Himantopus himantopus*). A few Little Grebes (*Podiceps novae-hollandiae*) were present and several Black Swans (*Cygnus atratus*) had nested; in one of the latter's homes was the remains of a Grey Teal's nest. The only duck currently discovered with eggs, however, were the Pink-ears.

THE NEST

When nesting, the Pink-eared Duck lines a hole in a tree or the empty nest of some other swamp bird with a copious mat of down. In the Moora swamps Coots' nests are commonly used, but C. L. Orton found one using the nest of a White-faced Heron 20 feet up in a tea-tree (Serventy and Whittell 1948), and elsewhere in Australia nests of the Straw-necked Ibis, Black-tailed Native Hen (*Tribonyx ventralis*) and Little Pied Cormorant (*Phalacrocorax melanoleucos*) are used.

A systematic search on 22 November revealed three occupied nests of Pink-eared Duck. Nest A (clutch 7) was inside a hole in a big Casuarina about 5 feet from the water; Nest B (c. 7) was within a similar hole in a paper-bark some 6 feet from the surface; and Nest C (c. 6) was about 50 yards from A and in the crotch of a paper-bark at 4 feet above water-level. None of the eggs—small, creamy-white, somewhat stained and rather glossy—showed any sign of hatching, and in each nest a thick wad of down completely covered the clutch.

Only at the third nest did I glimpse the departure of the sitting bird, although it must have flown on my first entering the water when I passed quite close. This bird must have returned while I was still visible but at the far side of the swamp. None of the sitting birds ever attempted any form of distraction display; the normal procedure when disturbed was for the bird to fly towards its mate and for both to swim leisurely away, to rest on the water at a safe distance until all was quiet once more.

That each of these tree-trunk nests was occupied was indicated by wisps of down adhering to the bark around the hole, and at nests A and B the warmth of the hole indicated immediately whether the bird had been sitting recently; it was quite unnecessary to touch the eggs. This down, which is medium grey-brown with light grey centres, adheres readily to any rough surface; it has an unusually 'tacky' feel. Although the presence of down outside a nest might be thought disadvantageous, at an open site the sticky down clings so well to itself that it forms a springy blanket completely enclosing the eggs, and even in strong winds shows no tendency to blow away. Being so light, adherent and air-trapping, it must act as a very efficient insulator. The first nest of this species found was on top of an old Coot's home; I was quite sure that there must be eggs underneath on account of the way in which the down was piled high, but the nest was empty. The eggs had hatched some time before, but the down had retained its shape despite the open situation in which one would have expected all the down to have been blown away.

In each instance down alone lined the nest. This lining was found to weigh 17·9 grams (Nest A) and 17·5 grams (Nest C).

These three nests are used year after year, and probably more than once a year in good seasons. Mr P. T. Sandland, who has searched the Moora swamps for many years, tells me that Pink-eared Ducks have been using these sites for thirty years to his knowledge; many of the eggs of this species in Australian collections have been gathered here.

INCUBATION

By 24 November a hide had been built in the water about 9 feet from Nest C where most of the subsequent watching was undertaken, and the birds were observed on this date from 8.05 a.m. till 1 p.m. The behaviour of the birds on this occasion was similar to that noted subsequently during incubation.

It was impossible to differentiate the sexes by their plumage patterns, although there were slight differences in the shape of the dark brown triangles on the birds' cheeks. Once or twice I suspected that both sexes might be sitting, but no proof of this was obtained. Nevertheless, solely for convenience, I have referred to the sitting bird as the female or duck in the following account, but this is an assumption for which I have no direct evidence.

While I was putting the finishing touches to the hide in preparation for entering, the two ducks sat quietly on the water 50 yards away, and no sooner had I disappeared than they drifted nearer to stand for a moment on a half-submerged log. Then one launched itself towards the nesting tree, followed closely by the other. The pair kept swimming up to within 5 feet of the base of the tree, the presumed male with its head retracted somewhat into the shoulders, the other with neck erect. The latter lifted its beak and gazed intently at the nest several times before flying up, climbing at about 45°. It had to make several attempts before obtaining a foothold, and as it flew the bird uttered a soft whistling 'tew-ee', a note that seemed the same as the usual flight call and a little softer than the very similar alarm note.

During the time the pair paddled quietly on the water below the nest, they kept up a soft whispering chorus, a purring 'twit, twit' series of notes. This chorus was invariably used whenever the two birds came up to the nest, but I was never able to determine whether or not both of them used it.

Pink-eared Duck (*Malacorhynchus membranaceus*)

The bird settled down immediately; barely touching the lining with its bill it insinuated its breast through the down on to the eggs, and shuffled itself into position with a series of sideways quiverings of its body. Ten minutes later the bird flew from the nest in alarm, having apparently seen some movement on the bank through the trees, but she was back almost at once, the male again in attendance, and thereafter incubation proceeded without interruption until 1 p.m., when I created a disturbance 100 yards away with the help of a long rope and put the bird off before emerging from the hide.

At about half-hourly intervals the duck changed its position. Frequently it stood up and turned the eggs with its bill. The bird was quite silent, and for much of the time dozed with beak tucked into the scapulars and with the down lapping around its flanks. The lower eyelid covering the eyeball was of a grey-buff colour. The sun shone on the bird for short periods each day, and I noticed that at such times the duck tended to loosen the feathers of the crown so that the pink ear was concealed. Once or twice the heat made the bird gape.

At this close range it was possible to gain a better idea of the bird's colouring. It was really a brown and cream duck rather than grey and white as Scott's plate in Delacour (1956) indicates. The under-tail coverts are buff. The patch of pink feathers grows within the groove in the skull that runs backwards from the eye socket, and since the feathers of the crown can be sleeked or fluffed, the pink patch may be pronounced or completely hidden. Sometimes one side of the head may show the pink ear, while on the other side this is invisible. Since sleeking and raising of the crown feathers often accompanies emotional changes in birds, it seems possible that bringing into prominence of the pink feathers may take place during sexual display in this species, but no information is yet available as to the function of the ear-patch in these birds. The amount of pink showing does not seem to be any indication of the sex of the bird concerned.

As soon as one of the duck had flown to the nest, the other usually swam back immediately to its favoured perch on a submerged limb about 10 yards away. Getting out on to the slippery branch was difficult, and sometimes several attempts were needed before the bird was balanced comfortably. Standing up, it wobbled its tail smartly, preened itself, particularly its breast feathers, with its huge and seemingly incongruous beak. The face was scratched with a foot brought up from under the wing. Mostly the bird slept, standing on one leg with head tucked back into the shoulders, but it would sometimes disappear from view and for part of this time it was feeding.

Aspects of display were occasionally observed. Thus on the morning of the 25 November I was suddenly aware of a Pink-ear close to a Coot sitting on eggs about 15 yards from the hide at Nest C. Both were threatening, the Coot with neck outstretched was reaching down from its nest, uttering the explosive noises characteristic of its kind, while the duck swam with its head and neck outstretched flat on the water, opening and closing its beak. The pink inside of the mouth and lower mandible was visible from the hide. At the same time the male sounded a loud trilling call, which was echoed by the incubating bird now alert and watching. The duck then moved away from the Coot, and I suddenly noticed another Pink-ear on the far side of the bushy tangle in which the Coot had built, and farther over still, another Pink-ear with at least three chicks in tow. This family group moved off in the direction of Nest A. Apparently the disturbance had arisen through the too-close approach of this party, and the Nest C drake in warning them off had incidentally aroused the Coot's antagonism. Later I found that the eggs in Nest A had hatched since the previous

evening, leaving one addled egg behind; probably it was this brood that had been involved in the episode with the drake from Nest C.

Several other disputes between the Coot and the drake Pink-eared Duck were noted. Thus on the morning of 26 November he stood on a log about two feet from the Coot's nest and, despite a few desultory snorts from the latter, began to doze. About ten minutes later the Coot's partner arrived, and the pair converged suddenly on the drake, which swam off hurriedly, making the same soft purring sounds as were used when approaching the nest. The incubating bird could see her mate, but evinced no interest in the incident.

An aggressive encounter involving a Pink-ear probably belonging to Nest A had also been noted on the 24 November, when a bird from this direction suddenly flew at the male from Nest C which had been cruising about feeding near by. The latter shot hurriedly back to its own area, whereupon the defending bird jumped on to a floating branch and with outstretched neck pointed its bill to the sky while it uttered a peculiar and quite loud rattling cry—probably the same call as the Nest C drake had used during its previous encounter.

THE HATCH

Hatching of the eggs and the departure of the young were only seen at Nest C. At 1 p.m. on 25 November one of the eggs was chipping, and by 7 a.m. the following day all were starred but no chicks were out. They could be heard tapping from within, but were not piping. Heavy rain fell that evening and overnight, accompanied by blustery winds and lightning, but the morning of the 27 November was finer and the nest held 4 chicks and 2 chipping eggs. All were covered with down as usual and the young remained motionless and silent until I opened the covering, whereupon one of them jumped straight into the water. Fortunately the others did not follow suit—some were still wet—and covering them over hastily I retrieved the impetuous one, taking it inside the hide with me lest it prove too restless and cause the other ducklings to depart prematurely.

The usual purring sounds accompanied the ducks' return, but for the first time the female continued to call like this as she stood at the nest, and she did so several times while brooding. She settled down quickly, sitting appreciably higher than when she had eggs, the down high around her flapping in a fresh breeze. None of the ducklings was visible, although the duck raised herself a little from time to time, purring quietly on each occasion. I was seldom able to catch the chitterings of the ducklings owing to the noise of the wind and the squawks of numerous young Coot in the area at the time. The duck paid little attention to the eggs and made no attempt to eat yolk remaining in the shells after hatching, as the Mallard sometimes does (Warham 1951). Brooding continued until 11.15 when I had to leave the hide, re-entering an hour later, after

slipping the eldest duckling back beneath the down, where it immediately became quiet once more.

The duck was back at once, unaccompanied by her mate this time, and from then on frequently uttered the purring call; her bill vibrated slightly as she did so. She was very alert and kept looking around. At 1.15 p.m. she stood up and purred loudly as she stood in the crotch before dropping to the water where her mate awaited her. Both swam rather slowly away, with the male purring and the female voicing a loud fluting 'tew-ee'. In the nest nothing stirred and the down had automatically covered the chicks. The pair circled back towards the tree, still calling as before. Suddenly I saw one chick on the water and glimpsed others falling. In a few seconds a group of four ducklings accompanied by the adults had formed, and all began moving away. They stopped about 20 yards from the nest, where the ducklings began feeding, dabbling quickly and eagerly with the tips of their bills immersed in the water. The male now acted as the focal-point for the young ones' activities; he stood on a log preening, shaking and scratching himself. He bathed in the water with the brood scurrying and circling around him.

Meanwhile the duck swam back to the nesting tree, where she paddled around for a few minutes, lifting her bill as she peered upwards, and whistling occasionally. I believe that she gave the purring note also at this juncture. She did not fly up but, giving a wild call, flew back to the brood. The male had taken no part in the other's inspection of the nest; he had simply stood over the young as they scurried around.

The family had apparently encroached on to the territory of another pair of Coot, both of which swam forward with arched wings; the duck accepted their challenge and charged them viciously, and as the Coots fled she gave the same powerful trilling call previously recorded. The drake took no part in this attack. Later the duck attacked yet another Coot that came near, afterwards raising herself from the water to stretch her wings; the male continued to preen, unperturbed by these quarrels.

The group gradually drifted away, and there was no sign of the ducks' reappearance by 3 p.m. when I emerged. The sky was now overcast, and scuds of rain announced yet another thunderstorm which lasted most of the night. In the nest were two eggs, one starred and the other chipped, but both chicks were dead.

The behaviour of the adults at the hatch may be compared with the findings of Collias and Collias (1956) on the Canvasback (*Aythya valisineria*) and Blue-winged Teal (*Anas discors*). Their account of these ducks' behaviour before calling their young from the nest, their alert attitudes and manner of looking around, would serve also as a description of the Pink-ears' manner at this stage of the breeding cycle. Furthermore, the way in which this duck used the purring note at the nest only after hatching had commenced suggests that, as with the Blue-winged Teal, the ducklings are thereby given an opportunity to become conversant with the purring calls though the chicks might never see their parents until they hit the water for the first time, owing to the way in which the down encompasses them. Again, this purring note is clearly akin to the special note described by these observers as used by Canvasback and Blue-winged Teal at hatching: 'relatively soft and low pitched and consisted of brief, rapidly repeated monosyllabic notes of weak intensity'. One difference seems to be that these notes were used regularly by the pair on the water before hatching occurred, and that at the time of departure the duck used a loud version of the

usual whistle in addition to the purring notes, apparently to induce the nestlings to make their descents.

THE CHICK

The downy chick of the Pink-eared Duck was described recently by H. J. Frith (1955). The ducklings examined at Moora agreed with Frith's description in most respects, but the following points may be noted. The bill is just over half

Downy Pink-eared Duck

as long as the head and rather different in shape from that figured in the sketch accompanying Frith's paper: it is short and spatulate, the membraneous flaps, which are wrinkled more or less longitudinally, being very marked. The egg-tooth is white, and the length of the bill in a chick probably 8–12 hours old was $\frac{11}{16}$ inch. The upper mandible was dark grey, the lower pink towards its distal end, dull wine coloured at the base. Breast and belly had a slightly creamy tinge, the down under the tail being suffused slightly with buff, corresponding with the buff under-tail coverts of the adult. My birds showed rather less dark around and below the eye than the bird in Frith's sketch.

The duckling that left Nest C prematurely dived well but was not greatly distressed when retrieved. Placed in a shallow, *Simocephalae*-filled pool, it dabbled eagerly into the mud with its bill; apparently feeding movements are innate. This duckling also exhibited a following response, for although it would run from me when placed in the water, it would run back immediately I moved away again.

The chick had two calls: a rather piping 'shripp shripp' much like the note of any other day-old chick, and a softer, twittering 'tititi'. The first appeared to be a distress call, and was only heard when the duckling was left alone in an empty case or was otherwise out of contact with a warm object; it ceased when the chick was handled gently, to be replaced by the twittering call. This clearly seemed to be a contentment note such as Collias and Collias describe for Canvasbacks and Blue-winged Teal. Furthermore, the distress call invariably ceased at my quite crude imitation of the adults' purrings. The duckling used the distress call when I had it with me in the hide, but the brooding bird gave no sign that it heard the duckling's cries.

NEST B

Bad weather interfered with my observations at this nest and only one four-hour session was possible. This sufficed, however, to confirm the general pattern of events noted at Nest C in that the two birds came to the nesting-tree together, uttered the same soft chirruping undertones while on the water, and the presumed drake's return to a perch near by where he dozed and preened, although occasionally disappearing, probably to feed. Here, before incubation was re-

sumed, both ducks flew on to a limb sloping at about 40° to the horizontal which leaned from the nesting-tree into the water. They alighted some 4 feet above the surface, gaining their balance without very much flapping of wings, and then walked up the limb until the highest bird was at least 8 feet from the water. The nest could not be reached from there so the birds had eventually to re-enter the water; both raised their bills and peered at the nest before one of them finally flew to it in a steep climb.

Aggressive encounters between these Pink-ears and Coot were also noted, and the ducks' attitudes were similar to those seen at the other nest—they stretched their necks and beaks out along the water towards the adversary, the beak slightly ajar.

This pair also gave a momentary glimpse of display while perched side by side on a submerged log: one bobbed its head up and down several times with its bill held stiffly at about 45°, but its partner gave no reaction.

Once when the pair were together on the water one of them indulged in a bout of apparent displacement preening, probing behind the wing and adopting a posture very like that figured by Makkink (1931) for the Shelduck (*Tadorna tadorna*).

FEEDING

Brief observations on the feeding habits of the Pink-eared Duck at Marada swamp were made. The method mostly used is that described by Frith (in Delacour and Scott 1956), as 'cruising with the bill in the water, filtering as they go'. It was noted that the birds paid particular attention to half-submerged limbs along which they would work with their bills slightly submerged. The reason for this was that when the sun was shining Cladocerans concentrated along the edges of the shadows cast by the limbs so that food was most plentiful in such places. The male would sometimes feed like this in full view of their sitting mates. Doubtless Shanks' account (1953) of two birds rotating about a point with their bills submerged and almost touching refers to ducks which have found some local concentration of animal food. This habit was not noted during the present study since it was mainly single birds which were watched, but on several occasions Pink-eared Ducks were seen to 'up-end': it was impossible to tell what they sought by so doing.

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Ross's Goose

THE PACIFIC FLYWAY

Waterfowl in the Pacific Flyway of North America

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THE Pacific flyway encompasses approximately the western quarter of North America. Between its breeding grounds and wintering areas pass some 10 million swans, geese and ducks each year. In the United States portion of the flyway these birds are hunted by about 450,000 sportsmen and are enjoyed by countless others. The Pacific flyway is one of four flyways recognised in North America. Although many birds pass from one to another, the flyway boundaries generally follow mountain ranges or other geographical features restricting movement between flyways. Waterfowl surveys, research, hunting regulations and other matters pertaining to this resource are carried out on a flyway basis.

This article, using the Pacific flyway as an example, illustrates the activities being carried out with regard to waterfowl in the United States. Mention is also made of the main species of the Pacific flyway and their migration patterns.

MIGRATIONS, SPECIES AND POPULATIONS

Extensive surveys carried out by Federal and State Governments of the United States, Canadian Government agencies and private organisations have revealed much basic data on the Pacific flyway in recent years. These surveys are designed primarily to serve as a basis for drawing up hunting regulations, which vary from year to year according to populations and conditions. The methods by which these surveys are taken will be described later.

Alaska, southern Alberta and Saskatchewan contribute well over half of duck and goose production of the flyway. Other important breeding areas include northern Alberta and the Northwest Territories; followed by British Columbia and the states of Washington, Oregon, California and Montana. Other states of the flyway, including Idaho, Utah and Nevada, contribute minor quantities of ducks and geese.

Wintering areas and intermediate refuges are just as important to the maintenance of the flyway as breeding grounds. While the ducks and geese of the Pacific flyway nest over a vast region, their wintering areas are most restricted. The state of California winters about 60% of these birds and Mexico about 12%. British Columbia, Washington, Oregon and Idaho combined winter only 25% of these birds, while other portions of the flyway have even less. Many parts of the flyway serve as important midway points between breeding areas and wintering areas. California, however, is the main concentration point for

waterfowl of the Pacific flyway. It is in this state that one may see the most spectacular concentrations of waterfowl in North America.

Some of the species involved are indigenous only to North America, while others are the same as those found in Europe, though different sub-species may be recognised for North America. It is not the plan of this article to discuss the different sub-species found in the Old and New Worlds. However, a discussion of the better-known and common species of the Pacific flyway appears worth while. Table I lists in their order of abundance the most common species of Anatidae in the Pacific flyway as found during recent winter surveys. It will

TABLE I

Approximate species composition of Pacific Flyway Anatidae by per cent

Pintail (*Anas acuta*)	33
Mallard (*Anas platyrhynchos*)	20
American Wigeon (*Mareca americana*)	14
Shoveler (*Spatula clypeata*)	6
Green-winged Teal (*Anas carolinensis*)	5
Snow Goose (*Chen hyperborea*)	4
Canada Goose (*Branta canadensis* subspp.)	4
Scaups (*Aythya marila* and *A. affinis*)	3
White-fronted Goose (*Anser albifrons*)	2
Ruddy Duck (*Oxyura jamaicensis rubida*)	1
Black Brant (*Branta nigricans*)	1
Scoters and Eiders (*Melanitta*, *Oidemia*, *Somateria* spp.)	1
Others	6

Fig. 1. Principal waterfowl refuges administered by the U.S. Fish and Wildlife Service in the Pacific Flyway States

Ross's Goose

be noted that three species—the Pintail (*Anas acuta*), Mallard (*Anas platyrhynchos*) and American Wigeon (*Anas americana*)—make up almost 70% of the Pacific flyway population. The Lesser Snow Goose (*Anser hyperboreus*) is the most abundant goose. These four species have adapted themselves well to the agricultural areas which have largely replaced natural marshlands. Shovelers (*Anas clypeata*), Green-winged Teal (*Anas crecca carolinensis*) and the Lesser Scaup (*Aythya affinis*) are also doing well. The White-fronted Goose (*Anser albifrons*) and Canada Goose (*Branta canadensis*) are familiar to Britons. These two species are favourites of American sportsmen. The latter species, which is represented by a number of sub-species, is the most widely distributed goose in the flyway, but is nowhere to be found in large concentrations like the Snow, White-fronted and *Branta canadensis minima*, which in the past has been called the 'Cackling Goose'. The last is one of the smallest sub-species of Canada Goose, and one which interests many outsiders inasmuch as it is restricted to the Pacific flyway. Unfamiliar to most Europeans also is the unique little Ruddy Duck (*Oxyura jamaicensis*). Black Brants (*Branta nigricans*), similar to the Brent Goose, are common inhabitants of coastal bays.

Fairly abundant species which fall into the category of others on Table I include the Whistling Swan (*Cygnus c. columbianus*), Gadwall (*Anas strepera*), Cinnamon Teal (*Anas cyanoptera*), Redhead (*Aythya americana*), Canvasback (*Aythya vallisneria*), Common Goldeneye (*Bucephala clangula*), Bufflehead (*Bucephala albeola*) and the Goosander known in North America as the Common Merganser (*Mergus merganser*). Many of these species are found in the Old World. Some of the less abundant species of the Pacific flyway include the Trumpeter Swan (*Cygnus cygnus buccinator*), Emperor Goose (*Anser canagicus*), Ross's Goose (*Anser rossii*), Fulvous Tree Duck (*Dendrocygna bicolor*), Blue-winged Teal (*Anas discors*), Ring-necked Duck (*Aythya collaris*), Barrow's Goldeneye (*Bucephala islandica*), Oldsquaw or Long-tailed Duck (*Clangula hyemalis*, Harlequin Duck (*Histrionicus histrionicus*), Hooded Merganser (*Mergus cucullatus*) and the Red-breasted Merganser (*Mergus serrator*).

The beautiful little Ross's Goose has become a centre of interest in recent years. Upon casual inspection one might mistake this species for a Snow Goose,

but its shorter head and bill, combined with its more petite appearance and behaviour, are distinctive. The breeding grounds of the Ross's Goose in the Perry River region north of the Arctic Circle, almost midway between the east and west borders of North America, are described in an earlier edition of the *Severn Wildfowl Trust Annual Report* (1949–50), under the title 'The Perry River Expedition, 1949'.

A study of the Ross's Goose on its California wintering grounds was initiated during the fall of 1953. Until that time little was known of the wintering status of this species. This goose appears in the Klamath Basin of north-eastern California in mid-October, and a month later begins a gradual southward movement of about 200 miles into the Sacramento Valley. By mid-December most of the Ross's Goose population moves another 200 miles farther south into a grassland area of the northern San Joaquin Valley, where they remain until February and March before returning north. In the Klamath Basin, Ross's Geese associate closely with Snow Geese, both as individuals and in flocks. In the San Joaquin Valley this species becomes somewhat detached from flocks of Snow Geese, so that censusing can be reasonably accurate. An aerial survey taken in February of 1957 disclosed about 8000 Ross's Geese. Utilising aerial photographs, it is felt the survey brought reliable results. In November of 1955 over 5000 Ross's Geese were counted from the ground in one flock in the Sacramento Valley. Such figures as the above reveal that there are far more Ross's Geese than previously were thought to exist, and fears that the species might become extinct have decreased. Unfortunately, the similarity of the Ross's Goose to the more common Snow Goose prevents effective protection for the Ross's Goose.

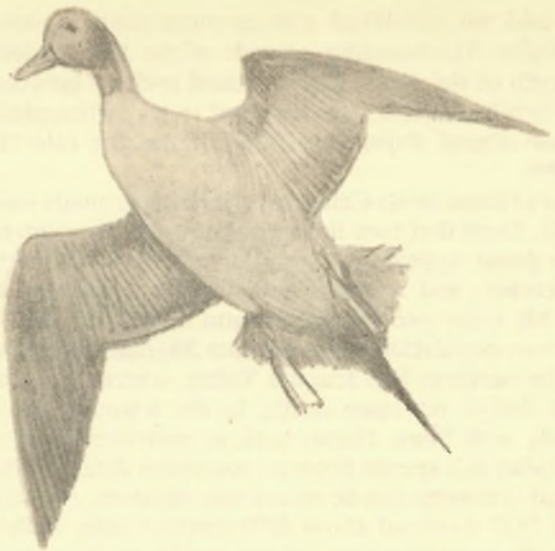
The Trumpeter Swan, another endangered North American species, is holding its own. Over a thousand of these birds are known to exist.

The swans, geese and ducks along with the American Coot (*Fulica americana*) in the United States are classed as game species. At the present time swans are protected because of their relatively low numbers. Most other waterbirds, as well as most of the shorebirds, are also protected by law.

MANAGEMENT OF THE WATERFOWL RESOURCE

Ownership of game and other wildlife in the United States is vested with the public rather than the individual landowner. Holding the proper licence, and a migratory bird hunting stamp in case of waterfowl, citizens may hunt according to regulations on public-owned lands of the United States, of which there are many. Most owners reserve the privilege of granting permission to hunt on private lands. In case of waterfowl habitat, which is becoming increasingly scarce in the United States, more and more landowners are leasing hunting privileges to private hunting clubs and individuals. As a result, places for the general public to hunt are becoming increasingly difficult to find. Nevertheless, wild game remains the property of the public, even though this fact does not convey the right to trespass on private lands.

Public ownership of wildlife resources in the United States has required that government agencies be active in the field of wildlife management. Both the Federal and state governments participate. In case of the Federal Government, the Bureau of Sport Fisheries and Wildlife of the U.S. Fish and Wildlife Service, Department of the Interior, by law is responsible for many matters pertaining to wildlife, and particularly waterfowl, because of international



Pintail drake

treaties and the interstate and international movements of this resource. One such responsibility is the establishment and enforcement of hunting regulations. Federal and state governments, the latter through their conservation departments, carry on other work to maintain the waterfowl resources of the nation. Activities pertaining to waterfowl that are carried out by these agencies include enforcement of hunting regulations, making waterfowl surveys, waterfowl research, maintaining waterfowl habitat through a system of refuges and waterfowl management areas, and the operation of public hunting areas. Privately financed organisations also carry on waterfowl work, but their role is not so extensive as in Britain.

Finances for waterfowl work by Federal and state agencies are obtained from several sources: sale of Federal migratory bird-hunting stamps, which hunters must attach to their licences for hunting waterfowl; a Federal tax placed on the sale of sporting arms and ammunition; annual Federal appropriations; the sale of state hunting licences; and state appropriations.

Hunting seasons on waterfowl, bag limits and other hunting restrictions are regulated according to the condition of the waterfowl populations. Extensive waterfowl surveys are required for obtaining these data.

An extensive survey for obtaining this information is the annual winter inventory. For this survey all wintering waterfowl habitat of importance in each flyway is covered simultaneously, in so far as possible. The survey takes place during January, when the birds are most heavily concentrated on their wintering areas and the hunting season is nearly over. In the Pacific flyway areas having low waterfowl numbers are covered by ground observers, while other areas having larger waterfowl numbers are covered from the air. Heavy concentrations of waterfowl in the Sacramento and San Joaquin Valleys of California are covered by use of aerial photographs. Here as many as 100,000 ducks will be recorded by a single photograph. Sample counts are made from each photograph for obtaining an index to the actual number of waterfowl present. A breakdown of the species involved in these concentrations is obtained from another aircraft by visual methods. Coverage of the important or inaccessible waterfowl areas from the air, and ground coverage on other areas, provide tabulations which

show whether the flyway population is increasing or decreasing. The status of each species is also indicated. During the past several years, populations in the Pacific flyway have remained remarkably stable from year to year.

Aerial surveys are made of breeding grounds periodically during the spring and early summer throughout Canada and Alaska by means of censusing transects. The data gathered from these surveys are very important in the setting of annual hunting seasons and bag limits.

The use of aircraft for making waterfowl surveys is relatively new. Experienced waterfowl observers find an aircraft the most efficient way to obtain waterfowl population data on areas of any size. Aircraft are flown from 100 to 300 feet above the ground, except while photographing, when greater altitude is needed. Aerial observations have three main advantages over ground methods. First, they allow the observer to look down on the waterfowl so that each bird can be seen individually, an advantage over a ground view, which at any distance allows the birds to be seen only as a dark mass or streak. An aircraft also permits seeing birds in tall vegetation that blocks the view of the ground observer. A second advantage of the use of aircraft is the vast amount of habitat that can be censused in a given interval of time by only two individuals, the observer and the pilot. The third advantage is in the effective coverage of areas that are inaccessible from the ground. In many instances, a pair of observers in an airplane can do a census job more efficiently than fifty or more ground observers using cars and boats.

Several types of aircraft are used. All are high-wing types giving maximum visibility, and are capable of minimum speeds of ninety miles per hour or less. One of the commonly used types can fly as slow as thirty-five miles per hour. The use of a tape-recorder by the observer allows the recording of observations without interrupting his view of the ground.

Some disturbance to waterfowl naturally results from the use of aircraft. However, this is seldom greater than the disturbance caused by other, usually larger and noisier, aircraft in the vicinity. Similarly, disturbance usually results when the birds are approached on the ground. Considering the vast amount of information that is gathered on waterfowl for their benefit, we do not regard the matter of disturbance as a major factor.

Ringing or banding operations are carried out in the Pacific and other flyways for many of the same purposes as in Europe. Most of the waterfowl banding is carried out by public agencies. During 1955 over 65,000 waterfowl were banded by state and Federal agencies in the United States. Additional birds were banded in Canada and Alaska. The birds are generally captured in one of three ways: by simple portable wire traps which utilise bait; by means of mortar-projected net-traps; and by driving into enclosures during flightless periods. The use of decoys is not practised to any extent, at least in this country. Neither are rocket net-traps used. The American mortar-projected net-trap or boom-trap was described by Peter Scott in the *Fifth Annual Report of the Wildfowl Trust* (1951–52, pp. 72–77), under the title 'The American Boom-trap'. In reviewing these reports, I find the technique of capturing geese by rocket nets has seen more development than mortar trapping in the United States.

During the course of studies on the Ross's Goose, both Snow and Ross's Geese were marked by means of dyes. Though only the wings were dipped, during the course of preening the birds smeared the material over and coloured the remainder of their bodies. After being held in a warm place overnight, the geese were released. The dyes used included a picric-acid solution in alcohol

which gave yellow, and a similar type solution using Rhodamine B which gave pink hues. Green was also obtained from malachite green. The picric acid proved the most lasting and was used on Ross's Geese. The colouring allowed a whole series of observations on these birds, from wintering grounds to breeding areas. It had no apparent effect on either the behaviour or health of the birds.

REFUGES

The most interesting aspect of waterfowl management in the United States is perhaps its refuge system. Without it the vast numbers of ducks and geese which occupy North America could not exist. Over 270 such public-owned areas, comprising over 17 million acres, are managed by the U.S. Fish and Wildlife Service in the United States, of which more than 200 are waterfowl refuges. Their main purpose is to provide habitat and protection to waterfowl and other wildlife. Additional refuges and waterfowl management areas are operated by the states. In the Pacific flyway there are about thirty waterfowl refuges operated by the U.S. Fish and Wildlife Service which range up to 165,000 acres in size. Most of these refuges have permanent staffs ranging from two to twelve or more in number. The number of state refuges and waterfowl areas in the Pacific flyway is about forty. These areas average somewhat smaller in size than those operated by the Federal Government, but their role is none the less important.

Fig. 1 shows the principal waterfowl refuges operated by the U.S. Fish and Wildlife Service in the Pacific flyway. These refuges have varied functions and programmes according to local requirements. For example, the Red Rock Lakes Refuge in Montana was set aside primarily to preserve habitat and give protection to the rare Trumpeter Swan. The Willapa National Wildlife Refuge provides protection to several thousand Canada Geese of the race *Branta canadensis occidentalis*, as well as other species.

The Malheur National Wildlife Refuge in Oregon includes nearly 100,000 acres of waterfowl habitat, consisting of marsh, meadow and lakes containing submerged waterfowl food plants as well as a limited acreage in grain. This refuge is an important point during the fall and spring migrations. For example, during late March half or more of the Pacific flyway Snow Geese population will be present on Malheur Refuge and adjoining farmlands. Up to 200,000 have been estimated to be present at one time here. Their next major stopping place to the north is five hundred miles away. Species which breed at Malheur in abundance, but which are otherwise in short supply in the flyway, include the Canada Goose, Gadwall, Cinnamon Teal and Redhead. Like so many of the Pacific flyway refuges, the waters of the Malheur Refuge freeze over during the winter months so that most of the birds are forced to move to California.

Many species of birds other than waterfowl use the refuge system. Abundant on many Pacific flyway refuges are such species as the Western Grebe (*Aechmophorus occidentalis*), White Pelican (*Pelecanus erythrorhynchos*), the American or Common Egret (*Casmerodius albus*), Sandhill Crane (*Grus canadensis*), American Avocet (*Recurvirostra americana*), Wilson's Phalarope (*Steganopus tricolor*), Forster's Tern (*Sterna forsteri*) and many others. The refuges attract many people who simply come to enjoy and photograph the birds, a source of recreation which is encouraged.

Most of the refuges contain an intricate system of dikes, canals, and water-

control structures for distributing and managing water at desired levels so far as the availability of water will permit. By the manipulation of water-levels, controlled livestock grazing, the encouragement or discouragement of Muskrats (*Ondatra zibethica*) and the employment of other natural and artificial factors, every effort is made to maintain the habitat at optimum conditions for waterfowl. Undesirable plants are discouraged and desirable species are encouraged. Plant ecology is thus the basis for many important aspects of refuge management. A problem which exists on almost every western refuge is retarding the encroachment of thick strands of cat-tail (*Typha* spp.) and hardstem bulrushes (*Scirpus acutus*) from open-water areas containing desirable species such as sago pondweed (*Potamogeton pectinatus*). The latter plant is perhaps the most important natural waterfowl food plant in North America. Tall emergent cover plants, such as bulrushes and cat-tail are used little when grown in large, unbroken stands. Since the amount of natural waterfowl habitat left in the Pacific flyway is only a fraction of what formerly existed, every effort is being made to make existing habitat on the refuges more productive than would be possible if these areas were left under natural conditions.

The Klamath Basin, an area which was formerly marshland and lakes but has since been largely reclaimed for agricultural purposes, lies in north-eastern California. During October half or more of the Pacific flyway waterfowl population will congregate on the Tule Lake and Lower Klamath National Wildlife Refuges in this area. This presents one of the great waterfowl spectacles of the world, as 5 or 6 million waterfowl will be present here at one time. To offset the loss of former waterfowl habitat in the Klamath Basin, these two refuges are managed intensively. Ninety-two miles of dikes impound marsh and lake waters for the production of natural food plants. In addition, refuge personnel are engaged in an extensive farming programme, as the 24,000 acres of natural habitat cannot feed adequately the large numbers of birds which visit the area. Cultivated crops are mostly barley (*Hordeum vulgare*). Croplands of private farmers adjoining the refuges are also largely in barley. Refuge barley serves two purposes. It not only feeds the birds but also prevents a serious economic loss to farmers by controlling bird damage to their fields. Through scaring devices employed by the farmers, the birds soon learn which barley is intended for their use. Around 7000 acres of grain are left unharvested for the birds each year on the Tule Lake and Lower Klamath National Wildlife Refuges. This grain is fed upon mainly by Pintails, Mallards, Snow Geese and White-fronted Geese.

Agricultural crop depredations by Coots at times becomes an important problem in the interior valleys of California. One of the most abundant migratory game birds in the Pacific flyway, Coots feed on young barley and other green food material in farming areas, and on more northern locations compete directly with waterfowl for sago pondweed and other aquatic plant foods.

As is now the case with many of the national wildlife refuges, parts of Tule Lake and Lower Klamath are open to public hunting during the regular waterfowl season. This area attracts hunters from many parts of the western United States. Portions of these refuges, which were in part financed through sale of duck stamps, may be opened to hunting as long as the waterfowl resource is not being endangered.

As winter closes in on the Klamath Basin and its lakes become frozen, the last hordes of waterfowl move south, principally to the Sacramento and San Joaquin Valleys of California, which have open water the entire year. Located

here are a number of refuges which are probably the most important in the Pacific flyway at the present time, for several reasons. They lie in the heart of the crowded Pacific flyway wintering area. This wintering area is intensively developed agriculturally, with many large cities and towns present. The limited acreage in refuge and waterfowl management areas in the Sacramento and San Joaquin Valleys thus has to hold several million ducks and geese. Farmers do not want these droves of birds on their land before crops are harvested. During the hunting season, which in the case of some crops, such as rice, occurs after the harvest, refuges often provide the only places where these birds can rest unmolested. Rice is a major crop of this area, and since the quantities of ducks and geese present here could destroy a field of rice in a matter of days, preventive measures must be taken.

Farmers can effectively herd waterfowl from rice-fields only when the birds may retreat to a place that provides food. The refuges furnish the answer. Around 2000 acres of rice are planted for waterfowl each year on the Sacramento, Colusa and Sutter National Wildlife Refuges. Larger acreages of lower-cost foods are produced on these and other refuges. These include barley, wild millet (*Echinochloa crusgalli*), as well as many others.

An increasingly important area in the northern San Joaquin Valley is the Merced National Wildlife Refuge. This area is a centre point for the Ross's Goose during the winter months, when this species confines its feeding activities largely to green grass.

In the Imperial Valley near the Mexico–California line is the Salton Sea National Wildlife Refuge. Here barley and other crops planted on the refuge help keep Wigeon and geese from the Valley's lettuce, alfalfa and other crops.

Hunters generally agree that refuges serve as a reservoir for the objects of their sport, and without them waterfowling would be gone in many areas such as the Sacramento Valley.

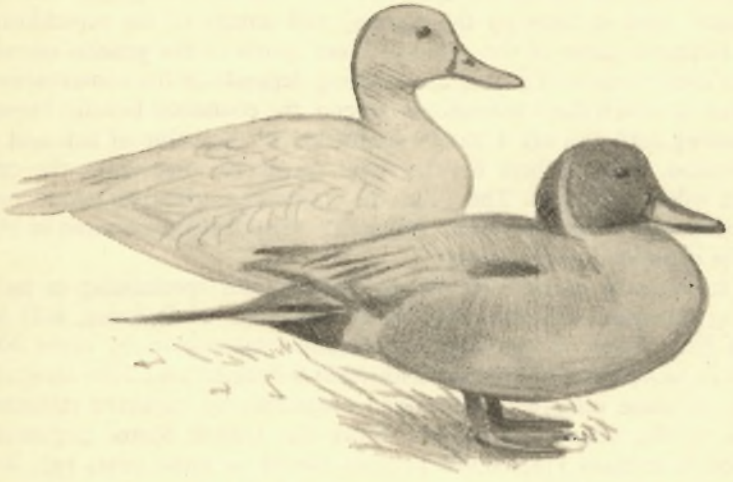
Refuges in other states of the flyway play important roles, too. They help to hold waterfowl away from the problem areas of California, provide shootable populations for the areas they serve, and produce many birds as well. Most of the waterfowl foods in these areas are from natural food plants rather than cultivated ones. The Bear River Bird Refuge in Utah and the Stillwater National Wildlife Refuge in Nevada are examples of fine natural marshes which are stopover points in migration as well as breeding areas for both waterfowl and many species of marsh and shorebirds.

RESEARCH

Waterfowl research has taken on many phases in the United States. Food habits studies have pointed the way towards better refuge management. Disease studies are helping point the way towards the curbing of such diseases as avian botulism. Caused by the bacterium *Clostridium botulinum*, this disease has killed ducks and geese by the tens of thousands in the interior portions of the Pacific flyway.

Investigations are constantly being carried out to determine the effects on waterfowl of habitat losses through proposed dams, reclamation projects and other alterations of present features by man. A recent evaluation of the wetlands of the United States has helped to focus attention on the serious problem of rapidly disappearing marsh and aquatic habitat. This critical situation has received much public interest and concern and, as a result, a greatly accelerated

land acquisition, research and management programme by state and Federal conservation agencies is now getting under way. This programme includes the setting aside and management of representative habitat at strategic points in each of the four waterfowl flyways, and should help to assure the perpetuation of North America waterfowl and other wildlife for the enjoyment of all who are interested in the out of doors.



Pintail

WILDFOWLING IN THE U.S.A. AND BRITAIN

The Importance of Wildfowling in the United States and Britain
A Review of *National Survey of Fishing and Hunting*, 1955

by Hugh Boyd

IN the early months of 1956 a 'survey of hunting and fishing' was made for the U.S. Fish and Wildlife Service 'to determine the importance of these truly American sports in our (i.e. the American) national economy'. The results of this survey were published a few months later. Circular 44 of the Fish and Wildlife Service (for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.; price 40 cents) is unlikely to be seen by many Trust members, though its contents are of great interest for comparison with what is known or may be guessed about the role of wildfowling in Britain. This review attempts to summarise those parts of the American survey relating to 'waterfowl hunters and hunting' and adds a very few facts and some more speculative estimates about the British situation.

THE AMERICAN PICTURE

The Fish and Wildlife Service inquiry set out to measure some statistical aspects of fishing and shooting, particularly the number of people who went fishing and shooting in 1955, and the time and money they spent in doing so. As the introduction to the Report remarks: 'There are intangibles beyond the grasp of statistics. The enjoyment, the satisfaction, the recreation of a fishing or hunting trip cannot be expressed in dollars. Only to the extent that the money a person spends for a particular form of recreation can suggest the value he places on that recreation, this survey has measured the value of fishing and hunting to the sportsman. And in showing the amount and nature of his expenditures, the survey indicates some of the value of these sports in the general economy.

'Since continuation of fishing and hunting depends on the conservation of the resources on which these recreations depend, the economic benefits from fishing and hunting activities are a partial indication of the value of fish and wildlife conservation. Many others besides these sportsmen also enjoy the country's fish and wildlife reserves. They, like the sportsmen, spend time and money in connection with their recreation. But unless they fished or hunted in 1955 they were not included in this survey.'

The survey was carried out by an organisation specialising in large-scale sampling censuses, with the truly American name of Crossley, S-D Surveys, Inc., of New York. It was based on personal interviews, by some 300 interviewers in more than 250 places, with 6220 fishermen and 3108 shooters. 'The findings of these interviews were then projected, by standard statistical procedures, to the whole population.' Since the United States population was estimated to contain 118,366,000 persons twelve or more years ago, in 1955 a sample of less than 10,000 interviews seems at first sight small, but the methods of selection, involving calls on 20,000 homes chosen by carefully designed sampling procedures, seems to have been efficient and free from important bias.

Numbers of Wildfowlers

It is estimated that in 1955 11,784,000 people went shooting in the United States and that 1,986,000 of these went in pursuit of wildfowl. Of 50,082,000 men aged 18 years or older 9,675,000 (19·3%) went shooting and 1,678,000 (3·4%) hunted ducks and geese. That is, wildfowlers made up 17·6% of the adult male shooting population. There were 36,000 women wildfowlers in the United States (one to every forty-seven men).

The Report does not show how many wildfowlers came from different population density groupings, but records that only 2·3% of the populations of big cities shot, compared with 5·9% of the inhabitants of small cities and suburbs and 14·7% of those in rural areas.

The proportion of shooters among men in different age-groups was highest (13·2%) in the 18–24 years' class, although it was not much lower elsewhere in the range 12–44 years. 8·1% among those 45–64 years old and 3·2% of those over 65 were still active.

Only 5·5% of all fishermen and shooters belonged to fishing or shooting clubs or other sporting organisations. The proportion of wildfowlers with such affiliations is not reported separately.

Time Spent in Wildfowling

In 1955 American wildfowlers are estimated to have spent 19,959,000 days in the field—a hunter's day being defined as any day or part of a day on which a

person went shooting; this being 11·8% of the total of shooting days. 17·6% of all shooters went out only once or twice during 1955, 44·4% three to ten times, 34·6% eleven to fifty times and 3·4% over fifty times. 21·8% of the shooting population took part in shooting trips lasting more than one day. There is no indication whether the frequency of trips by wildfowlers differed importantly from those made by people after game, although it appears that fowlers spent rather less time in the field than those engaged in other kinds of shooting.

Money Spent on Wildfowling

The 1,986,000 wildfowlers in the United States are believed to have spent $118,745,000—over £42,000,000, or an average of over £21 a head—on their sport in 1955. 56·3% of this expenditure was on equipment, including boats, camping gear and clothing as well as guns and cartridges. The cost of licences and duck stamps accounted for a little over a guinea a head. The bulk of the remaining money was spent on travelling, food and refreshments, subscriptions, rents and other similar charges. 'Some had spent almost nothing, others spent a great deal (one sportsman spent $12,190).'

Travelling

91·3% of wildfowlers travelled by car, their total mileage during 1955 being about 754,949,000, equivalent to an average of 411 miles for each mobile fowler. No separate tabulation is made of the frequency of different annual mileages by wildfowlers, but for shooters as a whole it appears that 14·1% travelled less than a mile in pursuit of their quarry in the course of the year (is shooting from the bedroom window widely practised?), 24·2% travelled between one and one hundred miles, 46·2% between one hundred and one thousand miles and 15·5% over a thousand miles. A calculation by the reviewer suggests that the average distance covered in a single trip, by those fowlers who had to travel at all, was 46 miles out and back.

SOME COMPARISONS WITH BRITAIN

The Numbers of Wildfowlers

If the proportion of fowlers amongst the adult male population of Great Britain was as high as in the United States, we would have had about 600,000 wildfowlers in 1955. Although we have never seen any estimate of the number of active fowlers in this country, we suppose such a total to be very much too high. The number of shooting licences, including game-keepers' licences, issued in the fiscal year 1953–54 (before the effect of myxomatosis on the rabbit population made itself felt) was 313,000. This figure should indicate roughly the size of the shooting population, the number of people shooting without licences being partly offset by the number of people licensed but not active in any particular season. How many of these 313,000 people shot or tried to shoot ducks and geese in the winter of 1953–54? Although the total shooting population was proportionately smaller in this country than in the U.S.A., if the fraction fowlers/all shooters had been similar (17·6%) active fowlers would have numbered about 55,000 at that time.

The numbers of fowlers have been estimated from the relation between the annual recovery-rates of ringed ducks and the numbers of shooting licences issued in corresponding years. When these data for the years 1948–54 were compared it was found, remarkably enough, that a straight-line relationship

existed between them, so that in the seasons when more people took out licences the recovery-rates of British-ringed ducks increased. A graphical solution of the relationships suggested that the average number of active fowlers in England and Wales in the years 1948–54 was 38,000. Data for Scotland were excluded because very little ringing had been done and very few recoveries reported there, but if the ratio fowlers/all shooters in Scotland was similar to that in England and Wales, an addition of 3500 should be made to give a British total of 41,500. This estimate is, of course, highly speculative, and is put forward in the hope of provoking a direct inquiry into the question rather than in the belief that it is a close approximation to the truth.

Travelling by Wildfowlers

No data are available to show how many million miles are travelled annually by British wildfowlers. It may be supposed that the proportion travelling by car is smaller than in America and that a significant fraction use bicycles. But a question of some interest is that of the extent to which fowlers go far afield in search of their quarry. Some provisional findings on this point have been obtained by studying letters reporting recoveries of ringed ducks and geese, and comparing the locality where the bird was shot with the address of the shooter. These data are not yet extensive enough to justify a detailed report, which would in any case be out of place here; but they do suggest that considerable differences may exist between different parts of the country in the relative importance of local and visiting fowlers.

Table I shows the numbers of ringed ducks reported as shot in various parts of England and in Wales in the seasons 1954–56, classified as 'shot by visitors' when the address of the shooter was more than ten miles distant from the reported locality of shooting, and as 'shot by residents' when the distance between the two localities was less than ten miles. Several of these samples, notably those from Wales and from the North of England, are obviously too small to be of significance, but the larger samples suggest that in the south-east (Kent, Sussex, Surrey) and in the Severn area (Gloucester, Somerset, Monmouth and Wiltshire), the proportion of ducks killed by fowlers coming from considerable distances is greater than elsewhere. By contrast, ducks shot in the south-west, the Midlands and perhaps the North seem to be shot almost entirely by locals. Even in those areas where visitors are most frequent, they only account for perhaps a quarter of the kill.

No comparable figures are available for Scotland, but an inquiry into the shooting of Pink-footed Geese in 1953–54 provides data on the behaviour of goose shooters in the North of England and in Scotland. The classification of 'visitors' and 'residents' in Table II is on the same basis as in Table I. The regional classification is that described in a paper in the *Seventh Annual Report*, p. 109. This table, too, indicates notable differences between regions, the Solway and Wash evidently attracting a very high proportion of itinerant goose shooters (though the proportion of visitors killing ducks in the Wash area is much smaller).

These figures are far removed from the American survey with which this review purports to deal, and yet they are not irrelevant to the central query put to British readers by the American survey: How important is wildfowling in Britain? The Wildfowl Trust is concerned with birds rather than men, and we do

TABLE I

Regional Distribution of British-ringed Ducks reported shot in England and Wales, 1954–56. The reports tabulated here exclude those in which details of the recovery locality or the address of the shooter were incomplete

Region	Shot by Visitors	Shot by Residents	Shot by Visitors / Reported Recoveries
			%
North of England ..	0	13	0
Midlands	0	22	0
Wash	9	41	18·0
East Anglia	26	134	16·3
S.E. England	9	23	28·2
South Coast	4	19	17·4
Severn	12	35	25·5
S.W. England	0	15	0
Wales	2	4	33·3
Totals ..	62	306	16·9

TABLE II

Regional Distribution of ringed Pink-footed Geese shot in Britain, 1953–54

Region	Shot by Visitors	Shot by Residents	Shot by Visitors / Reported Recoveries
			%
N. Scotland	7	30	18·9
E. Central Scotland ..	29	182	13·8
S.E. Scotland	3	23	11·5
Solway	28	30	48·3
Lancashire	2	20	9·1
Humber	0	50	0
Wash	14	20	41·1
Elsewhere	6	17	26·1
Totals ..	89	372	19·3

not propose to deflect our researches from the behaviour of ducks and geese to the behaviour of the men who pursue them, but it would be useful if the sportsmen themselves could be persuaded to find out who they are and what they are about.

WILDFOWL CONSERVATION IN THE NETHERLANDS

by G. V. T. Matthews

THE Netherlands and the British Isles are so intimately connected in the pattern of wildfowl distribution that some knowledge of conservation measures being undertaken in the former country is necessary for a full understanding of our own situation. I was therefore fortunate to be invited to join a party which Dutch conservationists took on a tour of their reserves in November 1956. The information gathered on this trip was supplemented by observations made on other visits in September 1955 and June 1956.

Public Relations

There is no doubt that the Dutch public have had a keen interest in the welfare of their wildfowl stocks for much longer than have people in this country. This is due in part to a widespread economic interest in wildfowl, but also because wildfowl are present in much greater numbers and spread over a much larger proportion of the country. Then in that small country, more than most, the never-ceasing pressure of expanding human population and concurrent land drainage and reclamation is particularly obvious to all.

The Dutch were also fortunate in producing, early in the present century, outstanding men of character who had the ability to elicit the powerful support,

collect the large sums of money and set up the competent administrative machinery which are essential for successful nature conservation. Only since the war have men of like calibre come on the scene in Britain. There is now full governmental support of the conservation movement in Holland. Its scale can be judged by the fact that about £300,000 a year from public funds are being made available for the purchase of *new* nature reserves. Even allowing for the price of land being on the average three times that obtaining in this country, this is a staggering sum by present British standards. (Our Nature Conservancy have been able to spend only about £5000 a year on the acquisition of reserves in the last three years.) Nor has voluntary contribution to nature conservation tailed off in the Netherlands. In the hard weather of February 1956, wildfowl were suffering badly through lack of food. Large supplies were made available, some being dropped from aircraft. Appeals for funds to support this work were made to the public. These were so successful that when the emergency passed the committee found that it had £10,000 in hand.

The Dutch have not taken as many positive steps as we have to bring the lay public into contact with wildfowl. In many cases such steps are unnecessary because a great part of the wildfowl population is easily seen from the roads and dykes and in protected areas the birds are remarkably tolerant of people completely in the open. But in a number of places full enjoyment of the birds is not possible because of the lack of covered approaches and of a Slimbridge-type observation hut or tower.

Administration, Management, Research

There are at present more than fifty wildfowl refuges in the Netherlands, ranging in size from a few acres to an estuary of 15,000 acres. The majority are wardened throughout the year. The entire outer coastline is a sanctuary. The reserves for the most part are owned by the state, coming under the Ministries of Finance, of Education and of Transport. Their administration and management is often in the hands of the Forestry Service, a government body, but many are run by private organisations. These may be national—the Society for the Preservation of Nature Reserves and the Society for the Protection of Birds—or regional in character, such as It Fryske Gea (Friesland) and the Noord-Hollandsch Landschap, Waterschap Wieringermeer, Zeeuwsch Landschap and De Beer Foundations. In some cases the organisation also owns the reserve in question. A small number of reserves are privately owned. The efforts of all these different organisations are to some extent co-ordinated by the government-sponsored Council for Nature Protection, and advice on management and new acquisitions is provided by that body's Scientific Commission. But there is no body like our Nature Conservancy having overall responsibility for research, advisory services, administration of legislation and acquisition and management of reserves, nor the opportunity for close collaboration by all parties which that provides.

Hitherto the acquisition of reserves has been largely a matter of expediency. But the Dutch are very keen that future acquisitions should be more closely dovetailed with biological requirements and are seeking to integrate their series of refuges with those of neighbouring countries. It is hoped that the chief migration routes will then be adequately sprinkled with protected places, where a proportion of the birds will be able to feed and rest undisturbed. The Dutch feel particularly strongly that it is little use offering sanctuary within their own

borders if the birds they save are to be subjected to persecution as soon as they move on south and west. This they do when hard weather sets in and the shallow waters freeze. One appreciates better the international aspects in the conservation of migratory birds when one lives in a 'staging area'. We ourselves are too prone, in our privileged position at the end of the line, to regard the wildfowl reaching us as 'ours' and to legislate as if they were only harvested in these islands.

Little work has been done on the scientific management of reserves to make them even more attractive to wildfowl. The emphasis has been laid on providing protection from destruction and disturbance, and it has been assumed, apparently with justification, that food stocks are adequate for the present population in normal conditions. Some excellent work has, however, been done on feeding habits, particularly in relation to possible agricultural damage. The main research effort, by the Institute for Applied Biological Investigations in the Field and by amateurs, has been directed to the study of distribution and populations. It is clear that estimation of numbers on the scale that occurs in the Netherlands presents many difficulties, particularly when the birds are spread over very large areas of water or sheltering in the extensive reed-beds. Certainly the range of the estimates produced by the distinguished members of our party was cause for sober reflection. We saw flocks of up to 7000 ducks, Mallard and Teal predominating; Coot were everywhere in like numbers, one flock of 1500 expanding and contracting like a great black whirlpool as it was attacked by a gull; Bewick's Swans occurred by hundreds. The main body of geese had not arrived, the weather being mild, but later we saw some thousand Greylags when on a trip up the Hollandsch Diep and through the twisting channels of the Biesbosch on a launch provided by the Ministry of Finance (Treasury!). The hospitable Dutch introduced us to a very agreeable form of bird-watching, sitting on deck with field-glasses in one hand and a glass of neat gin in the other. Lunch was taken anchored in the Sassche Plaat, off a mud island of some 250 acres, largely covered with *Scirpus*, on whose roots the geese were feeding. They were flighting to and fro quite unconcerned by the very dense river traffic. This latter had included a landing-craft flying the White Ensign, giving rise to some gentle digs from our hosts about gunboat politics.

From what we saw it would certainly appear that aerial survey, supplemented if possible by aerial photography, is the only method which holds out hopes of getting adequate estimates of the wildfowl populations present in the Netherlands.

Reclamation

The Dutch conservationists have developed excellent relations with the engineers carrying out the extensive land reclamation schemes. Opportunities occurring for the setting aside of areas in their original semi-natural conditions are seldom allowed to pass. A very important alteration in the general concept of land reclamation has come about in recent years. Hitherto the procedure was to throw a dam across an arm of the sea, or to build an arc of dykes from a relatively straight coast, then drain the enclosed polder. The process was then repeated and the land advanced step by step. In the land left behind, however, the water-table fell and the paradoxical situation arose that costly summer irrigation schemes were required. Conversely, in the polders nearest the current outer dyke, salt water seeped through, rendering the ground water saline and

restricting cultivation. Similar lessons on the dangers of over-zealous drainage have been learnt in America, where the summer drying-out has led to the formation of 'dust-bowls'. Such is their land-hunger that no Dutchman would contemplate the American solution of degrading farms back to marshes. However, they are taking steps to avoid the difficulties in future, as is shown in the reclamation scheme for the former Zuider Zee. First the dramatic, twenty-mile dyke was flung across the mouth of this great inlet of the sea. Then further dykes were built to enclose great areas to be pumped dry. The Wieringermeer Polder (50,000 acres) and the North-East Polder (120,000 acres) have already been drained and are in full cultivation. The dykes round East Flevoland (135,000 acres) had just been closed in the autumn of 1956, and we could see the tide going out for ever over this new land. Dredgers were still moving over the water, cutting drainage canals of the future. A rich but temporary feeding ground is exposed as the waters become shallow and recede. We did not see massed banks of waders, but driving, apparently straight out to sea, along the new Knardijk we came across an incredible concourse of at least 15,000 Scaup and 5000 Pochard. There were great flocks on the water, feeding on beds of a freshwater bivalve (*Dreissena polymorpha*) which had become accessible, or wheeling overhead in the sunlight.

Two more polders totalling 247,500 acres are planned. But there a halt will be called, leaving behind the main dyke a vast shallow fresh-water lake of more than half a million acres, the Ijssel Meer. Moreover, large areas of water are being left between the new polders and separating them from the older land. The Zwarte Meer (4500 acres) is already a famous reserve, and the new Veluwe Meer bids fair to rival it. Thus the most grandiose reclamation scheme to date has actually resulted in the creation of much superlative wildfowl habitat. It is perhaps worth emphasising again that these are, relatively speaking, fair-weather refuges. Also there will be reduction in the area of open water as the silt-laden streams empty into them. The clear, swift-running brook that we were shown near Hulshorst is a great rarity in the Netherlands.

Needless to say, the indefatigable Dutch will not rest content when the Zuider Zee project is complete. Already they are committed to the Delta Plan, throwing dykes across the numerous estuaries and inlets in the south of their country. There is heavy opposition from interests that will suffer, such as the fisheries, and the technical difficulties are far greater by reason of the depth of the channels and their swift, scouring tides. But the Dutch are convinced by their experience that it is far cheaper and safer to hold a relatively short line of extremely powerful defences rather than maintain the hundreds of miles of subsidiary dykes needed at present. Incredible as it may seem at first sight, such dykes will be dismantled as the immediate need for them passes. Most of the Netherlands is simply alluvial deposit, so all rocks must be transported from as far afield as Belgium, and are reckoned to cost a guilder apiece.

After the Delta Plan there is talk of joining up the chain of Freisian islands and driving the sea back to this outer arc. Small wonder that the Dutch conservationists have moments of despair, even though, as we have seen, reclamation is not now wholly inimicable to wildfowl. On the great closing dyke, which thrusts massively between the sea and the Ijssel Meer, holding them apart at different levels, I remarked expansively to one of our hosts that it must make him proud to be a Dutchman. He replied rather gloomily that he would be really proud of his countrymen when the birth-rate was dramatically lowered. And of course he was completely right. All our efforts to preserve

wildlife will be set at naught if the rising tide of humanity is not checked. Already the raging controversy over the Serengeti Park in East Africa sets the scene.

Land Drainage: 'Reallotment'

Besides their continual encroachments on the sea, the Dutch are assiduous in their endeavours to improve the land already reclaimed. The picturesque windmills have been largely supplanted by electric pumping installations, and the big rivers tamed between strengthened banks. Regular spring and winter floods are now a thing of the past, and great holding areas for wildfowl have vanished, particularly in the south of the country. A remarkable social revolution is in full progress, known as 'land reallotment'. Owing to large familes and complex inheritance customs, a farmer frequently owns several small plots of land, none of an economic size and widely separated. The disadvantages are the same as those of medieval strip-cultivation, overcome in England, with much friction and hardship, by the Enclosures. In the Netherlands drastic government action is being taken in several areas, particularly in those damaged by the 1953 floods, but also in parts of the country untouched by that catastrophe. An area with natural boundaries is designated for reallotment, meetings are summoned and in some remarkable way agreement is reached whereby each landholder receives a single block equivalent in value to his scattered holdings. The new holding is centred about his farm, and if this is not possible a new farm is built and the old one pulled down. Fresh canals are dug to improve drainage, and new roads are thrown across the land so that every field shall have direct access to a hard roadway.

This opening up of the land hits at the nature reserves, particularly the smaller ones, by drying them out and destroying their isolation. One landowner had solved both these problems by the same device on his private wildfowl sanctuary in Schouwen. The inner refuge of 200 acres, of which 50 are open water, is bounded all round by massive dykes 12 to 15 feet high. The water-table is thereby kept at a higher level than the surrounding land, and loss by seepage is more than matched by rainfall. The distance from dyke to dyke does not anywhere exceed a thousand yards, but the effect of isolation is very marked indeed and noises from surrounding farmland are muffled. Since breeding birds nest right up to the dykes, the effect is to extend the refuge by at least a hundred yards in all directions. Outside the dykes is a deep moat some 12 feet across, passable only by a drawbridge and forming an effective barrier against trespassers, cats, dogs and the like.

This refuge was started in 1930 and completed before the war. It was then largely ruined by the Germans inundating the island. Restored, it received an even more violent set-back in the disastrous storm-surge of 1953. For once a bird sanctuary provided immediate practical benefit, obvious to everyone. The refuge's dykes diverted the main onrush of the sea and gave the inhabitants of the nearby village time to flee from their houses and gather on the nearest high point, again the dykes. From here they were rescued by helicopter.

The area has now been 'reallotted', surprisingly, to benefit a refuge. All the owner's land is now grouped round the inner refuge, and, as he holds the shooting rights, the whole area of virtual sanctuary is thus about 500 acres. It is neatly bounded by roads on three sides and by the shore on the fourth, where the owner's manorial rights over the foreshore extend down to low-water

line. Several 'tiresome' neighbours have been moved elsewhere, and the flood-shattered farm-houses will be pulled down.

Shooting and Netting

The British shooter's lot is a happy one compared with that of his Dutch counterpart. Wildfowling in the true sense does not exist in the Netherlands. No shooting at all is allowed on the outer sea coast, although this restriction is less onerous than it might appear, since the coast is generally poor wildfowl habitat. Rather surprisingly, shooting licences (equivalent to our gun licences and costing £5) are only issued to shooters who have shooting rights over at least 100 acres for land game or 2½ acres for wildfowl. As a direct result of this restriction, only about 20,000 licences are issued each year. In this country, with a population only five times that of the Netherlands, the number of licences exceeds 300,000. The open season lasts from 1 August to 31 January, and shooting is forbidden on Sundays and feast-days. Shooting may only take place from half an hour before sunrise until half an hour after sunset. Shooting of birds on or near blow-holes or gaps in ice is not allowed, nor of birds exhausted by unfavourable weather conditions. The Minister of Agriculture has the power to stop all shooting immediately there is a severe frost, making his decision known by a simple announcement on the radio. Incidentally, similar powers are exercised in Denmark, Hungary, France and Germany. The Dutch stress the desirability of continuing the ban after the severe frost, since the survivors represent the best breeding stock. It is difficult to visualise British voters permitting a Minister to be armed with such arbitrary powers. But it is possible that shooters would impose voluntary restrictions on the rare occasions when this country is gripped by a heavy and prolonged frost; or even cut down on their own sport when such conditions occur on the Continent and our islands are the last refuge open to Europe's wildfowl.

Punt guns and swivel-guns are prohibited, but the use of mechanically propelled boats in immediate pursuit of wildfowl is permitted. Live decoys may be used tethered, provided they are neither blind nor maimed in any way. Barnacle, Brent and Canada Geese, Eider, Shelduck and Red-crested Pochard are protected completely. All other geese and duck may be taken during the open season.

The netting of geese by means of large spring-operated clap-nets, to which they are attracted by tethered decoys, has been nearly abolished. Special licences are issued to those who have long practised this technique, but not to would-be new recruits. Less than twenty persons are concerned with goose netting, each making an annual catch of between twenty and fifty geese, and considering it a particularly bountiful year if a hundred birds fall to their wiles. One may perhaps hope that the traditional technique will be kept alive for ringing purposes, as in the case of a woodcock-netting site we were shown near Rijs in Friesland. An enormous net 30 yards long by 13 yards wide is slung vertically on pulleys between two young telegraph-posts, straddling a known 'rode' in a wood. The operator watches intently in the half-light, and just as the flying woodcock is about to hit the net, the latter is allowed to slide down, entangling the bird in its now slack meshes. We spent some hours in the early morning staring at the net and saw three woodcock miss it. Even the operator's statement that he had caught 28 woodcock in the previous fortnight did not arouse much enthusiasm.

Duck Decoys

Undoubtedly the most controversial question in the Dutch wildfowl conservation picture is the part played by the duck decoys. There is no argument that in the past they have accounted for enormous numbers of ducks. The highest individual score in one year has been suggested as 100,000, but that is almost certainly an exaggeration. However, one decoy is known to have caught 30,000 in a season, in particularly favourable conditions, within the last quarter of a century. Decoys, as is well known, originated in Holland and had been in operation for centuries without causing serious diminution in stocks. To claim, as some wildfowlers have done, that only decoys could seriously shrink wildfowl numbers is to show ignorance of what happened in North America, where there were no decoys at all. Still, what we really want to know is whether the present decoys are being excessively destructive.

The number of active decoys in the Netherlands has shown a progressive decline over the past century or so:

1838	220
1888	170
1930	145
1948	120
1956	113

In addition to the active decoys there are 30 decoys in a fair state of preservation but no longer catching ducks.

A major factor in the decline of decoys is undoubtedly agricultural improvement. The opening up of the countryside is particularly disastrous to decoys, for they lose that isolation without which it is impossible to provide an undisturbed roosting-place. In one area that we visited near Rossum no less than nine decoys had recently been sterilised in this way. The virtual elimination of autumn flooding has also greatly reduced the catches, particularly in the case of inland decoys. Another factor which may be expected to have a strong influence on the survival of decoys is the extent to which they are profitable. Using Payne-Gallwey's figures (and noting in passing that he was not always accurate—he credited the Netherlands with only 70–80 active decoys in 1886),

Pintail drake

we may compare the prices received by the Dutch decoyman seventy years ago with today:

Species	Price per Bird in Pence		Rise in Price 1886–1956
	1886	1956	
Mallard	16	62	×3·9
Pintail	11	31	×2·8
Wigeon	8	21	×2·6
Shoveler	8	18	×2·3
Teal	5	13	×2·6

The year 1886 marked the nadir of the decline in price levels following the Napoleonic Wars. Using the cost-of-living indices where available and price levels in other cases, it would seem that the cost of living in the Netherlands has increased by six times since the 1886 period. A given catch is thus worth only from half to two-thirds what it was seventy years ago.

Nevertheless, though decoys must be less profitable than they were, they might still be workable if they gave a reasonable return. But any attempt to determine the average catch for the 113 Dutch decoys (and so arrive at a picture of their importance in European conservation) brings us up against the reticence to be expected under the shadow of the tax-collector. A recent attempt to measure the human harvest of cockles in Morecambe Bay, to compare with that of Oyster-Catchers, met with similar difficulties.

A decoyman in the Netherlands requires a wage of about £400 a year. The food used to entice the ducks into the pipes runs to another £100, and repairs, which may require extra labour, ground tax, water-rate, registration and other dues will certainly absorb another £100. So the decoy must catch £600 worth of ducks before it can maintain itself, let alone make a profit. The prices for the four decoys which had recently been sold as going concerns were £600, £1200 £1600 and £2700. We may therefore take an average market value of £1500, compared with the compensation the government were paying for decoys sterilised by reallotment—£1000 apiece. A return of £100 per annum on the investment would not seem excessive, bringing to £700 the value of the catch needed to make a profitable decoy.

The composition of the average catch for the whole country is given as Mallard 73%, Teal 15%, Wigeon 8%, Pintail 4%. Of course there are wide variations, many coastal decoys catching mainly Teal, others notable for their Pintail or Shoveler or Gadwall. But as an overall picture the above distribution is probably not misleading and indicates that a bag of 100 ducks will sell for about £21. A total catch in round numbers of 3300 ducks will therefore produce the income required for an overall profit, 2900 that for maintenance.

The average catch for 1956–57 as reported officially by 42 decoys was 2240. This accords with previous estimates by Dutch conservationists which vary from 2000 (made as long ago as 1939) to 2500 (1950).

The divergence of the 'official' average catch from the estimated minimum for profitable operation is due to two factors. Firstly the admitted catch is probably rather lower than the actual catch. Secondly the average has little meaning because the sizes of the individual catches vary so widely. Two decoys

are known to make catches of up to 20,000 birds each and some 25 are classed as 'really destructive' with catches of 5000–10,000 apiece. But many, perhaps the majority, are making small, uneconomic catches. Thus five decoys on Terschelling, known intimately by the investigator concerned, gave average catches of 730, 1316, 1283, 934 and 523 per decoy in the five seasons just before the last war. Such decoys are run on a part-time basis, the decoyman's main income being derived from other sources, such as farming.

We can conclude therefore that their failure to produce an economic return will not effect a reduction in the number of decoys to anything like the same extent as will agricultural improvements. At the same time it seems safe to conclude that the annual take at Dutch decoys does not exceed 300,000 birds.

This is quite a respectable total, but may be brought into proportion by considering shooting losses. The Dutch estimate that these exceed the decoy kill in their own country, and our own licensed shooters have each to shoot but one duck a year for a similar figure to be reached. Moreover, a considerable proportion of the Mallard taken in decoys are 'home-grown'. It is estimated that about 50,000 pairs, a third of the Dutch population of Mallard, breed in decoys and their immediate environs. They are encouraged to do so by putting out wicker nesting baskets, sometimes as many as 500 in the larger decoys. Almost every post in Friesland seemed to have a nesting basket. With so much encouragement, an average breeding population of a decoy of 350 pairs is not an excessive claim. We reckon that about 150 pairs of Mallard breed at the New Grounds, where they are only tolerated and consistently turned out of nesting boxes intended for their more exotic relatives.

Ringing data have indicated clearly that catches of Mallard early in the season, which have a peak in August, are almost wholly composed of Dutch-bred birds and represent almost two-fifths of the season's kill. The other three-fifths (say 180,000 birds) is composed of migrants, Mallard—which reach a second peak in December—predominating over other surface-feeding duck (blauwgoed) in a proportion of three to two. The decoy season is the same as that for shooting (August–January inclusive). The Dutch birds caught are usually birds of that year—those which have escaped the perils of their first season learn to stay out of trouble and remain as the more or less permanent 'lead' at the decoy.

The presence of a large decoy-bred population of Mallard means that the destruction of true wildfowl is considerably less than the overall total indicates. But the argument that decoys are actively beneficial in that they increase the population of Mallard is less attractive. Quantitatively there is no disputing the facts, but the quality of the product leaves much to be desired. Admixture with domestic blood is all too obvious in the majority of Mallard around decoys. Certainly a purist would not be distressed if the European population of Mallard was reduced by *this* 50,000 pairs. If one wants to farm ducks it would seem best to do so whole-heartedly as is done on a large scale round Harderwijk, using a high-protein diet of small fish for maximum production. At one point there our convoy of cars, full of wildfowl experts, was constrained by the narrowness of the road to follow a large lorry piled high with crates of Aylesburys, shedding a snowstorm of feathers.

A much more cogent argument for the retention of decoys is, paradoxically, their value as refuges. Even when being used for catching, decoys provide sheltered, undisturbed roosts for ducks, which would otherwise be lacking in a highly agricultural land. The decoyman guards his property jealously. In some

cases the decoy wood is surrounded by a moat crossed by only one bridge alongside his house, which is actually in the wood. There are severe laws against trespass and disturbance of decoys, supported by long-established public opinion in their favour. In most cases the freedom from disturbance assured by the 'afpalingsrecht' is not confined to the decoy and its wood but extends to a zone round it. The radius of this zone varies in different parts of the country as follows:

Province	*No. of working decoys and 'afpalingsrecht' (metres)*
Groningen	3 (all 500 metres)
Friesland	18 (1 nil; 1 400; 16 1200)
Wadden-Islands	11 (6 nil; 2 1130; 1 1200; 1 1506; 1 unknown)
Noord-Holland	9 (3 1130; 1 1318; 2 1506; 3 unknown)
Overijssel	13 (6 nil; 7 1130)
Gelderland	19 (18 753; 1 1506)
Utrecht	4 (2 753; 2 1130)
Zuid-Holland	17 (3 753; 1 767; 1 800; 8 1130; 4 unknown)
Noord-Brabant	15 (2 nil; 13 750)
Zeeland	4 (1 150; 1 600; 2 unknown)

Shooting is absolutely forbidden within the zone, and it was no coincidence that the only sizeable flock of Greylags we saw in the north of the country was feeding in the protected zone around Piaam decoy.

If a decoy falls into disuse, both the protective zone and the inner sanctuary of the pool will soon cease to be respected. Neither the state nor the conservation societies could provide funds to establish a warden at every decoy. Nor, indeed, would his employment be justified for such a small area unless he undertook ringing or the decoy was part of a larger nature reserve. So if the decoys at present active become non-operational, the diffuse sanctuary throughout the country that they now represent would be lost. There is a strong argument for maintaining the decoys on a selective catching basis, only Mallard being taken for the market. With Mallard comprising nearly three-quarters of the overall catch, such a limitation would be no great hardship to the decoyman or, alternatively, would require only a fairly small subsidy. Restrictive agreements are already in operation at decoys owned by a conservation society: Texel; Otterskooi, Giethoorn; Bakkerskooi, Wanneperveen; Kiarsderwijde, Wanneperveen; Breukelerveen, Utrecht; Naardermer, Amsterdam; Lekkerkerk, Zuid-Holland; Berkenwoude, Zuid-Holland.

Five other decoys, incidentally, have been turned into reserves where no catching is permitted: Anjummer Kolken (two decoys), Friesland; Giekerk, Friesland; Oude Miede, Friesland; De Dulver, Capelle; and three are devoted to ringing only: Piaam, Friesland; Gameren, Gelderland; Asperen, Gelderland.

Decoys do not only provide refuges for wildfowl. In very large areas of the Netherlands woods are absent save for those surrounding decoys. Indeed, it is generally a safe assumption that any isolated wood of mixed trees is a decoy-wood. They thus play a part in keeping up the stocks and widening the range of those species of animals and plants adapted to a woodland habitat. The Long-eared Owl and Golden Oriole are regular breeders in decoy-woods. Since the woods here have been in existence for centuries, they also provide interesting relict sites in the midst of intensive cultivation. Incidentally, decoy-woods played an important part in the saving of Dutch Resistance men from the Germans.

Decoymen do not welcome visitors, even those with official sanction, and I was able to examine only six decoys in detail, at Piaam (which had six pipes, all the rest having four), Giekerk, Vlieland, Asperen, Gameren and Schouwen. The Vlieland decoy was derelict, but was of particular interest in that the pipes were shielded by earthen dykes instead of rush screens. These were continuous along the length of the pipes, as were the rush screens at Giekerk. This type of screen is simpler to construct than the usual 'Venetian-blind' variety, but does not allow a dog to appear and disappear. The decoyman can only expose himself at one position, and then has to run along a narrow bank inside the pipe.

The use of earthen dykes has been followed in the Schouwen decoy which is an entirely new construction, built by the government to replace two lost by flood-silting and reallottment. The floods had destroyed all the trees in this area, and the traditional shelter of a decoy-wood was therefore not available. Instead, four 12-foot dykes had been thrown up round the whole decoy, the actual pipe screens being of rush. In addition, another dyke, 15 feet high, had been placed between the decoy and the more inhabited part of the surrounding countryside. Even with excavating machinery on the spot for flood repair work, this decoy had cost some £10,000 to construct. There is thus no fear that the number of decoys will increase in the Netherlands. This was the decoy's first catching season and it was little more than a raw excavation operated by the decoyman's widow, but already there was a good lead and the catch stood at 800. This decoy belongs to the owner of the private refuge described earlier, and will be restricted to Mallard catching in 1959. One of the original decoys here had incorporated a diving-duck trap—a cage 30 feet × 12 feet with a weighted door operated from a hide. Tufted Duck and Pochard used to be caught in fair numbers.

All the decoys seen had pipes of rectangular cross-section, and, being barely 7 feet high and 10 feet across, their mouths seemed very small compared with those at Slimbridge. In four decoys, instead of the pipes continuing to diminish in cross-section, they are terminated when about 5 feet high by a sloping area of wire-netting, the 'mirror'. The birds fly against this, drop to the ground and scuttle through a one-way swing wire door into a catching-box. The likelihood of birds flying up again may be further reduced by backward pointing osier sticks pushed into the ground below the 'mirror'. There seemed to be no opinion as to whether this type of trap, which originated in Friesland, was more efficient than the tunnel type. Its main advantage is that the pipes can be some 10 yards shorter, an important consideration when land is very precious.

It was surprising that in only two of the decoys—Asperen and Schouwen—was a dog used. In the others feeding alone is relied on to bring the call ducks into the pipe and the wild birds with them. This has the disadvantage that the 'call' birds are in the van and flush back when the decoyman shows, carrying some of the strangers with them. With a dog the habitués are less likely to take notice than are new-comers.

Only one decoyman insisted on the carrying of burning peat. We were told that the practice is rapidly dying out. This is surprising in view of the persistent suggestion that ducks have a well-developed sense of smell, a suggestion based mainly on the evidence of decoymen. But even if the faith in the ducks' sense of smell is dying, decoymen are still unwilling to pass up-wind of the pond. It is probable that ducks have a keen sense of hearing; sounds—the crackle of a leaf, footfalls on the quaking soil, even breathing—would be more easily detected

when the wind is behind their source. One cynical Dutchman suggested that decoymen tread more carefully when carrying a burning brand, while another advanced the opinion that a higher standard of personal hygiene amongst decoymen had eliminated the need for a smell obliterator.

Some hundreds of ducks were present in the Asperen, Gameren and Schouwen decoys, but good estimates are impossible when peering through cracks in screens. At Piaam a proper observation hide had been built. From this was revealed an incomparable spectacle in the brilliant sunlight. More than 2000 Teal and 500 Shoveler crowded the pool and its banks. These were trampled clear for two yards, and the birds were spread out evenly, at their 'individual distances', giving the effect of a brightly coloured, polka-dot scarf. The constant twittering uproar was insect-like in its intensity.

Conclusions

The Dutch are setting the rest of Europe an example by the vigorous way in which they are tackling the problems of wildfowl conservation within their borders. Widespread public interest and massive governmental support have been elicited. A good number of refuges have already been set aside and more are being designated every year. The extensive programmes of land reclamation and drainage are certainly bringing about a loss of wildfowl hatitat, but new habitats are also coming into existence and are being incorporated into the refuge system. Shooting is on a smaller scale than in this country, netting has almost vanished and the especial problem of duck decoys is well in hand.

The Netherlands is but a small country, and for their efforts to bear the fruit they deserve it is essential that other countries which share the same migratory wildfowl should take like measures of conservation. In particular, the British and Dutch efforts should be very closely co-ordinated. It is a sobering thought that we are the main market for wildfowl killed commercially in the Netherlands. In 1949 we imported a hundred thousand.

ACKNOWLEDGMENTS

Most of the facts and figures quoted were obtained in the course of discussions with Dutch conservationists, and in particular from Baron Charles Schimmelpenninck van der Oije, Professor G. J. van Oordt, Dr G. A. Brouwer, Dr M. F. Mörzer Bruijns, Mr M. C. Bloemers, Mr H. H. Buisman and Mr J. A. Eygenraam. In checking my notes or following up points raised I have had recourse to the publications of the Netherlands Section of the International Committee for Bird Preservation, and the following publications have relevant information:

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The British members of our party were Lord Hurcomb, Mr A. B. Duncan, Mr E. M. Nicholson and Dr J. Berry.

Garganey drake

STATION BIOLOGIQUE DE LA TOUR DU VALAT

by L. Hoffmann

THE Camargue never fails to bewitch visiting biologists, and if crude duty did not call them back to their country after a short or long time, most of them would stay and we would see a growing concentration of radiant people displaying field-glasses and living as in paradise. For the writer of these lines fate was not so cruel as for most others when he first visited the Camargue in 1947. He was just towards the end of his biological studies in Switzerland and no duty called him. So he ceded himself to the bewitchment, settled down in this beautiful country and developed his estate into a biological station.

From that it is clear that the station is neither devoted to a particular group of animals nor to particular problems, but to the Camargue itself. What we would like to find out is the web of conditions bringing together this wonderful land, and what we wish is to keep it safe for future generations.

In 1950 we began, M. Müller as assistant of the station, and I, with purely ornithological work. Soon we found out that we ought to know more about the ecology of the Camargue plants and invertebrates if we were to come to a deeper understanding of the ecology of the Camargue birds. So, in collaboration with the 'Centre National de la Recherche Scientifique', in 1953 and 1954 we began as a team on a basic quantitative ecological programme. M. Bigot follows the invertebrate animals and plants on some typical terrestrial Camargue stations, and M. Aguesse does the same work on some typical aquatic stations (mostly brackish water). As M. Müller and I simultaneously do regular census work on some birds, we have already a good numerical idea of the annual cycles of some birds and the biotic factors which may influence them. After a longer time we hope to be able to follow the long-term evolution which the Camargue undergoes under the influence of growing cultivation by irrigation. If we can find the outlines of these processes, we may be able to control them to a certain extent for the good of Camargue wildlife, working in collaboration with the 'Société nationale d'Acclimatation', the administrator of the 'Réserve de Camargue'.

Among the birds to which we pay special attention are the Flamingos, wildfowl, herons and waders. The Flamingos of the Camargue were already the object of several studies, and the books of Gallet and Yeates are well

known throughout the world. A less known and largely unpublished, but in fact probably the most important, study ever made of the behaviour and breeding-biology of Flamingos was done by H. Lomont, former chief warden of the Camargue Reserve, so that we already had much solid knowledge on which to base our own ecological observations In recent years we have determined the breeding success and taken mud and water samples on the main feeding-places. Since 1950 we have ringed 2364 chicks, driving them into a net corral when they are two months old, thus using the method of Peter Scott and others developed to catch moulting flightless geese. This ringing work brought us, up to 1 January 1957, 99 recoveries throughout the western Mediterranean and the Atlantic coast from Portugal down to Morocco.

Wildfowl are the dominant bird group in the Camargue during winter-time, and there is perhaps no other European country where such big flocks live in such comparatively little space. The lower part of Petite and Grande Camargue and Plan de Bourg holds on a surface of roughly 350 square miles a winter population of at least 150,000 wildfowl, most of them being surface-feeding ducks. Teal are the commonest, followed by Wigeon. Mallard and Gadwall are approximately equal third. We try to do census work on these wintering flocks. M. Müller makes weekly counts on the marshes belonging to the station. I fly over the whole region several times each winter, estimating the total population. Estimates are made by comparing during the flight the flock size with photographs of flock models.

We began ringing ducks in 1950, before the census work was started. As water is everywhere in the Camargue and the control of its level difficult, we thought that portable funnel-entrance traps would be better for us than decoys. The first seasons brought only very low catches, but in February 1953, after I had seen General Wainwright's traps at Abberton, we changed bait, following his advice and had bigger catches. Finally, we much increased the catches by constructing bigger traps, built in shallow water, in and around tamarisk tree groups, which give the ducks protection against the prevailing winds, and by baiting with big quantities of locally produced rice and millet. We think that we created with these great amounts of food really new habitats which were specially liked by the ducks when wind kept them from feeding on most of their usual places. In this way we ringed 6846[1] ducks in the 1955–56 season and had, with recaptures of birds already ringed, a total catch of 9978. This is the highest season catch of ducks, not only by any single station but even by any whole nation in Europe. At the end of the 1956–57 season our total of ringed ducks amounted to 12,288 birds, of which three-quarters were Teal, followed by Mallard and Garganey. Up to 1 January 1957 these birds brought us 4362 recaptures in our own traps and 1100 recoveries abroad—in France, in nearly all other European countries and in western Siberia.

Among the waders, we care chiefly about the common species such as Stilt and Avocet in the breeding season and Wood Sandpiper and others during migration. Raymond Lévêque made an ecological study of the Avocet, chiefly concerned with limiting factors.

We have found that several species of sandpiper and plover stay in the Camargue for a long time in early autumn, moulting their wing-feathers.

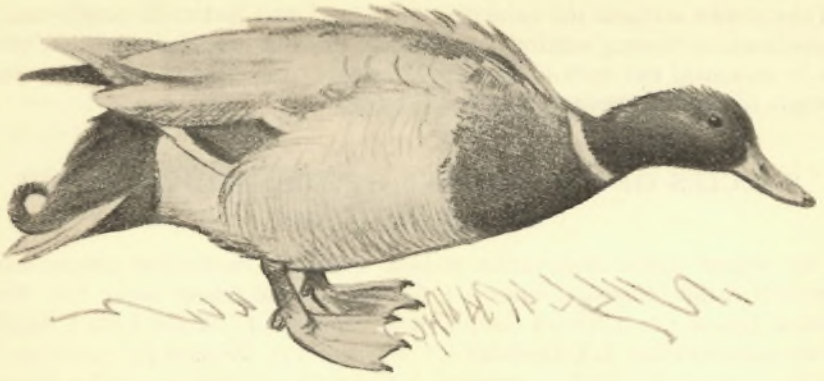
The Herons were first watched by our Spanish friend, J. A. Valverde, who made an ecological study on Egrets and Night Herons. In summer 1957,

[1] The claim that the Trust's total of 5882 in the same season was a European record (*8th Annual Report*, p. 15) evidently should not have been made.—EDITORS.

Graham Williams, a member of the British Trust for Ornithology, made a breeding and food research on the Purple Heron.

Our intentions for the future are to follow the same line, and to learn more and more of the biological web called the Camargue, using two methods simultaneously: (*a*) quantitative surveys of the complete fauna and flora on some typical stations, (*b*) monographic studies on some typical species.

Teal drake



WILDFOWL RESEARCH IN RUSSIA

Biological Foundations for the Regulation of Wildfowling in the Central Districts of the European Part of the U.S.S.R.

by V. F. Teplov and N. N. Kartashev

(*Oka State Sanctuary and Moscow State University*)

This paper was originally published in Russian in the (*Moscow*) Zoological Journal, *Volume* 35, *Part* 1, *pp.* 77–88 (1956). *A copy was made available to us by Professor G. P. Dementiev of the Moscow State University. It says so much about Russian attitudes towards wildfowl, wildfowling and wildfowl research, as well as providing important factual data, that it seems well worth reprinting at length. Mr D. D. Harber undertook the translation, for which we are most grateful. A few editorial changes have been made, with the objects of improving the layout of the tables and of removing some repetitions in the text, but no significant omission or additions have been made.*

INTRODUCTION

THE material for the present work was collected during 1953 and 1954 on the territory of the Oka State Sanctuary and in the adjacent shooting areas. The following were covered by our observations: the flood-lands of the River Oka within the limits of the Uzhevski and Yerakhturski regions of the Ryazan district, the flood-lands of the River Pra on its lower course (approximately 40 kilometres from its mouth), and a series of lakes outside the flooded areas and situated in the Oka Sanctuary (Yerus, Ukhanskoie, Tatarskoie, Kalnoie, Svatoie-Poluninskoie, etc.).

As a result of the work which was performed, we had at our disposal records of encounters with more than 32,000 waterfowl, information as to the species of 356 birds obtained by hunters and the results of the laboratory examination of 210 ducks. Besides this, over a period of years, over 700 ducks had been caught alive in the Sanctuary and ringed, and information about some of these was also utilised in our work.

In addition, all the material relating to duck ringing concentrated in the Ringing Bureau of the Chief Administration of Sanctuaries and Hunting Economy of the Ministry of Agriculture of the U.S.S.R. was examined and made use of where possible.

Taking into account the similarity of natural and historical conditions and the methods of hunting wildfowl, we consider that our proposals and conclusions can be extended not only to the Ryazan district but also to all other central districts of the European part of the U.S.S.R.

SPECIES OF WATERFOWL OF THE REGION OF THE OKA SANCTUARY

In the region under observation sixteen species of waterfowl are recorded: Whooper Swan (*Cygnus cygnus* L.), Greylag Goose (*Anser anser* L.), White-fronted Goose (*A. albifrons* Scop.), Bean Goose (*A. fabalis* Lath.), Mallard (*Anas platyrhynchos* L.), Gadwall (*A. strepera* L.), Wigeon (*A. penelope* L.), Pintail (*A. acuta* L.), Teal (*A. crecca* L.), Garganey (*A. querquedula* L.), Shoveler (*A. clypeata* L.), Goldeneye (*Bucephala clangula* L.), Pochard (*Aythya fernia* L.), Tufted Duck (*Aythya fuligula* L.), Scaup (*Aythya marila* L.), and Smew (*Mergus albellus* L.).

Of the species named, only seven—the ducks of the genus *Anas* (excluding the Wigeon) and the Pochard—nest with us annually.

The relative numbers of the species of wildfowl observed and obtained by local wildfowlers at different seasons are shown in Table I.

TABLE I

Relative Numbers of Wildfowl Seen and Shot in the Region of the Oka Sanctuary at Different Seasons

Percentages of Total Population

Species	Sight Records			Obtained by Hunters	
	Spring 1 April to 10 May (14,900 birds in all)	Summer 1 June to 31 July (3250 birds in all)	Autumn 15 Aug. to 1 Nov. (14,100 birds in all)	Spring (183 birds in all)	Autumn (173 birds in all)
Mallard	7·2	50·1	79·3	65·0	68·2
Teal	2·0	13·2	6·8	10·9	13·8
Garganey	5·9	29·5	3·1	16·4	13·3
Pintail	1·1	2·8	0·4	1·6	0·6
Shoveler	0·3	2·8	0·4	0·6	—
Gadwall	0·2	0·9	0·6	2·2	1·7
Wigeon	22·4	—	0·6	0·6	0·6
Tufted Duck	0·6	0·2	1·6	—	1·2
Scaup	0·3	—	—	—	—
Pochard	1·3	0·5	0·3	—	0·6
Goldeneye	0·2	—	0·8	—	—
Smew	0·1	—	0·1	—	—
White-fronted Goose	48·2*	—	—	2·7	—
Greylag and Bean Geese	10·1	—	—	—	—
Whooper Swan	0·1	—	—	—	—

* *Many of these geese would almost certainly have spent the winter at Slimbridge, for recoveries of Trust-ringed Whitefronts include several from Ryazan.*—EDITORS.

Some idea of the numbers of wildfowl at different times of the year is given by Table II.

TABLE II

Relative Abundance of Wildfowl Seen in the Oka Sanctuary Region

Species	Maximum number of individuals encountered in a day in the period of:		
	Spring Passage	Nesting and Moult	Autumn Passage
Mallard	40	150	1000
Teal	15	100	200
Garganey	120	100	200
Pintail	50	20	50
Shoveler	14	20	50
Gadwall	10	20	50
Wigeon	1300	—	60
Tufted Duck	50	1	150
Scaup	40	—	—
Pochard	70	20	50
Goldeneye	13	—	70
Smew	2	—	5
White-fronted Goose	1000	—	?
Greylag and Bean Geese	200	—	150
Whooper Swan	7	—	—

In spring in our region Wigeon and geese are the most numerous species; they amount to 80% of all wildfowl encountered. At this season Mallard, Teal and Garganey predominate amongst birds obtained by wildfowlers, and form more than 90% of the total number of birds killed. Mallard, Teal and Garganey also predominate during the nesting and moulting period; during this time they amount to almost 93% of the wildfowl recorded. During the period of autumn passage the Mallard is most often encountered (79·3% of the total records). This same species occupies first place among duck obtained by wildfowlers in autumn (68·2%). A characteristic feature of the wildfowl fauna of the region of the Oka Sanctuary at all seasons is the marked preponderance of vegetarian and omnivorous species over those eating animal matter, which is, in all probability, due mainly to the lack of transparency of the water and partly to its relative poorness in animal foods.

HUNTING WILDFOWL

Periods and Methods

In our region wildfowl are shot both in spring and in autumn. In spring, shooting is usually permitted from the time of the arrival of the duck (i.e. from the beginning of April) and continues up to 2–5 May, for more than thirty days. It is permitted in spring to obtain the drakes of all species and also geese on passage. The most general method of obtaining wildfowl in spring is the shooting of Mallard drakes which go to a decoy duck. Shooting geese by lying in wait for their evening and morning flights is less widespread. The remaining

species of wildfowl are very rarely obtained in spring and mainly at the same time as drake Mallard. Obtaining Wigeon and diving duck by the use of decoys (dummies) is not practised.

Autumn shooting of wildfowl is usually allowed with us from 1 August (only in 1954 was it changed to 15 August) and it continues up to the departure of the birds, i.e. until the beginning or sometimes the second half of November—for 92 to 107 days.

In autumn almost exclusively surface-feeding ducks are obtained with us (Table I); in August mainly by shooting at broods and in the remaining autumn months mainly by shooting during the evening and morning flights.

Duck occupy the main place among game shot by local shooters. At the present time cases are not rare where a single fowler obtains 15–25 drakes in spring and 50 or more individuals in autumn.

In the regions surrounding the Oka Sanctuary there are no game reserves. Their function is fulfilled by the territory of the Sanctuary in which considerable numbers of duck, reaching several thousand individuals, nest and in autumn spend the day. Thus, for example, in Markino Bog, with an area of about 50 hectares (about 124 acres), 40–50 broods of various duck species are to be found in favourable years; on Lake Pilki, with an area of about 2 hectares (5 acres), up to 500 Mallard spend the day in the second half of August and in September, and on Lake Yerus, with an area of 30 hectares (74 acres), more than 1000 duck not infrequently assemble in September and October. Taking into account the fact that the total area of the lakes of the Oka Sanctuary amounts to 350 hectares (865 acres), and that of the bogs to 3000 hectares (7400 acres, or $1\frac{1}{8}$ square miles), we must conclude that the Sanctuary exercises without doubt a very positive influence on the preservation of stocks of wildfowl in the adjacent hunting territories.

Justification of the Measures immediately necessary in order properly to Regulate Hunting

We consider it possible to allow spring shooting under the overriding condition that its times and methods should be brought into conformity with the interests of protecting and increasing game. Spring shooting must be carried on with the object of causing the minimum losses to nesting birds.

The Mallard must be considered the main species of wildfowl nesting abundantly in our region. This same species, as we have seen, is also predominant among the wildfowl obtained by shooting in spring.

The Mallard arrives early with us—at the end of March or the beginning of April. The average date of encountering the first Mallard over seventeen years is 1 April; the extreme dates are 13 March and 13 April. The local ducks which have already split up into pairs on their wintering grounds are the first to arrive. During the first ten to fifteen days after arrival, the Mallard pairs remain inseparable and not infrequently come down near the decoy ducks. Later, with the beginning of egg laying, the pairs separate during a considerable part of each twenty-four hours, and it is almost exclusively the drakes which approach the decoy ducks. At this same time (from about the end of the second ten days of April) a number of drakes without mates appear in the area. It can be supposed that these are birds which have not found a mate on the wintering grounds and which have arrived after the mated birds. The number of such 'bachelor' drakes with us is rather larger than that of the nesting pairs and, in distinction from these, they lead a nomadic life. Thus, for example, at Ageieva

Gora, in an area of about four square kilometres, the staff of the Sanctuary shot 18 Mallard drakes in the spring of 1953 and 24 in that of 1954. After this shooting the number of drakes in this area had not noticeably decreased, and they flew up to the decoy ducks no less frequently than at the beginning. This can be explained only by a continual arrival of 'bachelor' drakes. However, the problem of the status of this group of drakes can only be finally solved by ringing them.

The attitude of the wild Mallard, and also other species of duck, to the decoy ducks at different periods in spring is shown in Table III, which has been compiled on the basis of our observations during 73 experimental shoots in the spring of 1954.

TABLE III

Seasonal Changes in the response of Males and Females to Decoy Ducks

	Five-day Periods in April					Five-day Periods in May		
	6–10	11–15	16–20	21–25	26–30	1–5	6–10	11–15
Percentage of females among Mallard coming to a decoy duck	43·0	40·0	13·0	0	10·0	0	0	0
Number of drake Mallard coming to a decoy duck during 10 hours of hunting	5·5	3·2	5·7	8·6	9·5	6·7	7·2	12·7
The same for drakes of other species	0	0·7	0·7	0	0·4	2·9	7·7	18·2
The duration of experimental hunting in hours	23·5	28·0	47·5	10·5	28·5	10·5	19·5	5·5
Total number of Mallard coming to a decoy duck during all hunts	23	15	31	9	30	7	14	7
The same for other species of duck ..	—	3	5	—	2	6	26	15

Mallard drakes approach decoy ducks with particular intensity from the third ten days of April. Mallard females from this period and up to the end of the first half of May scarcely approach decoy ducks at all. Thus, out of 67 Mallard approaching decoy ducks during this period, only 3 (i.e. 4·5%) were females. We see a completely different picture during the first two ten-day periods of April. Mallard females very frequently approach a decoy duck at this time. Out of 69 Mallard approaching a decoy during this period, 20 (i.e. 29%) were females. From the second half of May the drake Mallards begin to assemble in flocks before their departure to their summer moulting places; a certain number remain for the moulting period in the region of the Oka Sanctuary.

The fact that female Mallard are very vulnerable to wildfowlers at the beginning of April is confirmed by the ratios among ringed duck obtained in spring in the central zone of the European part of the U.S.S.R. (Table IV).

The females of the remaining species of surface-feeding ducks are obtained in spring twice as frequently as those of the Mallard, due obviously to shooting at flocks on passage. It is necessary to bear in mind that the relative number of females among duck obtained in spring given in Table IV is very probably too low, owing to the fact that wildfowlers conceal some of the rings taken from females, the killing of which is forbidden everywhere in spring, and also because males predominate among the ducks which are ringed (this subject is treated in more detail below).

TABLE IV

Number and Sex of Ringed Ducks killed in Spring in the Central Zone of the European part of the U.S.S.R.

Species	April						May					
	1–10			11–20			21–30			1–10		
	M.	F.	%F.	M.	F.	%F.	M.	F.	%F.	M.	F.	%F.
Mallard	10	3	23	35	1	3	36	1	3	28	2	7
Other dabbling ducks: Pintail, Teal, Garganey, Gadwall, Wigeon, Shoveler	19	3	14	49	5	9	52	10	16	44	7	13

On the basis of what has been said above, the most acceptable time for shooting Mallard in spring under our conditions may be regarded as the period from 20 April to 10 May. This period is also suitable from the point of view of the proper organisation of shooting other species of surface-feeding ducks.

The latter conclusion is based upon changes in the relative numbers of the species of wildfowl during different periods of spring in the region of the Oka Sanctuary (Table V). The numbers of birds of each species are shown in the table as percentages of the total number of all individuals recorded during the given ten-day period.

TABLE V

Changes in the Relative Abundance of different Species in the Oka Sanctuary Region in Spring

Name of Species	April Ten-day Periods			May		
	1–10	11–20	21–30	1–10	11–20	21–30
Mallard	62·6	30·1	3·4	2·9	30·0	22·3
Teal	—	7·6	2·3	2·3	13·7	4·5
Garganey	—	8·7	7·0	4·6	18·0	61·7
Shoveler	—	1·7	0·6	0·2	7·3	5·5
Pintail	23·4	1·5	0·8	0·3	1·4	2·8
Gadwall	—	—	0·1	—	—	0·6
Wigeon	11·0	8·5	15·1	36·1	8·6	—
Goldeneye	3·0	—	0·1	0·1	—	0·9
Pochard	—	—	0·5	2·0	1·0	1·4
Smew	—	—	0·1	—	—	—
Greylag and Bean Geese ..	—	21·6	1·2	0·1	—	—
White-fronted Goose	—	20·3	63·8	51·4	20·0	0·3
Total number of birds involved*	137	427	4100	5500	235	640

* In 1954, when we collected material for Table V, the Tufted Duck, Scaup and Whooper Swan were not recorded at all on spring passage in the region of the Oka Sanctuary.

The main mass of migratory wildfowl (Wigeon, diving duck and geese) passes through our region during the third ten days of April and the first ten

days of May. Wigeon and White-fronted Geese stay in considerable numbers on those parts of the meadows which have emerged from the water and live there until the middle of May. The termination of spring shooting on 2–5 May, as is the case at present, in practice excludes these abundant species as objects of spring shooting. The same may be said about the diving ducks, which are, it is true, relatively few in number in our region.

The numbers of wildfowl in the period of spring passage are shown in Table VI, based on observations in 1953 and 1954.

TABLE VI

Numbers of Wildfowl seen in Spring in the Oka Sanctuary, 1953 and 1954

Year	Month and 10-day Period	No. of Hours of Observation	No. of Individuals recorded during 10 hours			
			Surface-feeding Duck	Diving Duck	Geese	All Water-fowl
1953	April 11–20	14	120	55	255	430
	21–30	11	350	100	315	765
	May 1–10	7	570	25	285	880
1954	April 1–10	5	140	10	—	150
	11–20	15	105	—	65	170
	21–30	25	430	10	1160	1600
	May 1–10	32	725	35	545	1305

The numbers of wildfowl during the first two ten-day periods of April are not large, and mostly consist of local nesting species (Mallard, Teal and Garganey) or of species passing through our locality without staying long (Greylag Goose, Bean Goose). In wildfowling during these first two ten-day periods of April, nearly all the birds killed are Mallard (Table VII).

TABLE VII

Numbers of Wildfowl killed in Spring in the Oka Sanctuary Region (1954?)

Species	Number of Birds Killed			
	April			May
	1–10	11–20	21–30	1–10
Mallard	17	36	51	15
Pintail	—	1	2	—
Shoveler	—	—	1	—
Gadwall	—	—	2	2
Wigeon	—	1	—	—
Teal	—	1	12	17
Garganey	—	1	8	11
White-fronted Goose ..	—	—	1	4
Total killed	17	40	77	49
Percentage of Mallard ..	100	90	66	31

If spring shooting were permitted from 20 April to 10 May, its effect on the local breeding population of duck would be considerably lessened, and it would be possible to include among its objects the gregarious northern species (Wigeon, White-fronted Geese and diving ducks) which at present are scarcely made use of with us.

The moving forward of the period of spring shooting to the last ten days of April and the first ten days of May would not result in a very great decrease in the total number of wildfowl killed in spring, since this is the period at which the central zone of the European part of the U.S.S.R. is most productive, as is seen from Table VIII, which records the numbers of ringed ducks recovered in this zone in spring.

TABLE VIII

Numbers of Ringed Ducks recovered in Spring in the Central Zone of the European part of the U.S.S.R.

Species	Number of Ringed Duck obtained in Central European Russia												Total	
	April						May							
	1–10		11–20		21–30		1–10		11–20		21–31			
	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%
Mallard ..	14	11·2	36	28·8	40	32·0	30	24·0	5	4·0	—	—	125	100
Teal	7	8·2	17	20·0	25	29·4	27	31·8	9	10·6	—	—	85	100
Garganey ..	1	2·4	8	19·5	14	34·2	15	36·6	1	2·4	2	4·9	41	100
Shoveler ..	—	—	2	22·2	2	22·2	4	44·5	1	11·1	—	—	9	100
Pintail ..	14	12·7	31	28·2	33	30·0	21	19·1	9	8·2	2	1·8	110	100
Gadwall ..	1	7·2	4	28·5	3	21·4	1	7·2	5	35·7	—	—	14	100
Wigeon ..	—	—	4	30·8	5	38·4	3	23·1	1	7·7	—	—	13	100
All Species ..	37	9·3	102	25·7	122	30·7	101	25·5	31	7·8	4	1·0	397	100

An essential condition for allowing spring shooting of wildfowl in the central districts of the European part of the U.S.S.R., in our opinion, is that it must retain a purely sporting character. Shooting in spring must not be linked with the mass killing of game. The number of birds obtained by fowlers at this season must be limited and must strictly correspond with the supplies of game in the shooting areas. This, of course, presupposes a considerable strengthening of the effective control of the appropriate organisations over spring shooting.

We consider the two prerequisites for allowing spring shooting of wildfowl to be: (*a*) the formation in every district of seasonal spring reserves, covering not less than a quarter of the territories occupied as nesting sites by duck, and (*b*) the carrying out of a mass shoot of the Hooded Crow in the shooting territories. This bird, as investigations in the Sanctuary have shown, destroys under the conditions prevailing with us large numbers of clutches of wild duck and other game birds. Every shooter who obtains permission to shoot in spring must have the task of destroying two or three pairs of crows.

A very important element in the preservation of wildfowl is the campaign against taking duck eggs, a practice which still occurs with us on occasion. The fines for destroying nests must be considerably increased, and the protection of

shooting territories, particularly meadows, improved. At the same time wide-spread, mass explanatory work must be carried on amongst shooters.

We will now proceed to deal with autumn shooting. We consider that its start should be fixed at a time when the absolute majority of the duck broods are able to fly. The usual date for the beginning of autumn shooting in our regions —1 August—does not correspond with this demand. During June and July in 1953 and 1954 117 broods of duck were recorded in the region of the Sanctuary, and notes were made of their numbers, approximate age and the stage of the plumage development of the ducklings. Using these data, we established the percentages of broods unable to fly for different species of duck by 1 August, the usual time for the beginning of autumn shooting (Table IX).

TABLE IX

Proportion of Broods of Ducks breeding in the Oka Sanctuary still unable to fly by 1 August

Name of Species	No. of Broods	Broods unable to fly by 1 August	
		No.	%
Mallard	56	15	27
Teal	27	8	30
Garganey	26	9	35
Pintail	3	2	67
Shoveler	3	2	67
Gadwall	2	1	50
All Species ..	117	37	32

At the beginning of August, among all species of duck, broods unable to fly formed 32%. Such broods were encountered most frequently among Garganey, Pintail, Shoveler and Gadwall, species which begin to nest later than the others—mainly on the banks of the lakes of the flooded areas which do not usually become free from spring flooding until the first half of May. In the cases of the Mallard and the Teal, which nest earlier and not infrequently in woodland, far from water, broods unable to fly were encountered more rarely at the beginning of August though the number of such broods was still quite large.

The later dates of the 'ripening' of broods of Garganey, Pintail, Shoveler and Pochard are well illustrated by the data for catching duck for ringing. In the Oka Sanctuary mainly young duck, not yet able to fly, are caught for ringing. Table X shows the relative numbers of different species of duck caught for ringing during the last ten days of July, and compares these with their relative numbers in nature, determined by mass counts in the nesting period.

Mallard and Teal are encountered among duck caught for ringing—i.e. among birds which are still unable to fly at the beginning of August—only half as frequently as they are met with among duck recorded during the nesting period. But Garganey, Pintail, Shoveler and Pochard are encountered more frequently amongst flightless birds caught than in the wild. One of the reasons for the rarity of these species as nesters with us can be considered to be the shooting of their broods before they are able to fly, as has undoubtedly taken place every year when shooting has been allowed from 1 August.

The data relating to the return of rings from duck (mainly adults) obtained

TABLE X

Number of Ducks caught for Ringing in the Oka Sanctuary in late July compared with the Numbers seen during the Nesting Period

Species	No. of Birds seen during the Nesting Period		No. of Birds caught for Ringing, 21–31 July	
	abs.	%	abs.	%
Mallard	1630	50	70	24
Teal	430	13	17	6
Garganey	960	30	120	42
Pintail	90	3	24	8
Shoveler	90	3	45	16
Pochard	15	1	12	4
All Species ..	3215	100	288	100

in the central zone of the European part of the U.S.S.R. also confirm that August shooting is most injurious to late-nesting species of wildfowl. Thus, for instance, among Pintail obtained in August the percentage of females is 69%, whereas in the case of the Mallard, which nests early, it is only 48% in this month. In September the females of both these species are obtained considerably less frequently—37% and 43% respectively. As has already been shown above, broods of flightless Pintails are encountered much more frequently in August than broods of Mallard. This is the reason why females of the former species are more frequently obtained: females with broods unable to fly are much easier game for hunters than females with broods already on the wing.

Taking into account the considerable number of duck unable to fly at the beginning of August, and also the fact that young duck beginning to fly use their wings unwillingly and are too confiding in relation to man for at least ten days after taking wing, we must regard it as necessary to shift the beginning of autumn shooting to the end of the second ten days of August.

If autumn shooting starts from 20 August the possibility of killing ducks unable to fly will be almost completely excluded, and there will be fewer adult females obtained while they are decoying dogs away from broods unable to fly and thus becoming the first to be shot by the fowlers. The autumn shooting of wildfowl should continue with us until the end of their mass stay here, i.e. until the end of October—for 70 days.

Besides putting in order the times for the autumn shooting of wildfowl, we consider the following to be among the steps which should immediately be taken in order to rationalise hunting: (*a*) the organisation of increased and effective protection of shooting territories during the period when duck are nesting, when with us cases of taking eggs and of duck unable to fly or in moult being caught by dogs are not infrequent, and (*b*) the formation of autumn shooting reserves embracing not less than a quarter of the flood-land territories. These reserves must be chosen so as to contain waters suitable for duck both to spend the day and to feed. The necessity of carrying into effect these two measures is obvious without special discussion. If shooting is allowed only during the period indicated and if reserves are organised, no limitation of the number of duck to be killed in autumn is in our opinion necessary.

CHANGES NECESSARY IN RINGING WATERFOWL

The practical value of marking and ringing animals in solving a number of questions connected with the rationalisation of their exploitation and as one of the methods of calculating the relative numbers of economically important species is obvious. The ringing of wildfowl has been carried on quite widely in the Soviet Union and has made it possible to elucidate a number of problems of their ecology, thus facilitating the organisation of wildfowling. For several species of duck we have learned in general outline the main directions of the seasonal migrations, the wintering grounds and some regions of mass moulting; for individuals of some species the constancy of nesting-places has been established and so on.

However, the relatively small number of birds ringed annually and the defects of the present distribution of the main ringing points make it impossible, as yet, to utilise the material obtained through ringing to a sufficient extent.

We will illustrate this with examples:

The number of ringed duck obtained should, theoretically, be proportionate to the total number of birds shot. An analysis of the material giving the numbers of ringed duck obtained in the European part of the U.S.S.R. (Table XI) shows that most are obtained in the southern zone (the shores of the Black Sea and the Sea of Azov and the adjacent regions, Transcaucasia, the shore of the

TABLE XI

Seasonal and Regional Distribution of Recoveries of Ringed Ducks in the European part of the U.S.S.R.

Month	European Part of the U.S.S.R.							
	Number of Ringed Duck obtained*							
	Southern Zone		Central Zone		Northern Zone		Total obtained in the European part of the U.S.S.R.	
	abs.	%	abs.	%	abs.	%	abs.	%
January ..	74	9·3	1	0·1	1	0·6	76	4·5
February ..	117	14·7	3	0·4	—	—	120	7·1
March ..	213	26·7	5	0·7	—	—	218	12·3
April ..	44	5·5	261	35·5	6	3·6	311	18·3
May	2	0·3	130	17·6	106	64·3	238	14·0
June	—	—	5	0·7	16	9·7	21	1·2
July	2	0·3	18	2·4	2	1·2	22	1·3
August ..	98	12·3	171	23·3	22	13·3	291	17·1
September ..	45	5·7	97	13·2	10	6·1	152	9·0
October ..	60	7·6	36	4·9	2	1·2	98	5·9
November ..	84	10·6	6	0·8	—	—	90	5·3
December ..	61	7·7	2	0·3	—	—	63	3·7
Total ..	800	100·7	735	100·0	165	100·0	1700	100·0

* Material relating to six species of Anatinae is included: 508 recoveries of Mallard, 294 of Teal, 126 of Garganey, 45 of Shoveler, 577 of Pintail, 96 of Gadwall, 54 of Wigeon.

Female Mallard

Caspian Sea and the lower Volga) in March, in the central zone in April and in the northern zone (the Karelian-Finnish S.S.R., Murman, the Arkhangelsk district) in May. These data correspond without a doubt to the actual position.

At the same time this material does not make it possible to compare the amounts of shooting in different zones, since parts of the duck populations of the northern and central zones of the U.S.S.R. are in practice hardly covered by ringing. For this reason the relative weight of spring shooting in the northern zone is obviously lowered—only 112 ringed duck, or 14·6% there, against 396, or 51·6% in the central, and 259, or 33·8%, in the southern zone. (The percentages were calculated from the total number of ringed duck obtained in the whole of the European part of the U.S.S.R. in March–May.) This disproportion appears also in comparing the intensity of autumn shooting in different zones; in August–October 203 birds, or 37·5% of the total of all ringed duck obtained in this period in the European part of the U.S.S.R., were obtained in the southern zone (Table XI), 304, or 54·4%, in the central zone, and only 34, or 6·3%, in the north. The peak numbers of ringed birds in all zones are obtained in August—the month when shooting begins.

According to the material relating to ringing, the intensity of autumn shooting is considerably less than that of spring shooting; in March–May in the European part of the U.S.S.R. 767 ringed duck were obtained, in August–October only 541. This in no way corresponds with the true position, and is due to the very small number of ducks ringed in their first summer.

The uselessness of the material relating to ringing in elucidating a number of important questions of duck ecology, a knowledge of which is necessary for planning shooting for sport and for trade (as is shown above), arises from the following defects in carrying out the ringing of waterfowl:

1. The fact that the total number of ducks ringed is inadequate for our large territory—only about 10,000 birds are ringed annually.

2. The limited character of the localities for mass ringing which are largely restricted to assembly places for moulting ducks in the southern regions of the country. Thus about 26% of the Mallard, 90% of the Wigeon, 96% of the Gadwall, 97% of the Teal and 99·8% of the Pintail ringed in 1950 in the U.S.S.R. were caught in the Astrakhan Sanctuary and adjoining regions.

3. The unequal covering of different species of duck. Of all ducks ringed in the U.S.S.R. in 1950, Pintail comprised 62·7%, Teal 17·7%, Mallard 8·7%, Garganey 6·4%, Shoveler 2·2%, Gadwall 1·5% and Wigeon only 0·8%.

4. The excessive uniformity of the sexual composition of the ducks ringed. In 1950, drakes formed 93% of the total number of ringed Mallard the sex of which was determined, drake Pintails were 74%, drake Wigeon 96%, drake Teal about 90%. This is due to the fact that the main mass of birds is ringed in the region of the Astrakhan Sanctuary, on the moulting grounds where adult males predominate.

5. Young birds of the year are almost completely omitted from ringing. Among duck ringed in 1950 in the U.S.S.R. young birds of the year formed 36% among Mallard and Shoveler, 3% among Gadwall, less than 2% among Teal, and only 0·5% among Pintail.

For these reasons ringing data give no indication at all of the relative extent to which spring and, in particular, autumn shooting is practised in different zones. The need of such data for planning shooting for sport and for trade is obvious and requires no further proofs.

The defects which have been indicated reduce misleadingly the percentages of females obtained in spring (Table IV), prevent the elucidation of the nature and the time of the dispersal of young birds from nesting-places in various localities in all zones, make it impossible to discover the extent to which various age and sex groups are shot or perish from natural causes in different years, and so on. . . .

On the basis of the above we consider it absolutely necessary, while increasing the amount of duck ringing in the places where they assemble for moulting in the south—the Kuban flats, the Volga delta, the lakes of the Naurzum and Baraba steppes, etc.—at the same time greatly to increase the ringing of wildfowl at the localities where they nest and moult in all zones of the Soviet Union, including the north. Given the necessary material support, the State Sanctuaries (Oka, Darwin, Kandalsksha, Pechoro-Ylych), the sanctuaries and stations of the Academy of Sciences of the U.S.S.R. and the Union Republics, the strongest and best organised hunting estates (on Lake Ilmen, etc.) can all become ringing centres. In these centres the catching and ringing of adult birds must be carried on in the spring, summer and autumn (which will ensure an increase in the percentage of recoveries). In the same places the mass ringing of ducks must be organised. In order to extend the work of ringing young birds, it is necessary to devise as soon as possible models of wing-tags which will make it possible to mark young that are still small and to supply these in sufficient quantities to a wide circle of markers. Besides this, it is necessary to ascertain the methods of catching birds on a mass scale on spring and autumn passage which are most effective under our conditions. Finally, it is necessary to direct attention towards improving the recording side of ringing: the correct identification of the species ringed, the determination of sex, of age, etc. It is necessary more widely to familiarise the public with the organisation of ringing work, to make it possible to increase the return of rings. Increase of the scope and alteration of the character of the organisation of ringing of wildfowl will make it possible to utilise the results of ringing on a wide scale in order to improve the planning of shooting.

If put into effect, the measures which are proposed in the present paper for properly organising wildfowl shooting will, without doubt, result in the immediate future in increasing the supplies of this group of birds in our shooting territories.

PINKFEET IN EUROPE

The Effect of the Cold Weather of February 1956 on the Distribution of Pink-footed Geese in North-West Europe.[1]

by Holger Holgersen

Principal Curator, Stavanger Museum, Norway

IN the latter half of January 1954 severe winter weather—with frost and snowstorms—burst in over a wide area reaching from West England and eastwards, including at least Northern Germany and Denmark. As a direct consequence, a great many Scandinavian migrants, having arrived in the autumn in the British Isles, either starved or froze to death (instinct birds), or were forced to undertake a second emigration within a few months (weather birds), an exodus which brought large numbers of birds far southwards and out of reach of the threatening weather. This was clearly demonstrated, not only by direct field observations in Western France, in Spain and Portugal, but also by numerous recoveries of ringed birds in most of Western Europe, from England to Gibraltar. The birds involved included many Norwegian Lapwing, Fieldfare, Redwing, Common Gull, Black-headed Gull and others (Holgersen 1954).

A parallel situation was created when in February 1956 another sudden and unusually severe spell of winter weather covered the northern parts of Central Europe. Denmark, Northern Germany and Holland were greatly affected. As expected, this weather situation soon gave a good many recoveries of ringed birds, individuals found starving or frozen to death. But other recoveries were made in places and at times which clearly showed that the birds had been trying to escape and—with or without success—find areas with more favourable conditions.

One of the most interesting species in this connection, since the number of recoveries is high enough to permit some conclusions, is the Pink-footed Goose (*Anser brachyrhynchus* Baillon). Mr Russell Webbe, of the Cambridge-Sherborne Spitzbergen Expeditions, ringed 43 individuals of this northern species in 1952 and 525 in 1954, a total of 568 birds, most of which were adults.

In the following we do not consider recoveries from the winter 1956–57 or later, only those reported up to the spring of 1956. The material on which this paper is based thus consists of 113 recoveries.

So far we know nothing of the route along which the geese travel in fall when they have left Spitzbergen, until they reach Denmark, where the flocks arrive in October, a few as early as September. In November also flocks pass through the country, but they do not stop to winter there. From October they are found in Germany in an area reaching from the island of Föhr to Ostfriesland, and this seems to be the principal winter quarters of the Spitzbergen Pinkfeet. Some of them, however, go farther west to the northern part of Holland (Friesland), which is a natural continuation of the North German coastal plains. Very few go past the Zuiderzee (IJsselmeer), as single ringed birds have been reported from Zeeland, from Belgium and one even in Northern France. These are the conclusions drawn from our recoveries in the winter of 1954–55 (and a few in 1952–53) which, as far as the weather is concerned, has been considered a normal year. In the table these recoveries are indicated by open circles.

[1] Condensed from an original paper in the *Stavanger Museum Year-book*, 1956, Vol. 66.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
DENMARK .	o	ooo ooo **	oo						11
GERMANY .									
Föhr		ooo ***	oo* *** *	ooo ooo	ooo o		ooo		26
Oldbg./East Friesland		oo*	o** *** ***	ooo ooo *** **	ooo ***		oo*	o	33
NETHERLANDS									
Friesland		o	*	o** *	ooo o**	*	*	*	15
Zeeland					o*		o		3
BELGIUM .						o**	**		5
FRANCE .					o*	*** *** *** *** ***	***		20
	1	18	19	21	20	19	13	2	113

o = Recoveries up to and including 1954/55. * = Recoveries up to and including 1955/56.

As far as the period September–January is concerned, the picture may be supposed to agree with the actual situation, but the very few recoveries in February (one in Belgium) March and April are hardly representative. Of possible reasons we mention the decrease in size of the goose flocks during the season, the close of the hunting season in certain districts, and no doubt the birds become gradually more cautious and wary.

The regional distribution of the recoveries is presented in the map, Fig. 1. Open circles show recoveries in September–January, black dots recoveries in February–April, i.e. after the culmination of the winter. We notice the recoveries in Denmark during the autumn passage, we find the wintering area from Föhr to the Zuiderzee with an offshoot reaching Zeeland and the Belgian coast, and we notice also the single recovery on the French Channel coast, apparently a pure exception.

Quite another picture is given by the recoveries made during the winter 1955–56, as will be seen both from the table—where the recoveries in this season are given as black dots—and from the map, Fig. 2 (symbols as in Fig 1).

The fall emigration apparently went normally. The geese turned up both in Denmark, on Föhr, and even as far west as in Oldenburg in October. In November numbers increased, and in the same month the majority shifted westwards to the area Oldenburg–Ostfriesland, where the birds were found also in December. Some few birds invaded Friesland, too, in November–December. Recoveries from January are scarcer, but they show the same distribution, with the addition that some individuals appear as far west as in

Zeeland, Belgium and Northern France. This last recovery, which is outside the normal winter area for the bulk of the geese, Mayaud (1956) explains by a short period of frost in the first part of January.

Then came February, with frost and snow and extremely difficult conditions for the birds. From correspondents in Northern Germany I learned that the goose flocks had disappeared; everything was covered with ice and snow and it was hopeless for geese in any numbers to find enough food. But where did they go? It isn't difficult to give an answer to that question, for in February 1956 flocks of geese poured in over Belgium and Northern France as seldom or never before. As the table and the map, Fig. 2, demonstrate, our Spitzbergen Pinkfeet were taking their part in the invasion, and the vanguards reached as far west as the Loire Estuary.

It is no wonder that French sportsmen got the impression that geese must be extremely numerous this winter and that they took the opportunity to chase them.

There were also great numbers of geese (and swans and ducks as well) in Holland at the same time, but here the hunting season closed from 1 February, so that reports on recoveries of ringed birds after this date must naturally be scarce. The three birds reported in February–April were found frozen or starved to death. As known from other sources, the Dutch people made admirable attempts to save the thousands of waterfowl gathered where there was still open water, and their efforts were crowned with the most glorious success. Counts and estimates showed that more than 430,000 swans, geese and ducks were within the borders of the country in February, and in addition more than 100,000 grebes, divers and rails.

From the table, it may look as if the Pinkfeet desert their quarters in Northern

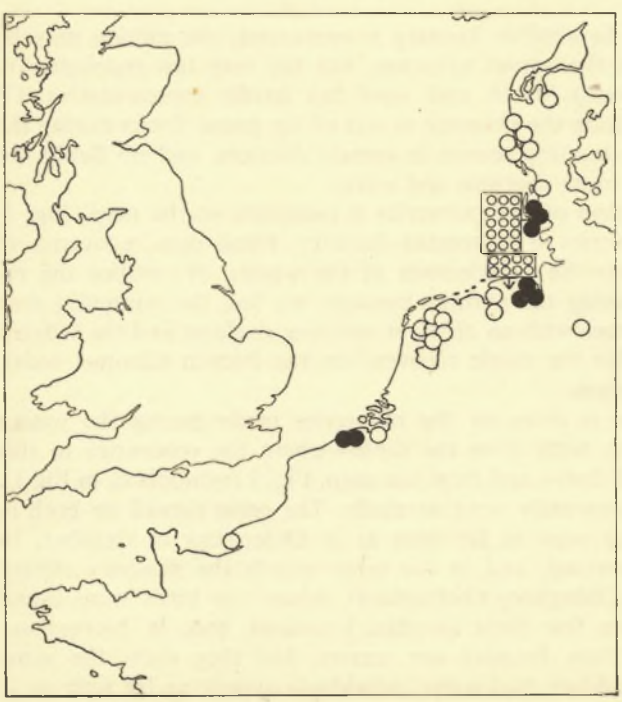


Fig. 1. Normal winter distribution of recoveries of Pink-footed Geese. Circles Sept.–Jan.; dots Feb.–April.

Fig. 2. Distribution of recoveries of Pink-footed Geese in winter of 1955–56. Circles Sept.–Jan.; dots Feb.–April.

Germany in the late winter—but before the spring migration—in normal years and not only in 1956. But this is not the case, as we learn from people living there. The lack of recoveries in February 1955, for instance, may be due to the decreased numbers of geese after the hunting season or to the survivors having become more shy. But one must also be aware that the material, in spite of the 113 recoveries, is not so large that it can be considered wholly representative. Ringing took place in 1952 and 1954 only, and the distribution of recoveries in time and space may thus easily become somewhat fortuitous.

That the flocks of geese within this wide area do move about during the winter is confirmed by observers on Föhr, at the Dollart and the Jadebusen, the principal winter quarters. In the limited area of Föhr (7 × 4 miles), as many as 8000–10,000 Pinkfeet (or at least mostly this species) may be seen simultaneously on the uninhabited northern and central part of the island. Thus it seems natural that the pastures may be so depleted that the geese have to go away for some time. They have to move also when deep snow covers the fields, as it did at the end of January 1955. But when the snow melts and the pastures are accessible again, the geese return. Similar reports have been received also from Oldenburg and Ostfriesland. Fortunately, the geese are capable of making rather extensive movements within their wintering area in response to the varying conditions, but nothing indicates that in normal years they definitely go away from this area (Schleswig–Friesland), at least not in any numbers.

For the present we may concede that our material is not sufficient, particularly as regards recoveries from the later winter, February–March. But we have every reason to believe that the normal wintering grounds for our Spitzbergen Pinkfeet reach from Föhr to the Zuiderzee. As far as the season 1955–56 is concerned, we have convincing proofs that severe winter weather in February

caused most of the geese to fly away from this area and into Belgium and Northern France, occasionally even over the French Atlantic coast. Three recoveries in Friesland in February–April show that some birds stayed behind here, but as counts gave only 1200 Pinkfeet for February (Over and Mörzer Bruins unpublished information), it is clear that the majority had left. We have no proofs that any of our geese stayed and survived in their German winter territories; on the contrary, both recoveries and reports from local observers indicate that these areas were deserted by the geese.

Great caution should be observed in the use of the totals of recoveries within the different areas, as given in the table. They should be considered in close connection with the actual numbers of birds wintering within the same areas, and these figures are so far unknown. Also, differing legislation in the various countries concerned may cause an uneven distribution of recoveries, at least in the latter half of the season.

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BRENT GEESE IN ESSEX

The Proportion of First-winter Birds in Flocks of Brent Geese in Essex

by P. J. K. Burton

DURING the past three winters (1954–55, 1955–56, 1956–57), regular counts have been made of the number of first-winter birds in flocks of Dark-bellied Brent Geese (*Branta b. bernicla*) on the Essex coast. In this way it is hoped to keep a check on breeding success from year to year. Such a check is particularly desirable for this species. The reported diminution of its numbers has aroused much concern, and at present it is enjoying a trial period of full protection. The counts have also yielded information on the behaviour and movements of feeding flocks.

The counts are carried out at high tide and just after, when the geese are comparatively close to the sea-wall. The flock is scrutinised by telescope, working from front to back (judged by the direction in which most of the birds are walking). The status—adult or first-winter—of each successive bird is called out and noted down by a second person. First-winter birds are distinguished by the presence of white edgings to the wing-coverts. This character remains clear-cut even in abraded birds in spring. The absence of a white neck patch is a juvenile character, lost in early winter and therefore of no use. Where conditions of light or distance make the identification of first-winter geese difficult, the count is abandoned.

During the winter of 1954–55 the counts showed considerable variation in the percentage of first-winter birds present. Accordingly, during the two following winters an effort to obtain more and larger counts has been made. In addition, a method of sampling has been used, based on the work of Boyd (1954). From the counts, the numbers of first-winter birds in samples of 50 have been extracted and arranged in frequency distributions. Only continuous

samples are used—no attempt has been made to create extra ones by combining groups of less than 50 from flocks seen at different times or places. Samples of 50, rather than of 100 (which would give percentage figures), are used because many more can be obtained without lessening the usefulness of the figures. The distribution of frequencies from the samples approximates quite closely to the normal, although extreme values occur rather too often. This is due to a tendency for family parties to move to the front of a feeding flock. This often leads to the birds in adult plumage but without the young splitting off as a separate flock behind, usually after about two hours of feeding. The two reunite, however, if flushed. Counts are therefore made immediately after the flock has landed, whenever possible.

The data for the three winters fall into two groups—the raw counts and the figures based on sampling. These are given in Table I below.

TABLE I

Season	Totals of Counts			Sample Data Mean number of first-winter birds in a unit of 50 geese	S.D.	S.E. of Mean	No. Samples
	ad.	1st W.	Total				
1954–55	462 (60%)	314 (40%)	776	—	—	—	—
1955–56	1498 (74%)	522 (26%)	2020	13·26	6·40	1·19	29
1956–57	1387 (93%)	97 (7%)	1484	3·52	3·90	0·78	25

The maximum Essex totals (from wildfowl counts) for the three successive winters have been about 6000, 5000 and 3700.

The figure for 1954–55 in Table I, though not as accurate as could be desired, is probably fairly near the truth. The proportions of first-winter birds in the first two winters (40% and 26%) correspond to the two classes into which Boyd's figures for White-fronted Geese have fallen—about 35% in some winters and about 21% in others. The figure for 1956–57, however, indicates a large-scale breeding failure. This phenomenon is seen also in the records of the Monomoy Brant Club (see below). It has been frequently attributed to storms on the Arctic breeding grounds. Gillham (in Cottam, Lynch and Nelson 1944) has described the effect of such a storm on breeding Snow Geese; these arrive to breed earlier than the Brent, and the birds he studied had time to lay second clutches. Had this happened to Brent their breeding season would have been ruined, as they have no time to raise a second brood.

The summer of 1956 was, in fact, late in the Arctic, and this may have a connection with the breeding failure of Brent, though this cannot be shown with certainty. Pinkfeet and Barnacle had a bad season in Greenland. However, British-wintering Whitefronts, which breed in the same area as Dark-bellied Brent, were apparently not affected.

The figures for the winter of 1955–56 exclude counts from Foulness on two dates in February. These gave a total of 717, of which only 32 (4·5%) were first-winter birds. They fall into a separate distribution from the Dengie counts, with much lower mode and mean. The rest of the counts of this winter came

from the Dengie area and cover the period December–April. The two possible explanations are that the Foulness birds were either of different origin to the Dengie birds, or a flock predominantly of birds in adult plumage without families which had separated off from the other birds wintering in Essex. Evidence favours the latter view; a visit to Foulness in January showed many first-winter birds, though no count was made, due to poor light. The total number of geese present at Foulness in February was about 350–400, more than 2000 less than in January, the remainder having presumably gone north to the Blackwater estuary (by inference from the fact that numbers here rose by 2000). Possibly those left at Foulness were the predominantly adult flock watched in February. The counts for 1956–57 are from both Foulness and Dengie. no significant difference having been found between the two.

If these figures are to be used as an indication of the status of Dark-bellied Brent, they must either be representative of the whole population or of a large part of it. There is no doubt that the latter condition is fulfilled; the Essex population amounts in some winters to 5000–6000. The whole European population has been estimated at somewhere in the region of 15,000. There is evidence, however, that Dark-bellied Brent in other British-wintering areas may come from different breeding grounds. In the winter of 1956–57, corresponding with the very low proportion of first-winter birds, the Essex population was substantially less than in the previous winter. Locally the mild winter was blamed. Numbers in the Wash, too, were much reduced, but the Brent wintering in North Norfolk, mainly Dark-bellied, showed no reduction in numbers. It may be that they came from places in which breeding had been successful. This could only be determined by adult/first-winter counts from these other areas.

Records of adult/first-winter counts are given by four other authorities. The best of such records are to be found in the log of the Monomoy Brant Club (Phillips 1932), a wildfowlers' society at Cape Cod, Massachusetts. In the nineteenth and early twentieth centuries, spring shooting of migrating American Brant (Pale-bellied—*B. b. hrota*) took place in this area. For many of the years the log has a note on the proportion of young birds, obtained apparently both

from field counts and examination of shot birds. Abundance is correlated with high proportions of young and scarcity with low proportions. In some years figures as low as 1% first-winter birds are given, in others as high as 60%. These latter figures are doubtless higher than the mean for the whole population, either by chance or through greater vulnerability of young birds to shooting, but must indicate a very good breeding year. The most notable feature is the ability to recover after periods of great scarcity. Cottam, Lynch and Nelson (*loc. cit.*) state that in the three years following the *Zostera* disaster in 1931–32, only 3%–7% first-winter birds were observed, and production of young was subnormal from 1932 to 1938. This raises the interesting possibility that the failure of the *Zostera* supply affected the population largely by an adverse effect on breeding capacity.

The remaining sets of counts come from Holland in more recent years. One is mentioned by the Netherlands Wildfowl Inquiry Committee—a set of counts from Zeeland in February and March 1948, totalling 238, including 50 first-winter birds (21%). Possibly some of the counts of Lebret (1956) were used in compiling this. Lebret's own counts from the Zandkreek, Zeeland, extend over several winters. They are summarised in Table II below.

TABLE II

Season	Total	% 1st W.	No. of Counts
1947–48	341	20	5
1948–49	528	0	2
1949–50	239	35	3
1950–51	251	3	2
19/1/54	51	10·2	1

Probably these birds were mostly Dark-bellied, though this is not mentioned. The sample for 1947–48 is best; if the further record quoted above is separate from these, it reinforces Lebret's figures. The absence of first-winter birds in the flocks of 1948–49 and 1950–51 may indicate poor breeding seasons, though not necessarily as bad as the figures suggest. The figure of 35% for 1949–50 may be fairly reliable, but no conclusion can be drawn from the remaining count.

Attempts have been made to obtain counts of brood sizes. If extensive enough, these can be used to calculate other important parameters of the population (Boyd 1957). So far, however, these efforts have been poorly rewarded. Brood-size counts are far less easy to obtain in Brent than in grey geese, which tend to spread out over a field, so that family parties are more easily picked out. Brent typically crowd in jostling masses at the tideline or on the water, and the confusion makes the distinction of family groups nearly impossible. Most of the brood-size counts obtained are from parties isolated from the main flock (there is perhaps some possibility that they are therefore atypical). Another disadvantage is that the geese usually do not arrive until high tide, and they disperse after the tide has ebbed past the *Enteromorpha* or *Zostera* zones. Hence, a party can only be watched for about three hours at the most, generally much less. It is therefore difficult to be quite certain about groups which appear anomalous (e.g. with one or three parents).

Table III summarises the results of the counts so far. Of these 54 parties, four (7·4%) were only accompanied by one adult and one was accompanied by

three adults. For the reasons given above, the permanence of these combinations is not known, except in the case of a single lame adult with one first-winter bird, probably the survivors of a party which had been shot at.

TABLE III

Season	No. of Broods	Mean Brood Size
1954–55	12	3·9
1955–56*	31	3·2
1956–57	11	3·1
Combined data of the three seasons ..	54	3·33 ± 0·19

* Mean size of 8 broods on the North Norfolk coast—2·6 (H. Boyd).

The clutch size of *B. b. bernicla* is 3–6, according to Russian sources. If the mean is taken to be 4·5, the reduction to the mean midwinter brood size of 3·33 suggests losses of about a quarter from those broods of which some at least survive, a rather smaller proportion of losses than might have been expected.

Finally, some suggestions as to how the scope of this study could be extended. First, still more counts. These should be reinforced by parallel counts from other areas, both in Britain and on the Continent. Brood-size counts of sufficiently large size are also needed. This would require a good deal of time. A further essential is extensive ringing, to provide information on flock mixing and on adult mortality. Lastly, information from the breeding grounds is wanted to shed light on such topics as non-breeding, age of breeding, reshuffling, etc. British expeditions can at best hope to obtain such information for *B. b. hrota*; similar facts about *B. b. bernicla* could only be obtained by a Russian expedition, since its breeding grounds are entirely within the Soviet Arctic.

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NORTH-EAST GREENLAND EXPEDITION 1956

by James Goodhart and Thomas Wright

INTRODUCTION

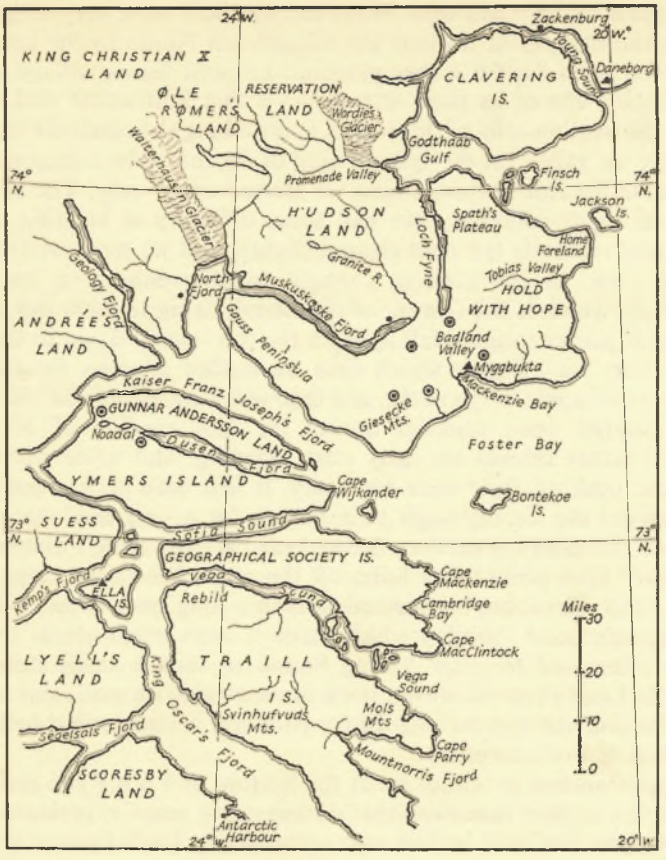
THE object of this expedition was to visit the Hold-with-Hope area of the North-east Greenland coast to discover the areas frequented in summer by Pink-footed (*Anser brachyrhynchus*) and Barnacle Geese (*Branta leucopsis*), to obtain an estimate of the numbers of each species present and to ring as many of them as possible.

By ringing Pink-footed Geese it was hoped to add more detail to the already extensive knowledge of the movements and population numbers of this species obtained by the activities of the Wildfowl Trust. In the case of the Barnacle Goose, some very interesting recoveries have been obtained from birds ringed in Jameson Land in 1955, and it was hoped to acquire more knowledge of their movements—and particularly wintering areas—by ringing birds that breed on Hold-with-Hope, which is farther north than Jameson Land.

The biggest problem to be overcome is landing on Hold-with-Hope in time to catch the geese while they are still flightless. The sea journey is usually made impossible until the last few days of July by the presence of a wide strip of pack-ice off the coast that is brought down from the polar pack. This polar pack-ice drifts slowly down the Greenland coast through the Denmark Strait into the North Atlantic. Even in late July it is a most uncertain business penetrating this ice-belt. The force and direction of the wind may pack it tightly, making it quite impenetrable for days on end, whilst favourable conditions result in wide open-sea lanes being formed.

Few ships penetrate through to the coast of North-east Greenland during the late summer. The odd Danish expedition ship contacts and relieves the various Danish stations up and down the coast, and one Norwegian ship, chartered by the Norwegian Polar Institute in Oslo, makes an annual visit to the Hold-with-Hope area. The Norwegian Meteorological Station at Myggbukta is relieved and re-supplied for the following winter. A few Norwegian trappers who have spent the winter and spring months trapping and shooting Arctic Fox, Polar Bears and Seals are also relieved. These trappers normally spend one or two winters in Greenland, and they are brought back by the Norwegian Expedition ship when others are landed.

We were most fortunate in being offered a passage on this Norwegian Expedition relief ship, which leaves Aalesund in Western Norway some time during the latter half of July. The exact date of departure depends to some



Part of N.E. Greenland

extent on ice conditions off the Greenland coast, and in a bad year the departure may be delayed some days. A special deckhouse with six bunks had been constructed on the port side by the forward hatch for the expedition, and these special arrangements stress the extent to which we were dependent on this generous Norwegian co-operation.

The expedition, which was led by Dr Thomas Wright from Marlborough College, consisted of five Englishmen and one Dane, Arne Schiøtz, from Copenhagen University. James Goodhart and Paul Carslake, two Cambridge University undergraduates, had been in Spitzbergen in 1952 and 1954 on similar missions, and the party had therefore a good deal of previous experience in ringing geese in the Arctic.

GENERAL ACCOUNT

The party arrived at Aalesund from Bergen by coastal steamer on 21 July; after a brief visit to the agents of the vessel, it was apparent that the boat—a modern wood-built sealer of 270 tons called the *Polarbjorn*—would not be leaving for three or four days at the earliest. This was a great disappointment, as every day lost meant that the chance of catching the geese grew smaller, especially if it had been a non-breeding year as had seemed very likely from the

weather reports that we had seen. However, we spent three very delightful days walking in the mountains around the magnificent fjords to the south-east of Aalesund; the town itself is a very pleasant, unspoilt fishing village well worth a visit by itself—one of its great attractions is that Kittiwakes nest on a great number of the window-sills of the houses overlooking the small fishing harbour.

Eventually we sailed on the late evening of 26 July into a reasonable swell, and set course for Jan Mayen, where we arrived on 29 July. The ship had no radar and in foggy conditions we had some difficulty in locating the island, but then quite suddenly the mist cleared slightly and we were rewarded with a spectacular view, in the evening sunlight, of Beerenberg—a mountain of volcanic origin which is the feature of the island, rising to 7400 feet above sea-level and with glacier tongues falling from the top steeply down to the sea.

After a short stay, during which time we landed supplies for the weather station, we set off again to the north, and then when on latitude 74° N. we turned west and entered open pack-ice during the late evening of 30 July. We encountered rather thicker ice early next morning, and some short spells of breaking and pushing aside were necessary. It had been perfect sunny weather since we entered the ice, although cold enough for a very thin veneer of ice to be formed on the calm sea between the pack-ice. We saw quite a number of seals, and one Ivory Gull some thirty miles off the coast. We raised Cape Herschell during the early afternoon, but seemed to take a long time to reach it owing to the astonishingly good visibility which made it seem much nearer than it was.

We first attempted to enter Young Sound to visit a small station before continuing to Loch Fyne. However, thick impenetrable ice made this impossible, and, after butting our way through heavy pack-ice, we proceeded to Loch Fyne first, which suited us admirably.

We dropped anchor in winter ice at the bottom of Loch Fyne and spent the night there; the captain remarked that during many years' experience in Greenland this was the first time he had seen winter ice in Loch Fyne at that time of year, and there now seemed no doubt that it had been an exceptionally bad spring.

We left the *Polarbjorn* in brilliantly clear weather and went up Loch Fyne in two lifeboats; we had some trouble breaking through the rotten winter ice, but after a journey of six hours we arrived at the trapper's hut at the head of Loch Fyne. On the way we saw 14 Barnacle on a grassy slope by the shore which flew strongly away as we approached—this was a very great disappointment, as it now seemed almost certain that it had been a non-breeding year. We landed and set off to the south, carrying enough food for six days. We soon saw that this northern end of Badlanddal was very suitable for geese; we then saw 9 adult Barnacle on a small pool, so we set up the nets and set off with the object of rounding them up. Quite soon one of the party disturbed a flock of about 100 Barnacle, which had been concealed behind a low sand-cliff at the side of a large lagoon, and away they flew, baying and calling, to settle again on the other side of the lagoon. The next day we crossed the sandy waste to the west side of Badlanddal and then, after pitching camp, we walked northwards into the area between Loch Fyne and Muskox Fjord. Quite soon we came on a small round lake—probably a kettle-hole—on which there were some 30 Pinkfeet; 15 of them flew away as we came in sight and about 10 more swam quickly to the edge of the lake and ran away over the tundra before we could surround the lake. However, 6 remained on the water; the nets were erected, the rubber boats inflated and the drive started. When these 6 geese were cornered at one end of the

pool, 5 of them flew away, leaving 1 which immediately dived and swam under the boats, surfacing about 30 yards away.

On the next day (3 August) we walked south down the west side of Badlanddal and pitched camp at the north end of the Vestersletten. The mosquitoes were proving very troublesome, and we always found it wise to camp away from water and in an exposed place in order to obtain all the benefit that was possible from the gentle winds that were blowing. We then split into three parties of two and thoroughly explored the Vestersletten; between us we saw at least 310 Pinkfeet (but only three families) and 70 Barnacle—and here again there was much the same story of non-breeding, as there was only one family. The next day we caught this family, which consisted of one adult and three young. As we approached the lake 18 adult Barnacle flew off, and we had no difficulty, by using the boats, in driving the 4 geese into the nets.

It now became quite clear to us that it had been a virtually complete non-breeding year, and that there were going to be very few geese that were catchable in the 130 square miles that we had already covered, so that we would achieve very little by remaining in the area for a further fortnight as had been arranged with the captain of the *Polarbjorn*. By good fortune we knew that the *Polarbjorn* would probably call at Myggbukta Radio within the next two days, so we struck camp and walked in three parties of two to Myggbukta Radio. As far as the geese were concerned, it was much the same story—in the pool-studded area of southern Badlanddal we saw over 200 adult geese, all of which were flying strongly together with 24 young Pinkfeet and a few attendant adults; these latter—although not chased at all—were last seen disappearing in a northerly direction, and were finally visible only through binoculars and they were still running fast! We drove this enormous area of marsh and lagoons the next day, but we drew a complete blank.

Whilst we were at Myggbukta one of the trappers who was there told us some interesting facts about the trapping. The previous winter had been a very poor one, and the average number of Arctic foxes caught was about 50 per trapper. In a good year the number may be more like 150. The foxes depend on the small rodent, the lemming, which is their main food. Every four years or so the population of the lemming reaches a maximum, and the numbers then quickly tail off to a minimum. When there is a large number of lemming there are many foxes, but as the lemming decrease so do the foxes. Each trapper has a large coastal beat. He may have as many as 24 small huts each ten miles or more apart. Over the area there may well be as many as 150 fox-traps. He travels from hut to hut by Nansen sledge pulled by a team of six or eight Husky dogs. On his way he visits each trap and resets it if necessary.

The trap consists of a flat wooden structure about 3 feet square. This is inclined and set in the inclined position by means of three pieces of wood fitting into notches and delicately balanced. On one of the pieces of wood is placed the meat bait, which rests quite near the hinge of the main wooden plate and underneath it. On top of the wood are placed many heavy stones weighing perhaps as much as 2 hundred-weight. When the fox pulls at the bait the great weight collapses on to his neck and kills him instantly.

A few years ago a trapper could expect to get up to 100 kroner (£5) for a good white fur, but today he will get only about 30 kroner owing to changes of fashion.

In years when there are many lemming, snowy owls are also very common. As many as ten have been seen at once sitting on the radio aerial at Myggbukta, but this year, unfortunately, we saw none.

The trappers feed their dogs on seal meat, dried fish or musk ox. Supplies of dried fish are left by the expedition ship when it visits the station in the summer. Seals are shot during the autumn, winter and spring, and the meat forms a most important source of dog food. Musk ox are very hardy, large and shaggy animals, and they are increasing steadily. They feed on vegetation and can only thrive in countries where the winter is severe. In West Greenland, where attempts have been made to introduce them, they cannot survive the winter effectively. This is due to the fact that periodical mild spells of weather are likely to occur at any time. These partially thaw the snow, which soon freezes again. The firm, hard crust formed prevents the oxen from nosing their way through to the vegetation below and as a result they die of starvation. In Spitzbergen, where they are able to maintain themselves, periodical mild winters result in serious checks on the population.

Wild life is protected in East Greenland by the Danish authorities, and the regulations regarding the musk ox vary from year to year according to current reports on the status of the animal. Last year the trappers were allowed to shoot six. This year the number was increased to ten, but on condition that they were all males.

The trapper depends very much on the meat for his own personal needs.

The musk ox is, generally speaking, a docile creature, and if treated with respect is quite harmless. They usually wander about in family groups, and it is the lone bull which can be a little aggressive if disturbed. On one occasion two of us were moving camp when we came across a small family of three standing in our path on the shores of a large lake. In fact, an ideal position for a photograph.

The following extract from a diary describes what ensued:

'We did not bother to remove our heavy packs, as we were so confident about the harmless nature of the animals. As usual, on our approach the bull took up his stance in front of the family and stood eyeing us, quietly rubbing his nose against a large near-by stone. We must, we thought, get one really good close-up. Arne stepped in front of me and was little more than 8 or 10 yards from the bull, with me just behind. I thought I detected an aggressive look in the bull's eyes, and just as I held up my camera to get him in view there was a sudden scuffle. The bull snorted and charged. Arne turned quickly and stepped behind me. If only I had stayed composed for a fraction of a second I should have had a bright picture. I did not. In turning I overbalanced, and my pack shot over my head and became entangled in the camera and binocular straps, pinning me helplessly to the spot. Pots, pans and other bits and pieces loosely held on the pack clattered to the stones as they were scattered. There I was, with my back to the bull, completely helpless, unable to do more than stagger a few paces and at his mercy. All this took place in a split second. Meanwhile, the bull had advanced rapidly six paces only and was standing there just behind me staring incredulously. With difficulty, and help from Arne, I removed the pack and retreated. Everything was strewn in front of the bull's nose. He stood motionless, uninclined to move an inch. We walked slowly away, and when we were about a quarter of a mile from the family they turned tail and fled at top speed along the shore of the lake, led by the bull, and disappeared up the mountain.

'This incident certainly gave us a shake. We returned to collect our goods and chattels, and moved on with a little more respect for the musk ox than we had before.'

We discovered from the captain of the *Polarbjorn* that the spring comes

later on the coast because of the cooling effect of the pack-ice, so he suggested that we might meet with more success in one of the inner fjords; we decided to go to Noadal, which is an undulating area that joins Gunnar Anderson's Land with Ymers Island, and lies between the head of Dusens Fjord and Blomster Bay. Five members of the expedition spent from 7 to 11 August in this very pleasant area, and made a thorough survey of the wild life in it; they saw 30 Pinkfeet and about 52 Barnacle, including one family of three which promptly swam out to sea.

Meanwhile the remaining member of the expedition, James Goodhart, continued with the *Polarbjorn* along the east side of Ymers and Traill Islands, and was eventually halted for a day in thick fog and bad ice conditions. The next day the boat entered King Oscar's Fjord, and he landed at Antartiskhavn, where a mixed flock of 14 Pinkfeet and 38 Barnacle—all adults—was seen. The next day he landed at Holms Bay. A small flock of adult Pinkfeet was seen up the Kampelv and about a mile from the sea. The next day the *Polarbjorn* continued north, passed Ella Island and into the Antarctic Sound, and the expedition was reunited again in Blomster Bay. There were a great number of large icebergs in the fjords in this area which, together with most spectacular geological formations and magnificent fjord scenery and high, steep mountains, made our stay in Antarctic Sound one of the most memorable of our time in North-east Greenland.

We spent the next two days visiting Brogetdal and Muskox Fjord, before steaming back down the Kaiser Franz Joseph Fjord to Cape Broer Ruys, which is some fifteen miles east of Myggbukta. Here we split into two parties: one walked to the mouth of the Glommen and the other walked round the Ugle-hojene and had an excellent view to the north of the large, lake-studded area of the Ostersletten—it looked a most suitable area for geese. During our stay here we saw 380 adult Pinkfeet and 80 adult Barnacle—but only six families of young geese.

The *Polarbjorn* picked us up on 15 August and we went north and up Young Sound to Zackenburg, and then on north again in what proved to be an abortive attempt to drop stores at Cape Maurer on the east side of Kuhn Island; however, ice blocked our way, and we had to return and drop the supplies at Vandenoes, which is the south-eastern point of Sabine Island. We then turned south and arrived at Mountnorris Fjord on the evening of 19 August; such ornithological literature as there is about this area indicated that there were thought to be no geese on Traill Island, but inland from the head of Mountnorris Fjord we saw 187 adult Pinkfeet and 85 adult Barnacle; there were also indications that a considerable number of geese had been visiting the seashore in that area.

We left the Greenland coast and set course for Aalesund on 20 August, and it seemed that the brief Arctic summer was drawing rapidly to a close because, after experiencing three weeks of perfect, calm, sunny weather, we left in a severe blizzard. At first we were in scattered pack-ice and a few bigger bergs, but early the next morning we encountered close pack-ice and our progress was much slower until we were finally free of the ice late on the evening of 21 August. We had seen a few Kittiwakes and Fulmars over the pack, but in some places there were literally thousands of Little Auks feeding in the calm sea spaces between the pack-ice.

During our time in Spitzbergen we had noticed how few birds—other than geese—there were. We found this to be even more pronounced as far as this part of Greenland was concerned. A list of the species seen appears in Appendix I.

Records of Pink-footed and Barnacle Geese seen

The trappers and others who stay up there all the year round gave us many reports of geese in various areas; no mention has been made of any of these. It must be emphasised that a great deal of attention was paid to making sure that no well-grown young were overlooked in the goose flocks.

The areas visited were as follows:

Area between Loch Fyne and Moskusokse Fjord

East side:	126 Barnacle.	No young.
West side:	70 Pinkfeet.	No young.
	154 Barnacle.	No young.

Southern Badlanddal

180 Pinkfeet.	24 young which, although not being chased, were last seen going at great speed to the north until they were visible only through binoculars.
40 Barnacle.	No young.

Vestersletten

310 Pinkfeet.	One family of five and two of six.
70 Barnacle.	One family of three.

Southern Ostersletten (to include the two valleys coming up from Foster Bugt)

380 Pinkfeet.	Three families.
80 Barnacle.	Parties of five and twelve young (? three families).

Noadal

This was not an easy valley in which to count geese accurately, and the numbers given below are minima.

30 Pinkfeet.	No young.
52 Barnacle.	One family containing three goslings.

Brogetdal

The light was very bad during the visit to this valley, and the following are essentially estimates.

200 Pinkfeet.
35 Barnacle.

Mountnorris Fjord

The literature on this area had indicated that there were no geese on this island.

187 Pinkfeet.	No young.
85 Barnacle.	No young.

Antartiskavn

14 Pinkfeet.	No young.
38 Barnacle.	No young.

Some Observations and a Discussion on the Phenomenon of Non-breeding in the Arctic

The observations made by a British expedition in Jameson Land and also conversations with the staff at Myggbukta Radio suggest that 1955 was a good breeding year for both Pink-footed and Barnacle Geese. We know that 1956 was a very bad breeding year for both these species over a considerable area of

the coast of North-east Greenland; in fact, out of some 700 potential breeding pairs of Pinkfeet there were 12 families, and similarly with the Barnacle—340 potential breeding pairs and 5 families. While it is realised that some of the 'adults' may have been sexually immature, this is nevertheless a very small breeding percentage.

The suggestion has been put forward in the past that lack of snow-free ground when the birds arrive is the reason for the phenomenon of non-breeding. It seems that an enforced break in the breeding cycle, due to lack of a suitable nesting site, is sufficient to dull the breeding urge so that no breeding will take place that year even if subsequently suitable conditions prevail.

It has been most interesting to study the meteorological records from Myggbukta Radio between 10 May and 15 June. In 1955 a little ground became free of snow on 15 May, and this was a few days before the geese arrived; by 9 June half the ground was free of snow. In 1956 there was *no snow-free ground at all* until 14 June. The temperature comparison between the two years is also interesting: 1955 was distinctly milder with night temperatures mostly above freezing after 26 May, while in 1956 the night temperatures were always below freezing until the end of the third week in June.

The main question that remains to be answered is the critical date for the ground to be partially free of snow if there is going to be a good breeding year. Meteorologically 1955 and 1956 provide a great contrast and, as the geese usually arrive about 17 May, it may well be that 20 May might be the critical date for some of the ground to be free of snow. It would seem that expeditions contemplating goose-ringing in this area would be well advised to telegraph Myggbukta Radio on 20 May to ascertain the snow cover before deciding whether to continue with their plans or not.

However, it may be recorded that the three young Barnacle that we caught on 4 August were quite well advanced, as nearly all their down had been replaced by feathers; this would indicate that this pair started breeding very soon after their arrival.

A small island some miles off the coast in Mackenzie Bay is usually a tern colony. However, no terns bred there in 1956, but their place was taken by three pairs of Pinkfeet. The staff at Myggbukta Radio said that they had never known this before, and it is suggested that the geese used it because, being in such an exposed position, the wind kept some of the ground free of snow.

As may be seen from our notes on other species (Appendix I), most of them had bred to a small extent if at all. In the case of the King Eider, which seems to have bred quite well, all the young that we saw during the first two weeks of August had only been hatched a short time; it seems possible that an interruption in the breeding cycle had less serious effects on the year's breeding success than was the case in other species. The Eider also bred to some extent, and the same may be true of this species.

All the other ground nesters only bred to a very small extent and the few divers that bred also had very small (and therefore late) young. The non-breeding of the skuas cannot be attributed definitely to the snow cover, as it was not a lemming year, which may have considerable bearing on the fact that they did not breed.

The Snow Bunting—the only hole-nesting species—had a good breeding year and the young were well advanced. This seems to be good evidence that it was lack of snow-free ground at the end of May which either held up or prevented the breeding of the other species.

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The Danish Greenland authorities, the University Museum staff in Copenhagen, and Dr Finn Salomensen all helped us a great deal, and during the whole planning of the expedition every assistance was given to us.

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Postscript—August 1957

The hazards of the ice off the Greenland coast have once again been emphasised this year when the Norwegian ship *Polarbjorn*, on its annual expedition to North-east Greenland, has been reported trapped and severely damaged in the ice somewhere near the Hold-with-Hope area. The ship was abandoned and the crew taken off by helicopter.

APPENDIX I

Notes on Bird Species other than Geese seen during our time in North-east Greenland

GREAT NORTHERN DIVER (*Colymbus immer*)

1 August. One bird seen on two occasions at the southern end of Loch Fyne. On both occasions the bird circled high above us and then made off to the west.

9–11 August. A pair were seen with two small chicks on a small lake near Blomsterbukten on Ymers O.

RED-THROATED DIVER (*Colymbus stellatus*)

We found this species to be a common bird in all the areas that we visited. We saw no chicks at all except in Badlanddal, where one pair had two quite small young on 2 August. We saw them mostly in separate pairs except in the Noadal area, where there were groups of up to seven birds in the air at one time.

LONG-TAILED DUCK (*Clangula hyemalis*)

4 August. Seven adults in eclipse plumage seen on a small pool between the Mackenzie River and Myggbukta Radio.

6 August. A few birds seen in Dusens Fjord.

8 August. Our only breeding record—two young and one adult in Noadal.

EIDER (*Somateria mollissima*)

31 July. A party of eleven males sitting on winter-ice near Finsch Oer in Gael Hamkes Bugt.

17 August. At Germaniahavn there were eight flocks near the shore, and each consisted of between three and four females and four and six young.

We have no other breeding records, but adults were seen at Kap Petersen, Loch Fyne, Brogetdal and Mountnorris Fjord.

KING EIDER (*Somateria spectabilis*)

3 August. In Vestersletten seven females and four young were seen on a lake.

5 August. On a small pool near Myggbukta there were two females and eight young.

14 August. In Ostersletten a female with three young.

PTARMIGAN (*Lagopus mutus*)

7 August. One seen on high ground south of Noadal.

This was the only occasion that we went up into the mountains, which is the reason for this single record.

RINGED PLOVER (*Charadrius hiaticula*)

This was the commonest wader and was found in the most marshy areas. In the very dry and sandy areas in eastern Badlanddal it was the only bird present. About thirty pairs were seen on a ridge 600 feet above sea-level south of Noadal. The general impression gained was that most of them were not breeding and, in fact, we only found four pairs with one young each.

TURNSTONE (*Arenaria interpres*)

1 August. One seen to chase a Long-tailed Skua in north-east Badlanddal.

2 August. A pair with one young in north-west Badlanddal.

4 August. A pair around the small pools between the Mackenzie River and Myggbukta Radio.

18 August. Seven on the shore near Kap Herschell.

19 August. A few on the shore at the head of Mountnorris Fjord.

DUNLIN (*Calidris alpina*)

5 August. A pair seen round the pools near Myggbukta Radio.

9 August. One in Antarctiskhavn consorting with a Ringed Plover.

10 August. Four seen up the Karupelv from Holmes Bay.

SANDERLING (*Crocethia alba*)

1 August. One in north Badlanddal.

3 August. A few seen in the Vestersletten.

11–13 August. Seen in Brogetdal.

19 August. A number seen inland from the head of Mountnorris Fjord.

ARCTIC SKUA (*Stercorarius parasiticus*)

1 August. One seen in Loch Fyne area.

5 August. One seen around Myggbukta Radio.

LONG-TAILED SKUA (*Stercorarius longicaudus*)

This species was very common in all areas visited except Noadal. We did not see any young, nor was there the slightest indication that they were breeding. It was quite usual to see four or six together roaming the countryside.

IVORY GULL (*Pagophila eburnea*)

30 July. One seen in the ice about twenty miles east of Kap Herschell.

GLAUCOUS GULL (*Larus hyperboreus*)

Seen in small numbers in all areas visited.

ARCTIC TERN (*Sterna macrura*)

This species was seen quite frequently throughout the area, usually near the coast.

1 August. Present in Loch Fyne; some birds perched on small pieces of winter-ice. One pair may have been breeding.

10 August. Many seen around small island off Kap Petersen.

12 August. At least 120 feeding in the muddy water close to the face of the Walters Hausen Glacier.

WHEATEAR (*Oenanthe oenanthe*)

7–11 August. Several present in Noadal, including some young birds.

12 August. One in Brogetdal.

REDPOLL (*Carduelis flammea*)

9 August. One pair seen in Noadal.

LAPLAND BUNTING (*Calcarius lapponicus*)

19 August. A young bird seen inland from the head of Mountnorris Fjord.

SNOW BUNTING (*Plectrophenax nivalis*)

This species seems to have had a reasonable breeding season, as most of our records are of family parties or groups of family parties.

7–11 August. Numerous in Noadal.

12 August. Present in Brogetdal.

15 August. At least 60 in Dyraelv on Hold-with-Hope.

19 August. A pair inland from Mountnorris Fjord.

APPENDIX II

Itinerary

26 July. Left Aalesund in evening on *Polarbjorn* for Jan Mayen.
29 July. Called at Jan Mayen, then continued north late that evening.
30 July. Entered scattered ice in the evening.
31 July. Ice a little thicker. Raised Kap Herschell during early afternoon. Tried to go up Young Sund, but ice blocked the way. Continued into Gael Hamkes Bugt and anchored for the night in winter-ice at the bottom of Loch Fyne.
1 August. Left in the ship's boats for the head of Loch Fyne, where we landed. Started walking south immediately, carrying food for six days, goose-catching equipment, tents, etc. Camped on the east side of Badlanddal about three miles from the sea.
2 August. Crossed sandy waste to west side of Badlanddal; walked over all the area between the head of Loch Fyne and the head of Moskusokse Fjord. Camped on that side.
3 August. Walked south down the west side of Badlanddal to the northern end of Vestersletten. Pitched camp; then split into three parties of two and walked over nearly all the Vestersletten.
4 August. One adult Barnacle and three well-grown young caught in north-eastern Vestersketten. Split into three parties of two again and walked by different routes to Myggbukta Radio.
5 August. M/s *Polarbjorn* arrived early in the morning. Went to try to catch the few Pinkfoot goslings that we had seen during the walk on 4 August.
6 August. Expedition on board *Polarbjorn* again. Went up Dusens Fjord, and five of the expedition put ashore at eastern end of Noadal.
7–11 August. Party in Noadal carried out a very thorough survey of the wild life in this area, and climbed to Point 1657 to the south of Noadal.
7 August. *Polarbjorn* continued south on the eastern side of Ymers O and Traill O. Eventually halted by fog and ice conditions.
8 August. Remained still for most of day at edge of ice in fog. Then, being unable to find way into Mountnorris Fjord, set course for Antarctiskhavn.
9 August. A short stay in Antarctiskhavn, during which time the member remaining on board made a short trip up the valley that goes south from Antarctiskhavn. Set course back to Mountnorris Fjord, found a way through the ice in the better visibility and sailed right up to the western end of the fjord. *Jopeter* seen stranded on the shore.
10 August. Back to Antarctiskhavn, then on to Mestersvig. Then on again to drop stores at Kap Petersen. Went ashore for a few hours inland from Holmes Bay on southern Traill O. Continued up King Oscar's Fjord to spend the night at the eastern end of Vega Sund.
11 August. Back west along Vega Sund, continued north up King Oscar's Fjord, passed Ella O, through Antarctics Sund and the expedition was united again in Blomsterbugten.
12 August. Continued to Brogetdal and some members walked nine miles up it. On again in the evening and sailed along the face of the Walters Hausen Glacier. Spent the night anchored half-way up Moskusokse Fjord.
13 August. Back to Brogetdal to pick up members of the crew who had remained there to fish for 'salmon'.
14 August. Sailed down Kaiser Franz Joseph's Fjord into Foster Bugt, and were put ashore on Hold-with-Hope foreland fifteen miles east of Myggbukta.

15 August. Split into two parties of three: one going to the mouth of the Glommen just north of Kap Broer Ruys, the other going to the east of Uglehojene and back down the Dyraelv.

16 August. *Polarbjorn* returned from Myggbukta to pick us up; continued north to try to drop stores at Kap Maurer on Kuhn O.

17 August. Ice blocked our way, so we eventually dropped them at Vardenoes on the south-east point of Sabines O.

18 August. South to Young Sund to pick up salmon fishers at Zackenberg. Called at Kap Herschell and then turned south down east coast.

19 August. Into Mountnorris Fjord and sailed to western end of it to find that the *Jopeter* had been refloated. Split into three parties of two, and did a survey for geese about eight miles inland from the head of the fjord.

20 August. Set course back for Aalesund in the first snow-storm we had experienced during our time in Greenland.

21 August. Clear of the pack-ice by the late morning.

25 August. Arrived Aalesund.

APPENDIX III

Rations

A man/day ration consisted of the following:

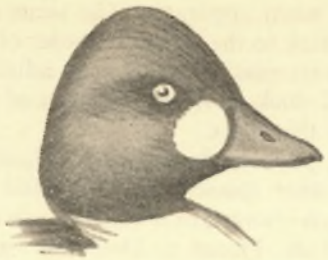
	oz.		*oz.*
Dehydrated meat	2	Powdered milk	1½
Pemmican	2½	Biscuits	4
Porridge oats	4	Mlo	1½
Margarine	4	Dried vegetables	½
Sugar	3	Mint cake	2
Chocolate	4	Cheese	1

This gives a weight of 30 oz. per man per day: even during our more energetic periods it was generally agreed that this was a very generous ration, and there is no doubt that a considerable saving in weight of food carried could have been made without interfering with the physical fitness of the members of the expedition.

Six man/day rations (i.e. enough for the expedition for one day) were packed into a fibre-board box. This type of container, although very light, was not really very satisfactory, as it absorbed sea- and rain-water, becoming limp and fragile.

Many of the individual foods (including the very sharp dried vegetables) were packed in polythene bags which were found to be quite excellent in every respect.

Small quantities of luxuries were carried as well, and included tea, jam, marmalade, curry powder and various soups.



SKULL PNEUMATICITY

Skull Pneumaticity in Wildfowl in relation to their Mode of Life

by Dr Jeffery G. Harrison

THE bones of birds contain air—an adaptation which results in a relative lightness for flight. This is a generally accepted fact, but one which may well require modifying as our knowledge of the air systems of birds grows. The large, highly pneumatic skull of an owl is one of the best examples of this adaptation, but by no means all birds have such skulls, and this is particularly true of wildfowl.

I have so far studied the skulls of 68 different species of wildfowl, and although I still have some gaps to fill, the findings do indicate a high degree of functional adaptation, although much remains to be discovered. I have yet to find a single skull which is fully pneumatised. There is a basic pattern of pneumatisation which appears to be common to most geese, the swans and dabbling duck. This is illustrated in Figs. A–C. After hatching, air cells invade the skull from the nasal apparatus and auditory capsules and soon give rise to stage A, in which air is present in the nasal bone and has spread medially from both mastoid areas to meet in the mid-line. The main airless area of bone in the vault of the skull has three thickened ridges of bone, in which air subsequently develops to give rise to stage B. This is shown in the X-ray photograph of a Shoveler's skull, transilluminated by a small electric bulb placed within the skull. In stage C, a fourth pneumatised bar has developed from the postero-lateral border of the orbit as an extension of the air in the base of the skull. This is the most advanced stage seen so far in those species in this group.

Turning now to the diving duck, a different state of affairs is found, as in only one species does the air invade the skull to a similar extent. This is in the Red-crested Pochard, which is the least diving of the diving species. In the others, air develops in the auditory capsules and occasionally meets in the mid-line (Goldeneye, Barrow's Goldeneye, Scaup and Tufted Duck), while only one species examined has had minimal air in the nasal bone, this being a Pochard. Other species (Velvet and Common Scoter, Eider, Maccoa and Ruddy Duck, Smew and Red-breasted Merganser) have the air limited to the mastoid areas and base of the skull. The nasal bones are airless and the supporting ridges in the vault of the skull are well developed. This is illustrated in Fig. D.

Two species of diving duck require special mention—the Goldeneye and Barrow's Goldeneye—as they have been found to have skulls unlike any other duck. In these, there is a huge air sinus extending over the vault of the skull,

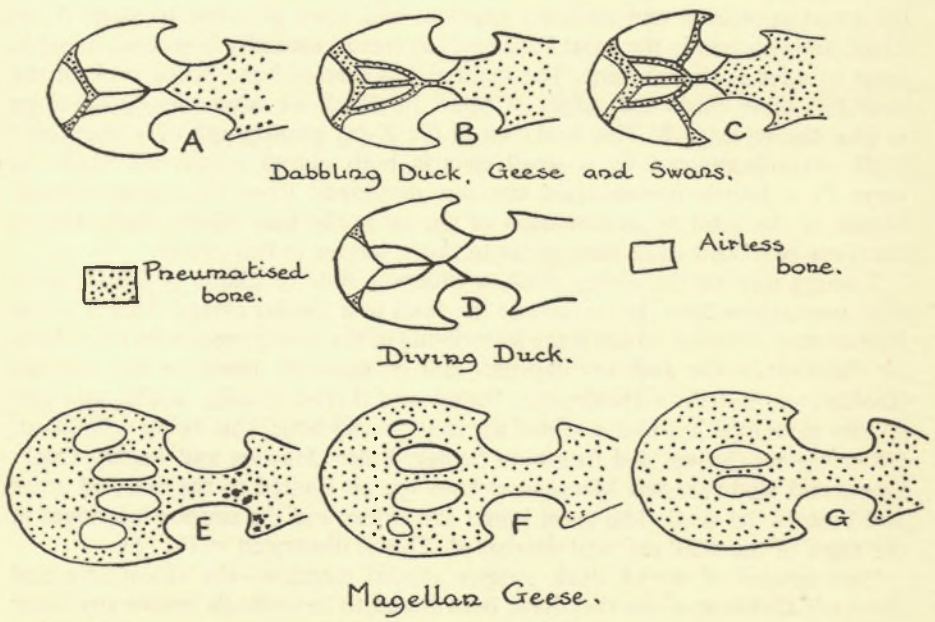
as an extension of the nasal apparatus. The sinus is larger in drakes than in ducks, and may reach back to the anterior border of the occipital bone in some drakes. The X-ray photographs show this in an adult drake Goldeneye (straight X-ray), and in an adult duck after the injection of radio-opaque lipiodol into the nose in order to fill this sinus.

Before discussing the possible significance of these findings, it is necessary to mention one or two other species. The Falkland Island Flightless Steamer Duck has a skull of much interest, as it conforms to that which I have described as typical of a diving duck. Placed by Delacour tentatively near the *Tadornini* (Shelduck), this species is an expert diver. The Shelduck skull, on the other hand, conforms to that of the geese–dabbling duck group. A single adult Mountain Blue Duck had a skull as shown in Fig. A. Considered by Delacour to be possibly a highly aberrant *Anas*, the species dives for food.

The Magpie Goose is thought to represent an ancestor of the present geese and duck (Delacour). It is not surprising therefore that its skull is quite distinct, although I have only been able to examine one so far, an immature which died at the Trust. There is a heavy medial ridge of bone only, and two areas of airless bone in the frontals of a distinctive pattern.

The South American Sheldgeese appear interesting. Of fourteen adult Greater Magellan Geese examined, all except one show more pneumatisation than I have previously described (Figs. E–G). Four immatures and the other adult show that the pneumatisation proceeds along the lines of the thickened ridges, as in other wildfowl. The Kelp Goose similarly develops pneumatisation almost to stage E, while retaining the airless occipital bone, but only two examples have been seen.

How are these findings to be correlated to the mode of life? At the present stage of this research, it seems possible that it might be related to diving. Birds



Skull vaults seen from above to show the relationship of pneumatised and airless bone

which possess fully pneumatised skulls, such as the great order of perching birds, owls, etc., do not dive. On the other hand, other diving species such as the Cormorants, Grebes, Auks and certain diving Petrels possess skulls comparable with those of deep diving duck, such as the Scoters. All wildfowl are capable of diving, even such species as the Mute Swan (often in the face of danger), and I have an Eastern Greylag Goose which frequently dives and swims strongly under water, obviously enjoying it. I have records of Mallard diving for small fish and Mandarins feeding by diving.

The species with the most air in their skull-bones are the Greater Magellan Goose and the Kelp Goose. These are described by Delacour as 'distinctly land birds' and 'largely pedestrian' respectively. Pneumatisation then decreases to that seen in the swans, the other geese and the dabbling duck. Finally we reach the stage of minimal pneumatisation, as found in the true diving duck. It seems likely, therefore, that the reason for this lack of air within the skull-bones of wildfowl is functional in origin. In further support of this, there is the fact that other species of underwater divers, quite unrelated to wildfowl, have comparable skulls. Also, if Delacour is right in his classification of the Falkland Island Flightless Steamer Duck, we then have two related species, this and the Shelduck, with differing skulls, the one a diving and the other a dabbling duck by habit.

It seems to be a common factor among those species which dive that skull pneumatisation is diminished, the diminution varying directly with the efficiency of the species as an underwater diver. Air within the skull would presumably be subjected to underwater pressure changes when diving, and lack of pneumatisation may be an adaptation to avoid unpleasant effects from this. The following table shows the volume to which 120 cubic feet of free air would be reduced at different depths:

Depth	*Positive Pressure*	*Absolute Pressure*	*Volume*
Surface	0 lb. per sq. inch	1 atmosphere	120 cu. ft.
33 feet	14·7 lb. per sq. inch	2 atmospheres	60 cu. ft.
66 feet	29·4 lb. per sq. inch	3 atmospheres	40 cu. ft.

Scott and Boyd give feeding depths for diving duck as follows:

Tufted Duck	— food obtained by diving in shallow water.
Pochard	— rarely more than 20 feet.
Goldeneye	— not more than 20 feet.
Scaup	— food obtained principally in shallow water.
Eider	— up to 50 feet.
Common Scoter	— 30–60 feet.

With this in mind, my findings so far suggest that the Tufted Duck, Pochard, Scaup and Goldeneye do tend to have a little more air in their skulls than the Scoters, Eider, Stiff-tails and Saw-bills.

Another factor which may be significant is skull buoyancy, for a fully pneumatised skull would tend to rise when submerged, which would be an obvious disadvantage when feeding. In contradiction to this, there is the skull of the two species of Goldeneye, which are so completely different from all other diving duck examined. The relatively large size of their heads is due to the air sinuses over the dome of the skull, and these must play a part in skull buoyancy. It seems possible that the sinus air could form a reserve supply when the Goldeneyes are feeding shallowly submerged. Further data on diving times is

needed to see if Goldeneyes can, in fact, dive for longer periods than diving duck without air sinuses, bearing in mind that the deeper the dive the greater will be skull buoyancy and the less available the air.

While studying these wildfowl skulls I have been struck by the very complicated naso-lacrymal apparatus in duck, particularly certain diving species, and it is likely that a new field of research awaits to be explored here, and the findings may well link up with this work on skull pneumaticity. The whole should make an intriguing study. I am conscious of many gaps still to be covered —the Long-tailed Duck, Bufflehead and the Torrent Ducks, to mention but a few. That I have been able to examine so many is due to the kindness of Mr Peter Scott and the scientific staff of the Trust, who have taken so much trouble to get me specimens that have died in the collection, and also to Mr Philip Wayre and Mr Walter Salmon, who have sent me specimens from their collections which had died. Captain J. V. Wilkinson, D.S.C., G.M., R.N., collected me some most valuable wildfowl, while in command of H.M.S. *Protector* in Antarctic waters, and for many examples of British wildfowl I am indebted to members of the Kent Wildfowlers' Association. I am also most grateful to Dr Hugh Hay, Consulting Radiologist, who has been so helpful with the X-rays on my behalf; as has Mr Gordon Anckorn with the photography.

South Georgia Teal (*Anas g. georgica*)

THE SOUTH GEORGIA TEAL

by G. B. Spenceley

SOUTH GEORGIA, a small speck on the map of the South Atlantic, is an island, mountainous and snowbound, surrounded by the world's most stormy seas.

It was discovered by Captain James Cook in 1775 when he was sailing south in search of the mythical southern continent. Although in the same latitude as Cape Horn, geographically and climatically it belongs to the Antarctic. From the Weddell Sea flow cold ocean currents which maintain a low temperature, and the winds which blow from the west, uninterrupted by land, make South Georgia one of the stormiest places in the world.

The Teal were among the birds noted by Captain Cook on the first landing on the island. At the beginning of the present century they were probably abundant in all the coastal areas. The German expedition in 1890 observed several flocks of about a hundred individuals at Royal Bay. Unfortunately the

birds are no longer numerous, for, to the visiting whalers and sealers starved of fresh meat, they offered an attractive source of food. As with most of the birds of South Georgia, they showed little fear of man and they were an easy prey to the whalers' guns.

Robert Cushman Murphy from the American Museum of Natural History visited the island (1912–13) in the last of the Yankee whalers, the brig *Daisy*. He has recorded the experiences of this voyage in a charming book, *A Logbook for Grace*, a diary which he kept for his wife, which was published many years later, but the full fruits of his observations of the Teal and other birds are to be found in his standard work, *Oceanic Birds of South America*.

The South Georgia Teal is a pioneering member of a group of ducks inhabiting the southern tip of South America. It most clearly resembles the widely distributed Brown Pintail of that area, but it is smaller in size, has more dense spotting of the throat and fore neck and has 16 instead of 14 rectrices. Murphy in 1912 found them fairly common in the Bay of Isles. They were mostly in evidence on grassy islets, and despite persecution were remarkably unsophisticated. They blended very well with their environment, all but for their bright eyes and yellow bills. The call of the male is a shrill whistle, repeated several times and frequently uttered in flight. The duck utters a soft quack and a gurgling note.

After a lengthy search Murphy found one nest. This was in February, but he believed most of the young hatch during December and January.

The South Georgia Survey, 1955–56, the third expedition to the island to be led by Duncan Carse, had survey as its main object, and, perforce, most of the six months in the field were spent on sledging journeys in the interior. Nevertheless, it was hoped that an opportunity would occur of catching and bringing back alive a number of South Georgia Teal for the Wildfowl Trust.

During the season about 60 pairs of Teal were seen by members of the expedition, about half of which were sighted in late September at Hestesletten on the shores of Cumberland East Bay and others in the Bay of Isles. It was assumed from Murphy's records that December was the usual nesting-time and no attempt was made to capture South Georgia Teal, or indeed would have been possible, until a four-man party occupied a camp at Elsehul, at the extreme north-west end of the island, between 13 December and 9 January. During this period about 15–20 pairs of South Georgia Teal were seen, and an extensive search for nests was made in the tussock country over a wide area; only two nests were found.

The first nest was located on 19 December close to the camp site; it contained two eggs. When the nest was revisited later the same day it was found to have been deserted, and the eggs were already gone, presumably having been taken either by rats or Antarctic Skuas. The nest was never reoccupied. A second nest was found on 30 December; there were five eggs. In the hours of darkness the nest was twice visited by two people with a torch and small net; but each time only one parent bird was in occupation. On the second occasion, the sitting bird, a female, was caught without difficulty.

The two nests found were most carefully concealed; each was sited at the base and in the middle of a clump of thick tussock, with complete cover afforded by over-arching blades of dead grass. Both were situated on tussock slopes a little above the level to which the Elephant Seal normally climbed when hauling out.

In captivity, the bird never settled down, and there was no evidence that she

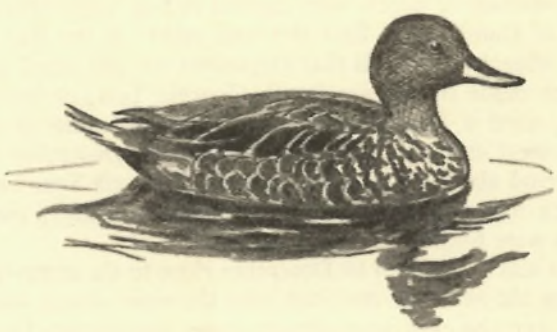
ever ate any of the food provided—broken biscuits dry and pre-soaked. A pen enclosing a small pool was constructed of wire-netting in the hope that this familiar habitat would encourage her and provide opportunity for her to find at least some natural food; but she became rapidly and increasingly listless and inactive, and died on the fourth day of captivity.

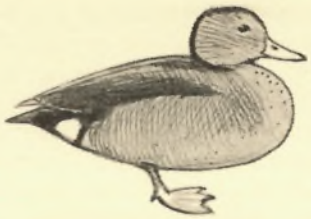
Bearing in mind the considerable area searched, and the fact that only two nests were found despite the comparative frequency of the species in this locality, some doubt is cast on Murphy's statement that December is the usual nesting-time. Furthermore, with few exceptions, all the birds seen in the Elsehul–Undine Harbour area were feeding in pairs and, on 4 January a fledgling was seen, almost as large as the parent birds and with full adult plumage.

All the South Georgia Teal seen were near the coast; they fed either from kelp-covered rocks and pools at low tide or, and more frequently, from the edges of fresh water tarns and streams inland. In late September they were seen in a flock of about 30 pairs over Hestesletten; otherwise they were seen in pairs —sometimes 2 pairs together—except on one occasion when visiting a freshwater tarn in mid-December near Undine Harbour, when a flock of 10 pairs was seen.

South Georgia Teal are not timid; a cautious approach can be made to within 10 feet without causing alarm, and when disturbed they take flight only when in danger of being overtaken. In this way they can be coaxed in any desired direction, but a noisy or hurried approach will immediately set them on the wing.

It is the care with which these birds can be shepherded along the ground, and their apparent reluctance to fly, that will provide the clue to their capture. But there still remains the problem of keeping them alive. To rear the chicks with a foster-parent would appear to be the best solution.





Drake Ringed Teal (*Anas leucophrys*)

THE FLIGHT OF RINGED TEAL

by Noel Dudley

AFTER observing the pair of Ringed Teal (*Anas leucophrys*) which are full-winged and live in the aviary, it has been noticed that, in flight, the wing-beat of the male produces a thin high-pitched whistle. By comparison the female's wing-beat is almost silent.

As the female was incubating in July and early August, it was at first thought that she had perhaps been moulting at the time of the observation, thus accounting for the absence of 'whistle' in her wing-beat.

However, on further investigation it was apparent that the male was also moulting at this time, as several of his feathers were to be seen lying round the pen. This indicates that moulting does not affect the 'whistle'. Furthermore, it is known that this accompaniment is present in the flight of this species at all times of the year. It had been assumed that the noise was produced by both male and female, but it now seems that the wing structure of the male is in some way different from that of the female.

Ringed Teal ♀

PHOTOGRAPHS

The Trust is greatly indebted to the following for permission to reproduce the photographs they have taken:

Gordon Anckorn
J. V. Beer
Prof. W. H. Elder
Dr Hr. Haefelinger
Dr L. Hoffmann
David B. Marshall
G. B. Spenceley
Sport & General Press Agency
Miss P. Talbot Ponsonby
John Warham
D. Woodside

The Trust has established a new collection at the Peakirk Waterfowl Gardens, near Peterborough, with the objects of providing an amenity for Members and for the general public in that part of England and at the same time helping to maintain the nearby Ringing Station at the ancient and famous Borough Fen Decoy. (Above) The Ten Island Pond. (Below) The Ring Pond.

Sport and General

Peakirk Waterfowl Gardens. (Above) The Goshams, part of the property upon which the Waterfowl Gardens have been created. (Below) Mr Billy Williams, whose death on 10 January, 1958, at the age of 74 has been a grave loss to the Trust. For almost 30 years he was decoy man at Borough Fen Decoy, and he supervised the establishment of the Waterfowl Gardens.

The Peakirk Waterfowl Gardens were opened to the public on 12 April, 1957, by His Royal Highness the Duke of Gloucester. The Duke and Duchess, with their son Prince Richard, are seen inspecting the Collection with the Hon. Director and Mrs Scott: in background are the Earl Spencer, Lord Lieutenant of Northamptonshire (wearing hat), and Mr R. E. M. Pilcher, Chairman of the Peakirk Committee of the Trust. (Above) Geese in the Ten Island Pen.

Sport and General

Magpie Geese *Anseranas semipalmata* in the area of the rice-growing project at Humpty Doo, Northern Territory of Australia. The picture below was taken from an aircraft.

P. Talbot-Ponsonby

Magpie Geese breeding at Slimbridge. (Above) The male guards the female at the nest. (Below) The female with red-headed goslings, about twenty-four hours old.

J. V. Beer

Station Biologique de la Tour du Valat (pages 154-156). (Above) Dr L. Hoffmann, Director of the Station, carrying poles for making a corral for catching flightless Flamingoes *Phoenicopterus ruber*. (Centre) The corral under construction. (Below) Young Flamingoes after a successful drive. (Opposite above) Visiting one of the duck traps which have been so successful in catching Teal *Anas crecca* and other ducks wintering in the Camargue. (Below) The catching box of one of the duck traps. This prevents the ducks becoming muddy and dishevelled while being caught up for ringing.

Hr Haefelfinger

L. Hoffman

(Above) 15,000 Lesser Snow Geese *Anser c. caerulescens* on Malheur Lake, Malheur National Wildlife Refuge, Oregon. (Below) An air-thrust boat used by the U.S. Fish and Wildlife Service in the Malheur National Wildlife Refuge. Boats of this type can travel easily over shallow, weed-choked water, impassable by more orthodox craft.

David B. Marshall

Waterfowl of the Pacific Flyway (pages 128-137). (Above) Aerial view of rice fields on a refuge in the Sacramento Valley of California. About 200,000 ducks show in this photograph. (Below) Another aerial view of a rice paddy containing thousands of ducks, mostly Pintail, *Anas a. acuta*.

David B. Marshall

P. Talbot-Ponsonby

(Above) Newly hatched Smews *Mergus albellus* three of which were successfully reared at Slimbridge in 1957. (Below) South Georgia Teal *Anas georgica georgica* photographed in the wild during the expedition to the island led by Mr Duncan Carse (see pages 196-198). (Opposite) Kerguelen Pintails *Anas acuta eatoni* at Slimbridge. These were part of a new shipment from Kerguelen Island in the South Indian Ocean.

J. V. Beer

A pair of Bewick's Swans *Cygnus columbianus bewickii* bred successfully at Slimbridge in 1956, the first fully authenticated instance of this species breeding in captivity.

J. V. Beer

(Above) A pair of Falkland Flightless Steamer Ducks *Tachyeres brachypterus*, which arrived at Slimbridge in the summer of 1957. The male is on the left. (Below) A female Bronze-winged Duck *Anas specularis*.

J. V. Beer

New Zealand Brown Ducks *Anas aucklandica chlorotis* (above) and a pair of New Zealand Scaup *Aythya novae-seelandiae* (below) at Slimbridge. These birds were added to the collection through the agency of the Department of Internal Affairs of the Government of New Zealand.

J. V. Beer

(Right) The Acrow Tower at the south end of the Big Pen at Slimbridge, completed early in 1957. This Tower provides excellent views for visitors of the wild geese on the Dumbles in winter. (Below) A view of the Pens from the Tower.

J. V. Beer

David Woodside

Nene in Hawaii (pages 112-117). (Above) A wild male 'on guard' close to a nest. This shows all the characteristic features of the habitat, including the persistent cloud. (Below) The nest, with a clutch of two eggs, fifty yards from the male's look-out, and hidden under a giant koa tree log surrounded by pukeawe (poo-kee-a-vee) scrub.

W. H. Elder

P. Talbot-Ponsonby

(Above) Another view of the family of Blue Ducks. (Below) Two of the five Blue Ducks sent to Slimbridge in the spring of 1957 by the Department of Internal Affairs of the New Zealand Government. They were caught on the same place and may even be the same birds.

J. V. Beer

Blue or Mountain Ducks *Hymenolaimus malacorhynchos*. A family party seen by Mr and Mrs Scott near Owhena, North Island, New Zealand. In the upper picture the female is on the left and the male on the right. In the lower picture the male is on the left, with the female behind him.

P. Talbot-Ponsonby

Charles Lagus

Salvadori's Ducks *Anas waigiuensis* in the Fauna Section at Nondugl, New Guinea. This is the collection of Sir Edward Hallstrom under the care of Mr F. Shaw Meyer. The picture above shows the speculum of a male. The views of the ducks on the water show the characteristic carriage of the tail, and the similarity of the two sexes. The species is apparently entirely confined to the highlands of New Guinea.

P. Talbot-Ponsonby

(Above) Awahga porters carrying the B.B.C. camera and film equipment on the expedition. (Below) Mr Charles Lagus, the B.B.C. cameraman who accompanied Mr and Mrs Scott on their world tour, crossing a mountain river during the search for Salvadori's Ducks. Unfortunately, no wild Salvadori's Ducks were seen on this excursion into the moss forest.

P. Talbot-Ponsonby

An expedition in search of Salvadori's Duck *Anas waigiuensis* in New Guinea (pages 100-103). (Above) The home of Salvadori's Duck at 6,000 ft. on the Ganoigl River above Nondugl in the Wahgi Valley. The birds also inhabit high mountain lakes. (Below) Awahga tribesmen making the fire for a picnic lunch. Mother-of-pearl shell is worn through the nose and in cold weather the arms are used as a scarf.

P. Talbot-Ponsonby

John Warham

Young Pink-eared Ducks. The duckling in the upper photograph is feeding, although only about seven hours old. The lower picture shows that the bill is already of the highly specialised adult form when the duckling is hatched.

P. Talbot-Ponsonby

(Above) A pair of Pink-eared Ducks. The presumed female (on the right) has raised her head to look at the nest before flying up. (Below) The hide used to obtain the photographs on this and the two previous pages. The nest is in the lowest fork of the tree on the left.

John Warham

The Pink-eared Duck *Malacorhynchus membranaceus* photographed in Western Australia. Female incubating. The photographs below and opposite show particularly well the extraordinary shape of the bill. The photograph opposite was taken during the final visit of the female to the nest before the departure of the young.

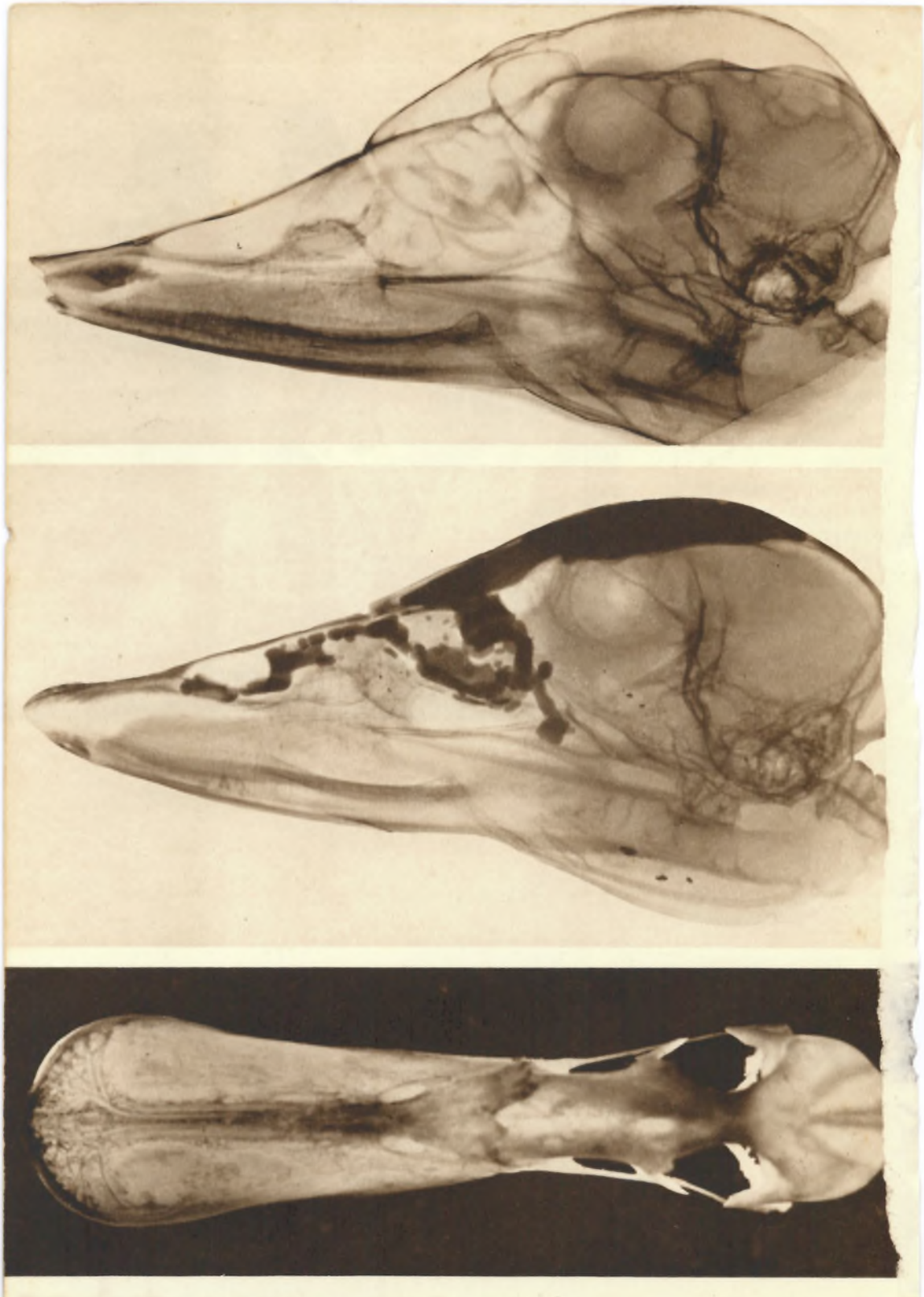
John Warham

(Above) A billabong near Humpty Doo, Northern Territory of Australia, typical habitat of Magpie Geese and Pygmy Geese. (Below) Green pygmy Geese *Nettapus pulchellus* on the same billabong.

P. Talbot-Ponsonby

North-East Greenland, 1956 (pages 180-192). (Opposite above) Musk Oxen.
(Centre) The sealer *Polarbjorn*, in which the expedition travelled from Norway, made fast to the ice off the Greenland coast. (Below) A camp in the goose valley of Badlandsdal, near Myggbukta Weather Station.
(Above) Members of the expedition holding Barnacle Geese and goslings caught for ringing. (Below) A small glacier in Mount Norris Fjord.

G. T. Wright



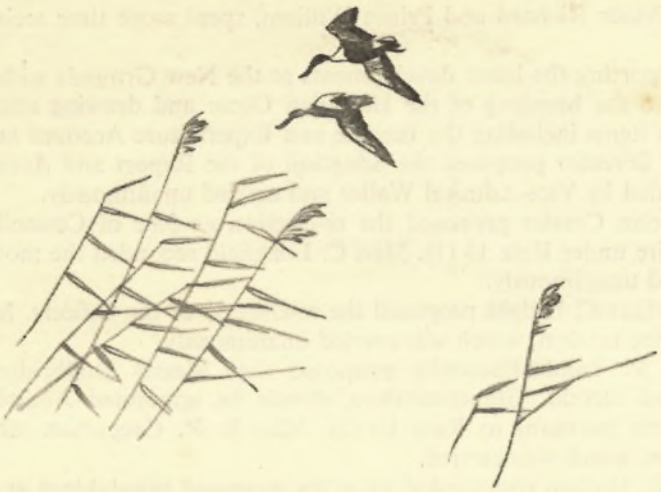
(Top) Adult duck Goldeneye (straight X-ray) to show air sinus covering the vault.

(Centre) Adult drake Goldeneye (Lipiodol X-ray) to demonstrate sinus continuous with the nostrils.

(Bottom) Shoveler skull, transilluminated to show pneumatised bars within the vault.

(See page 193: Skull Pneumaticity.)

Gordon Anckorn



TENTH ANNUAL GENERAL MEETING

MINUTES

THE Tenth Annual General Meeting of The Wildfowl Trust was held at the Royal Society of Arts, John Adam Street, London, W.C.2, on Thursday, 16 May 1957.

In the absence of the President, Field-Marshal the Rt Hon. the Viscount Alanbrooke, K.G., G.C.B., O.M., G.C.V.O., D.S.O., the Chair was taken by Sir Landsborough Thomson, C.B., O.B.E., Chairman of the Scientific Advisory Committee.

1. The Minutes of the Ninth Annual General Meeting, which had been circulated with the Report of Council, were taken as read and signed by the Chairman.

2. Before proposing the adoption of the Report and Accounts, the Director reported with deep regret the death of the Rt Hon. the Lord Dulverton of Batsford, O.B.E., Vice-President of the Trust from its formation, and of Dr Richard Clarke, O.B.E., F.R.C.P., Member of Council and Chairman of the New Grounds Committee.

The Hon. Director gave two items of news:

His Royal Highness the Prince Philip, Duke of Edinburgh, had paid an informal visit to The Wildfowl Trust at Slimbridge and had spent the night of 15 May 1957 as the guest of Mr and Mrs Scott. He had spent several hours seeing the grounds and had shown great interest in the birds. During the afternoon of the 15 May, Prince Philip visited the Bristol Gliding Club at Nympsfield and spent several minutes at the controls of Mr Scott's sailplane. This was his first experience of gliding. Prince Philip left the New Grounds the following day by helicopter.

On the afternoon of Friday, 12 April 1957, His Royal Highness the Duke of Gloucester officially opened the new branch of The Wildfowl Trust at Peakirk, near Peterborough. Her Royal Highness the Duchess of Gloucester planted a tree in the grounds of the Waterfowl Gardens, and the royal party, which

included Prince Richard and Prince William, spent some time seeing the new project.

After reporting the latest developments at the New Grounds with particular reference to the breeding of the Hawaiian Geese and drawing attention to a number of items including the Income and Expenditure Account and Balance Sheet, the Director proposed the adoption of the Report and Accounts. This was seconded by Vice-Admiral Waller and carried unanimously.

3. Sir John Craster proposed the re-election *en bloc* of Council Members due to retire under Rule 13 (1). Miss C. Longfield seconded the motion, which was carried unanimously.

4. Mr Maxwell Knight proposed the re-election of the Officers. Mr P. Riley seconded the motion, which was carried unanimously.

5. Miss P. Talbot-Ponsonby proposed that Messrs Dudbridge & Sons, Auditors of Stroud, Gloucestershire, should be appointed Auditors for the ensuing year pursuant to Rule 10 (1). Miss E. R. Gregorson seconded the proposition, which was carried.

Mr H. K. Hallam commented upon the increased gate-takings at The Wildfowl Trust during the past year, and said that he was sure he was expressing the opinion of all members in offering his congratulations to the staff of the Trust. He also drew attention to the new Gosling Membership, which he welcomed as a practical method of building up interest in birds among children.

The business of the Meeting was then concluded, and the Director showed colour slides taken by Mrs Scott on their recent round-the-world tour.

MEMBERSHIP

THE membership of the Trust in January 1957 had reached 5094, over two hundred more than the previous maximum, reached in 1954. The number of Full Members showed a further small decline, but there was a notable increase in Life Membership and the Gosling Scheme has attracted a number of young Members.

January 1956		*January* 1957
86	Life Members	120
3370	Full Members	3308
1103	Associate and Parish Members	1261
—	Gosling Members	217
128	Corporate Members	160
29	Contributors	28
Total 4716		Total 5094

CLASSES OF MEMBERS

There are now seven classes of Members, whose respective privileges and rates of subscription are detailed below.

1. **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 subscription, *excepting any sum already being paid yearly under Deed of Covenant.*

2. **Full Members:** Annual subscription 2 guineas. Entitled to free access to pens and observation-huts at the New Grounds 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.

3. **Junior Compounded Members:** Only persons under 21. One payment of 10 guineas. 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.

4. **Associate Members:** Annual subscription, 10*s*. Entitled to free access to pens and observation-huts, and to free copies of all *Bulletins*. (Associate Members may, by subscribing an additional 11*s*., 1 guinea in all, also have one copy of each *Annual Report* posted to them on publication.)

5. **Gosling Members:** Annual subscription, 7*s*. 6*d*. Limited to persons under 16. Entitled to free access to pens at the New Grounds on Saturdays and Sundays. Goslings will also be given an adopted duck each time they renew their membership, and may adopt a duck at any time for 2*s*. 6*d*. instead of the usual 5*s*. (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 were given in a leaflet issued to all members.)

6. **Corporate Members:** Annual subscription 2 guineas. Limited to Educational Establishments, Youth Clubs, Training Colleges, etc. Entitled to free access to pens and observation-huts at New Grounds in parties by arrangement with the Curator. (Sundays before 2 p.m. excepted.) One free *Annual Report*; one copy of all *Bulletins* during Membership.

7. **Parish Members:** Annual subscription, 2*s*. 6*d*. Limited to persons living in Slimbridge Parish. Entitled to free access, with one free guest, to pens only at the New Grounds. Copies of all *Bulletins*.
   Clubs, Institutes, Libraries, etc., not qualifying as Corporate Members, for an annual payment of not less than 1 guinea may become *Contributors* and receive one copy of the *Annual Report* and *Bulletins*.

THE WILDFOWL TRUST

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER, 1956

EXPENDITURE

1955 £		£ s. d.	£ s. d.
8254	To Valuation, 31 December, 1955		9704 0 0
	„ Membership:—		
1503	Salaries of Administrative Staff	1752 18 7	
569	Office Expenses, Postages, etc.	793 0 5	
539	Printing and Stationery, General	1233 1 10	
238	Telephone	267 8 10	
144	Bank Charges	116 6 2	
237	Miscellaneous Expenses	386 17 9	
2487	Printing Annual Report	1500 0 0	
116	Expenses of Annual Dinner	185 0 3	
133	Staff Travelling Expenses	256 9 3	
5966			6491 3 1
	„ New Grounds:—		
4223	Salaries of Outside Staff	4778 8 2	
189	Staff Travelling Expenses	438 4 6	
1227	Purchases and Transport of Wildfowl and Eggs	883 3 2	
2558	Food for Wildfowl	3189 7 11	
406	Rent, Rates and Insurance	466 13 3	
1068	Materials, Repairs and Replacements	1912 9 8	
456	Vehicles and Mechanical Equipment and Expenses	604 13 7	
250	Electricity	309 8 2	
33	Hatching Expenses	144 9 0	
10,410			12,726 17 5
1560	Hostel, Upkeep		1688 10 0
	„ Purchases for re-sale:—		
1085	Printing Christmas Cards	1285 9 10	
96	Post Cards	678 8 3	
21	Booklets, Books, etc.	872 15 6	
—	Prints	155 5 3	
239	Ties	371 3 11	
284	Pottery	1307 2 1	
180	Films	267 6 2	
135	Leathercraft	111 12 0	
157	Car Badges	539 8 3	
—	Scarves	619 15 4	
—	Jewellery	399 10 3	
68	Sundry	83 19 1	
2265			6691 15 11
		Carried forward	37,302 6 5

INCOME

1955 £		£ s. d.	£ s. d.
	By Membership:—		
6731	Subscriptions, Ordinary	7160 15 7	
—	Subscriptions, Life Members	592 5 0	
2350	Income Tax on Covenants	2143 13 10	
134	Donations	1267 9 0	
118	Receipts from Annual Dinner	191 12 6	
327	Receipts from Sale of Annual Reports	246 3 9	
9660			11,601 19 8
	„ New Grounds:—		
8771	Gate Takings	12,865 9 8	
1072	Sale of Surplus Wildfowl	648 5 10	
9843			13,513 15 6
	„ Sales:—		
728	*Key to The Wildfowl of the World*	232 5 9	
1516	Christmas Cards	1999 5 4	
100	Surplus Christmas Cards	— — —	
362	Post Cards	1010 18 9	
15	Booklets, Books, etc.	1198 14 9	
211	Prints	348 3 5	
400	Paintings	— — —	
314	Ties	455 3 9	
329	Pottery	1773 14 5	
248	Films	339 14 8	
131	Leathercraft	225 19 6	
285	Car Badges	242 15 3	
—	Scarves	710 4 5	
—	Jewellery	215 17 0	
22	Sundry	230 16 11	
4671			8983 13 11
	„ Scientific and Educational:—		
1205	Fees and Collections at Lectures	216 0 0	
790	Duck Adoption	496 9 1	
284	Donations for Abberton Ringing Station	262 10 0	
456	Donations for Boro Fen Decoy	4 10 0	
	„ Grants:—		
1326	The Nature Conservancy	2471 3 4	
—	Nuffield Trust	397 10 0	
400	Bristol Zoo (towards Salary of Resident Biologist)	400 0 0	
4461			4248 2 5
		Carried forward	38,347 11 6

			Brought forward		37,302	6 5
	To Scientific and Educational:—					
1343		Salaries	2485	3 7		
615		Rocket Netting Expenses	250	7 10		
366		Expenses of Lectures	73	2 5		
200		Travelling Expenses	467	11 2		
764		Abberton Ringing Station	852	10 0		
—		Orielton Ringing Station	61	5 0		
502		Boro Fen Decoy	542	1 3		
591		Wildfowl Counts	294	1 0		
503		Scientific Equipment and Expenses	610	4 4		
277		Duck Adoption	177	5 9		
—		Grant to Expedition	150	0 0		
—		Aerial Survey	87	0 8		
5161					6050	13 0
	„	Capital Expenditure:—				
264		Brooders	—	— —		
166		Deep Freeze Refrigerator	—	— —		
269		Conversion of Garage into Wildfowl Counts Office	—	— —		
150		Electrical Wiring	—	— —		
300		Excavation of New Pool	—	— —		
178		Floodlighting and Sundry Equipment	—	— —		
301		Nylon Rocket Netting Equipment	—	— —		
140		Decoration and Repairs to Bungalow	—	— —		
145		Resiting Fuel Tanks	—	— —		
—		Peakirk Development	2574	16 4		
—		Sales Hut	381	8 0		
—		Gates	29	6 2		
—		Laboratory	85	0 0		
—		Tower	318	6 10		
—		Garages	857	0 4		
—		Pump	160	10 1		
—		Office Equipment	282	0 9		
1913					4688	8 6
					48,041	7 11
400		Written off Buildings			597	13 10
2400		Transferred to Reserve Account			1100	0 0
10		Balance, Excess of Income over Expenditure for the year			14	9 9
£38,339					£49,753	11 6

		Brought forward	38,347	11 6
9704	Valuation, 31 December, 1956		11,406	0 0
£38,339			£49,753	11 6

NOTE.—The figures in the margin are those for the year ended 31 December 1955 and are given for the purpose of comparison only.

THE WILDFOWL TRUST

BALANCE SHEET 31 DECEMBER, 1956

LIABILITIES

1955 £		£ s. d.	£ s. d.
	Sundry Creditors:—		
2988	On Open Accounts		4965 11 1
	Loan Accounts:—		
	Balance, 31 December, 1955	9905 0 0	
	Add further Advances	3362 13 10	
		13,267 13 10	
	Less Repaid	750 0 0	
9905			12,517 13 10
	Reserve Account:—		
	Balance, 31 December, 1955	2400 0 0	
	Add Transferred from Income and Expenditure Account	1100 0 0	
2400			3500 0 0
	Income and Expenditure Account:—		
5059	Balance, 31 December, 1955	5069 10 0	
10	*Add* Excess of Income over Expenditure for the year	14 9 9	
5069			5083 19 9
	Carried forward		26,067 4 8

ASSETS

1955 £		£ s. d.	£ s. d.
	Cash:—		
44	In Hand	51 11 0	
2218	At Bank, Westminster Bank Ltd.	3845 16 7	
37	do. Lloyds Bank Ltd.	17 6 8	
2299			3914 14 3
	Sundry Debtors and Payments in Advance:—		
822	Sundry Debtors. On Open Accounts ..	579 10 5	
62	Payments in Advance	27 0 0	
884			606 10 5
	Valuation (as valued by the Honorary Director):—		
6959	Wildfowl..	8736 0 0	
420	Land Rovers	375 0 0	
2325	Coops, Henhouses, Huts, etc.	2295 0 0	
9704			11,406 0 0
	Narrow Boat:—		
1000	Valuation, 31 December, 1951	1000 0 0	
	£ s. d.		
225	*Less* Rents to 31 December, 1955 325 0 0		
100	Rent, year ended 31 December, 1956 .. .. .. 100 0 0		
		425 0 0	
675			575 0 0
	Carried forward		16,502 4 8

				NOTE.—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 21 October, 1952, with the option to purchase for ten shillings, after rents amounting to £1000 have been paid.			
	Brought forward	26,067	4 8			Brought forward	16,502 4 8
				New Buildings, etc., New Grounds, Slimbridge, Gloucestershire:—			
8000				Balance, 31 December, 1952		8000 0 0	
—				Additions		3362 13 10	
						11,362 13 10	
					£ s. d.		
800				*Less* Written off to 31 December, 1955	1200 0 0		
400				Written off in year ended 31 December, 1956	597 13 10		
						1797 13 10	
6800							9565 0 0
				NOTE.—The New Buildings, etc., to be written off over a period not exceeding that of the lease.			
£20,362		£26,067	4 8	£20,362			£26,067 4 8

We have examined the above Balance Sheet of the Wildfowl Trust, dated 31 December, 1956, 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.

3 April, 1957.

(Signed) S. J. DUDBRIDGE & SONS,
Auditors.

OBITUARY

THE death of Dr R. C. Clarke, O.B.E., F.R.C.P., the Chairman of the New Grounds Committee, has deprived the Trust of one of its most enthusiastic and helpful Council members. The Council has also learned with deep regret of the deaths of the following Members:

Viscount Allendale, C.B., C.B.E., M.C.
Lt.-Colonel G. Babington
H. L. Baxendale
P. Blake
Maria, Lady Bowlby
Miss H. M. Edwards
J. C. Gascoigne
Mrs M. Graham-Clarke
H. C. Haldane
Dr W. B. Loveless
The Hon. Mrs Lyell
F. G. Macalpine
R. D. Marriott
R. M. Moncrieff, O.B.E.
Her Grace the Dowager Duchess of Montrose
The Rev. Canon G. R. G. Norris
H. C. Pickney
Lady Reynolds
Brigadier B. L. de Robeck
Dr H. E. Smith
F. H. Stileman
R. L. Tufnell
Major-General G. L. Verney, D.S.O., M.V.O.
Mrs E. W. Walker
A. T. Waterhouse
Mrs E. M. Wilson
G. C. Wooltorton

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