

**The seventeenth Annual Report of**

# **The Wildfowl Trust**

**Edited by Hugh Boyd**

**Illustrated by Peter Scott**

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# The Wildfowl Trust

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*Patron* HER MAJESTY THE QUEEN

*President* His Grace the Duke of Norfolk, K.G., P.C., G.C.V.O.

*Vice-Presidents* Captain R. G. W. Berkeley  
The Rt. Hon. The Lord Howick of Glendale, G.C.M.G., K.C.V.O.  
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Sir Percy Lister, Kt.  
Sir Isaac Wolfson, Bt., F.R.S., F.R.C.P., D.C.L.

*Trustees* His Grace the Duke of Beaufort, K.G., P.C., G.C.V.O.  
The Rt. Hon. the Earl of Mansfield  
John Berkeley  
H. H. Davis  
H. C. Drayton

*Hon. Treasurer* Guy Benson

*Hon. Director* Peter Scott, C.B.E., D.S.C., LL.D.

*Council*

Dr. Bruce Campbell	E. A. Maxwell
Michael Crichton, O.B.E.	R. E. M. Pilcher, F.R.C.S.
J. O. Death	Dr. G. W. Storey
Capt. J. A. Fergusson- Cuninghame	Miss P. Talbot-Ponsonby
Dr. J. E. Harris, C.B.E., F.R.S.	Sir Landsborough Thomson, C.B., O.B.E., D.Sc., LL.D.
G. A. J. Jamieson	Major General C. B. Wainwright, C.B.
G. M. Jolliffe	The Hon. Vincent Weir
K. Miller Jones	J. P. Williams
C. J. S. Marler	

*Invited to attend  
Council Meetings  
ex-officio* A. G. Hurrell (Ministry of  
Education Assessor)

*Finance Committee*

Guy Benson ( <i>Chairman</i> )	R. C. P. Hollond
Michael Crichton, O.B.E.	G. A. J. Jamieson
J. O. Death	K. Miller Jones
H. C. Drayton	Miss P. Talbot-Ponsonby
James Fisher	

*Scientific  
Advisory  
Committee*

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Prof. A. J. Cain	Prof. G. M. Hughes
Dr. Bruce Campbell	Sir Julian Huxley, F.R.S.
R. K. Cornwallis	R. E. Moreau
Dr. H. D. Crofton	Prof. C. W. Ottaway
Dr. J. H. Crook	R. E. M. Pilcher, F.R.C.S.
Dr. G. M. Dunnet	Dr. G. W. Storey
Dr. J. G. Harrison	Prof. W. H. Thorpe, F.R.S.
Dr. L. Harrison Matthews, F.R.S.	Major General C. B. Wainwright, C.B.
Prof. R. A. Hinde	Prof. E. W. Yemm

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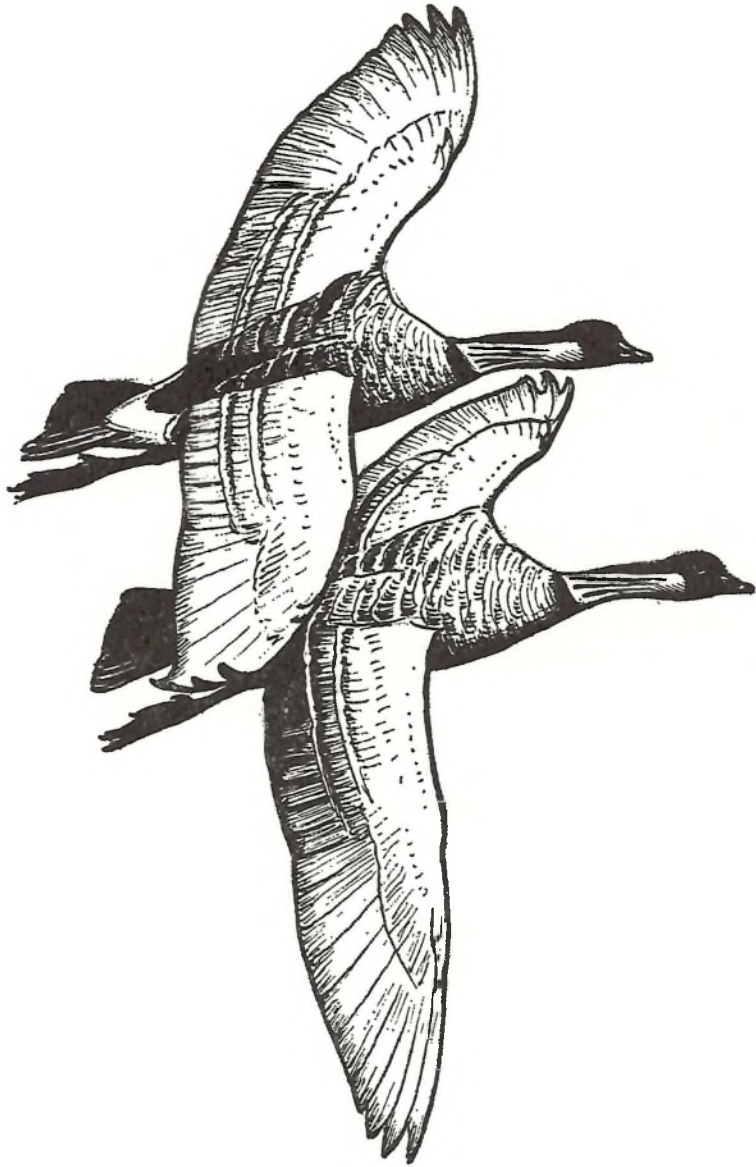
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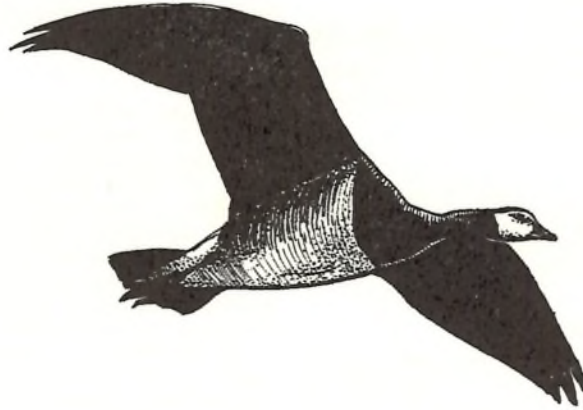
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## Annual Report 1964-65

### **The Presidency**

After serving as President for five years His Royal Highness The Duke of Edinburgh, K.G., K.T., retired from office under the terms of his agreement. His Grace The Duke of Norfolk, K.G., P.C., G.C.V.O., graciously consented to serve for a period of three years and was elected at the Annual General Meeting in May 1965.

### **Council and Committees**

The Officers, Council and Committees of the Trust as at 31st December, 1965, are shown on page 2. Meetings of the Council were held in London on 6th January, 9th March, 22nd July and 11th November and of the Finance Committee on 23rd February, 15th July and 4th November. The annual meeting of the Scientific Advisory Committee was held at Slimbridge on 22nd March.

### **Annual General Meeting and Dinner**

The Eighteenth Annual General Meeting was held at the Royal Society of Arts on 13th May, and the Annual Dinner took place at the Hyde Park Hotel the same evening. The minutes of the Annual General Meeting will be found on page 7. The speakers at the Dinner were Ian MacPhail, Peter Scott, James Fisher, and Stephen Potter.

### **Development**

The Research Centre was finished and taken into use on 1st February, 1965, and

in the first three months of the year the project was extended to include the rebuilding of the old wooden gate house. This was completed in time to be in use at Easter. A permanent exhibition in the Wolfson Hall explaining the scientific work of the Trust's research unit was opened to the public in the summer of 1965, and at the end of the year work was begun on a supplementary exhibition relating the work of the Trust to nature conservation and to other problems confronting mankind.

Two new observation hides were built in 1965, one in the Rushy Pen providing visitors in winter with a view of the visiting Bewick's Swans, and one overlooking the flash in the Tack Piece and connected to the Trust's grounds by a fenced corridor, which passes through a tunnel under the entrance to the Tack Piece.

### **Identification Competition**

There were 82 entries for the Trust's Fourth Wildfowl Identification Competition for Schools, which was held at the New Grounds on 20th March. Leighton Park, who have always distinguished themselves in this event, swept the board by taking the first three places in Group A, the first, third and fourth in Group B, with Bristol Grammar School in second place, and the first place in Group C, followed by two teams from Beaudesert Park second and third.

### Borough Fen Decoy

The Duck Decoy at Borough Fen was opened to the public on 22nd and 23rd May and Mr. and Mrs. R. E. M. Pilcher again very kindly explained its history and working to over 150 visitors.

### Gosling Party

About 200 children came to the annual party for Gosling Members at Slimbridge on 23rd December, 1965, and very much enjoyed the film *Plap*, which was shown by Tony Soper.

### Members' Collections

In 1965 the following members kindly opened their collections of waterfowl to fellow members of the Trust: C. J. Bird, Arthur Cadman, T. Curtis, J. O. Death, A. W. E. Fletcher, R. Law, Miss E. Manasseh, E. A. Maxwell, A. McLean, Mrs. B. Michell, Mrs. C. Mumford, George Newman, F. W. Perowne, R. E. M. Pilcher, G. R. Pryor, G. L. Reid, Shrewsbury School, E. O. Squire, R. J. Stainsby, Mrs. P. V. Upton, J. Williams, D. Wintle.

### Visitors

In spite of an appallingly wet summer there were over 180,000 visitors to the

Trust's two collections in 1965. The table below gives a comparison with recent years.

### Finance

There was a further substantial increase in 1965 in the cost of running the Trust and the total expenditure, including £3,000 spent on capital development and £2,500 invested in an increase in gate house stocks, exceeded £100,000. This was just covered by revenue, but with no margin for further repayment of loans. Loans were however reduced by £4,300 to £7,200 with money accrued from 1964.

In September a letter was sent to members asking them if they would consider making bequests to the Trust in their Wills. In response a number expressed their intention of leaving legacies to the Trust: others said that they preferred to send an immediate donation and these donations reached the welcome total of £1,100. This sum is not included in the revenue mentioned above, but was credited to a special Contingency Reserve.

The Accounts and Balance Sheets for both 1964 and 1965 will be found on pages 116-122.

	1961	1962	1963	1964	1965
Slimbridge	151,533	162,030	130,143	151,180	141,841
Peakirk	33,203	30,982	29,434	43,678	42,735
	<u>184,736</u>	<u>193,012</u>	<u>159,577</u>	<u>194,858</u>	<u>184,576</u>

### MEMBERSHIP

As will be seen from the figures below the Trust's membership increased during 1965 by 188. The small reduction in the number of Associate Members was no doubt due

to the increase to £1 in the rate of subscription, authorised by the Annual General Meeting in May.

Class of Membership	31 Dec 62	31 Dec 63	31 Dec 64	31 Dec 65
Life	299	304	316	316
Full	3423	3584	3644	3953
Associate & Parish	1764	2039	2422	2254
Junior Compounded	9	10	12	15
Gosling	285	759	644	685
Corporate	107	101	94	95
Contributors	32	42	38	40
	<u>5919</u>	<u>6839</u>	<u>7170</u>	<u>7358</u>

## Terms of Membership

**LIFE MEMBERS:** A single payment of 50 guineas. Entitled to all privileges of Full Membership (see below), and exempt from payment of any subscription, excepting any sum being paid yearly under Deed of Covenant.

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

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

**ASSOCIATE MEMBERS:** Annual subscription 20/-. Entitled to free access to pens and observation huts, and to free copies of all Bulletins.

**GOSLING MEMBERS:** Annual subscription 12/6d. Limited to persons under 18. Entitled to free access to pens at the New Grounds, and at Peakirk, and to all bulletins. (With the aim of encouraging interest in Wildfowl among children, a system has been introduced of grades of Goslings, with appropriate distinguishing marks and promotion by recognition-test. Full particulars of this scheme are given in the separate leaflet available at the Gate Hut at Slimbridge or Peakirk.)

**CORPORATE MEMBERS:** Annual Subscription 10/-. Limited to Educational Establishments, Youth Clubs, and bodies which are members of the Council for Nature. Parties from member bodies may visit the New Grounds and Peakirk in numbers of

not less than ten, and not exceeding one coach load at any one time, on payment at the Gate of the entrance fee, except that one adult in charge of a party of ten or more is admitted free. Times must be arranged beforehand with the Curator, and parties are not admitted before 2 p.m. on Sundays. One free Annual Report, one copy of all Bulletins during Membership.

**CONTRIBUTORS:** Organisations which do not qualify for Corporate Membership may become Contributors by subscribing not less than one guinea a year. Contributors receive all Trust publications.

**ARRANGEMENTS FOR VISITORS:** The grounds are open to the public daily (except Christmas Day) from 9.30 a.m. on weekdays and from 12 noon on Sundays. Sunday mornings are reserved for Members.

### *At Slimbridge:*

*From the beginning of summer-time until 9th September* visitors are admitted up to 6.30 p.m. and may stay in the grounds till 8.00 p.m.

*From 10th September to 20th October* visitors are admitted up to 5.30 p.m. and may stay till 6.30 p.m.

*For the rest of the year* visitors are admitted up to half-an-hour before sunset and may stay till half-an-hour after sunset.

### *At Peakirk:*

The visitors are admitted up to 6.30 p.m. or up to half-an-hour before sunset, whichever is the earlier.

The *admission charges* are 5s. 0d. (children under 16, 3s. 0d.) at Slimbridge and 3s. 6d. (children under 16, 1s. 6d.) at Peakirk.

For *parties* application must be made well in advance in writing to Slimbridge or Peakirk. School parties can only be accepted when a warden is available to show them round.

## Minutes of the Eighteenth Annual General Meeting

1. The Eighteenth Annual General Meeting of The Wildfowl Trust was held at the Royal Society of Arts, John Adam Street, London W.C.2., on Thursday, 13th May, 1965, at 5.00 p.m.

2. The following Officers and Members of Council and 69 Members of The Wildfowl Trust were present:

H.R.H. The Duke of Edinburgh, K.G.,

*K.T. Retiring President*

Guy Benson, Esq., *Hon. Treasurer*

Michael Crichton, Esq.

J. O. Death, Esq.

Captain J. A. Fergusson-Cuninghame

G. A. J. Jamieson, Esq.

G. M. Jolliffe, Esq., F.L.A.S.

Christopher Marler, Esq.

E. A. Maxwell, Esq.

K. Miller Jones, Esq.

R. E. M. Pilcher, Esq., F.R.C.S.

Peter Scott, Esq., C.B.E., D.S.C., LL.D.,

*Hon. Director*

Dr. G. W. Storey

Miss P. Talbot-Ponsonby

Sir Landsborough Thomson, C.B., O.B.E.,

*Chairman, S.A.C.*

Major General C. B. Wainwright, C.B.

Sir Isaac Wolfson, *Vice-President elect*

3. Apologies for absence were received from the following Officers and Members

of Council, and 27 Members of The Wildfowl Trust:

His Grace the Duke of Norfolk, K.G.,  
P.C., G.C.V.O.

His Grace the Duke of Beaufort, K.G.,  
P.C., G.C.V.O.

The Rt. Hon. the Lord Howick of  
Glendale, G.C.M.G., K.C.V.O.

General Sir Gerald Lathbury, G.C.B.,  
D.S.O., M.B.E., A.D.C.

The Earl of Mansfield

John Berkeley, Esq.

Howard H. Davis, Esq.

H. C. Drayton, Esq.

J. P. Williams, Esq.

4. Before beginning the business of the meeting, His Royal Highness The President said that his term of office, previously arranged by agreement, had expired, and that he was not retiring from the Presidency for any other reason. He believed that a regular change of President was beneficial.

He was glad to say that the condition of the Trust was better at present than it ever had been. The collection of waterfowl was well cared for, and the scientific work was increasing, thanks to Sir Isaac Wolfson, in improved accommodation afforded by the fine new Research Centre financed partly by the Wolfson Foundation.

The Wildfowl Trust had become a world authority on its subject, and its educational programme was rapidly expanding. It was a worthy recommendation that so many people had grown up well informed on the subject of natural history, through an increasing interest in the countryside being demonstrated to them, and in this field also the Wildfowl Trust was making a most valuable contribution. The problem of wildlife conservation was becoming daily more urgent, and the cultivation of opinion through educational programmes would make all the difference to its ultimate success. Life on this planet in future years would be intolerable if man's awareness of his environment and care for it was not actively fostered through the new science of the Ecology of Man. In this respect the present years were critical. His Royal Highness said how much he had enjoyed his years as President, and wished the Trust every success. He indicated that further personal association with the Trust in the future would not be an impossibility, and that in the meantime there were ways in which Ex-Presidents could be helpful.

The Hon. Director thanked His Royal Highness for his remarks, and proposed a vote of thanks to him for so graciously being President of the Wildfowl Trust for

the past five years. The vote was carried by acclamation.

5. The Minutes of the Seventeenth Annual General Meeting circulated with the Agenda were accepted and signed by the Chairman.

6. The Hon. Director gave an account of the year's activities at Slimbridge and Peakirk, after which he moved the adoption of the Report of Council. This was seconded by Mr. T. L. Outhwaite and carried unanimously.

7. The Hon. Treasurer moved the adoption of the accounts for the year ending 31st December, 1964. The motion was seconded by Mr. F. W. Perowne and carried unanimously.

8. Mr. K. Miller Jones proposed, and Mr. I. G. Raby Jolley seconded, the following amendments to the Rules of The Wildfowl Trust:

(a) Rule 6(1) lines 2 and 3.

*Present wording:* 'The annual subscription payable by Full Members shall be two guineas per annum, the annual subscription payable by Associate Members shall be ten shillings per annum, and the annual subscription payable by or on behalf of Gosling Members shall be seven shillings and sixpence per annum.'

*Proposed Amendment:* Delete and substitute: 'The annual subscription payable by Full Members shall be two guineas per annum. The annual subscription payable by Associate Members shall be one pound per annum, except that in the case of Associate Members who are for the time being liable under a Deed of Covenant executed before the 13th day of May, 1965, to pay the Trust a sum of not less than ten shillings per annum, after deduction of United Kingdom Income Tax at the current rate for the time being in force for a period of not less than seven years, the subscription shall be ten shillings per annum. The annual subscription payable by or on behalf of Gosling Members shall be seven shillings and sixpence per annum.'

(b) Rule 5(4) (vi) lines 5 to 8

*Present Wording:* 'Admission to the Trust's collections for Corporate Members shall be on payment for each member of the party of the entrance fee in force at the time of the visit.'

*Proposed Amendment:* Delete the full stop in line 8 and substitute a comma and add: 'except that one adult in charge of a party of ten or more shall be admitted free.'

9. The following elected Councillors retired under Rule 13(1):

Dr. Bruce Campbell



J. O. Death, Esq.  
Captain J. A. Fergusson-Cuninghame  
G. M. Jolliffe, Esq., F.L.A.S.

In accordance with Rule 7(6) the following Council nominees were elected without vote:

G. A. J. Jamieson, Esq.  
Miss P. Talbot-Ponsonby  
Major General C. B. Wainwright, C.B.  
The Honourable Vincent Weir

10. After serving as President for five years His Royal Highness The Duke of Edinburgh, K.G., K.T., retired from office under the terms of his agreement. His Grace the Duke of Norfolk had graciously accepted nomination for election to the Presidency for a period of three years. Mr. K. Miller Jones proposed the election of Officers *en bloc*. The motion was seconded by Colonel G. Barrett and carried unanimously:

*President:* His Grace the Duke of Norfolk, K.G., P.C., G.C.V.O.  
*Vice-Presidents:* Sir Percy Lister  
Captain R. G. W. Berkeley  
The Rt. Hon. The Lord Howick of Glendale, G.C.M.G., K.C.V.O.

General Sir Gerald Lathbury, G.C.B.,  
D.S.O., M.B.E.  
Sir Isaac Wolfson, Bt., F.R.S., F.R.C.P.,  
D.C.L.

*Trustees:* His Grace The Duke of Beaufort, K.G., P.C., G.C.V.O.  
The Earl of Mansfield  
John Berkeley, Esq.  
H. H. Davis, Esq.  
H. C. Drayton, Esq.

*Hon. Director:* Peter Scott, Esq., C.B.E.,  
D.S.C., LL.D.

*Hon. Treasurer:* Guy Benson, Esq.

11. The Hon. Treasurer proposed that Messrs. S. J. Dudbridge and Sons of Stroud, Gloucestershire, be re-appointed Auditors to the Wildfowl Trust for the ensuing year pursuant to Rule 19(1). Mr. C. A. Norris seconded the motion which was carried unanimously.

12. The business of the meeting was concluded at 5.40 p.m. and followed by a showing of the new Wildfowl Trust film *Wild Wings*, produced by British Transport Films for general release.

### Obituary

The death of Mr. Harold C. Drayton on 7th April, 1966, has deprived the Trust of one of its most generous benefactors. Mr. Drayton had been a member of the Finance Committee since 1954 and in 1964 raised nearly £10,000 towards the cost of the Research Centre.

The Council has learned with regret of the deaths of the following Members and Associates, notified since March, 1965:

Miss T. Almack  
J. G. Ambrose, O.B.E., M.C.  
Brigadier C. V. Bennett  
John Blott  
Air Vice-Marshal J. D. Breakey,  
C.B., D.F.C.  
Brigadier The Earl of Caithness,  
C.B.E., D.S.O.  
John Cartwright  
Colonel H. J. Cator, M.C.  
The Viscount Chetwynd, F.S.A.  
A. G. Gaydon  
A. Godding  
Dr. John Hale  
Dr. H. C. Hopkinson  
Major R. G. Hutchinson  
General Lord Ismay, K.G.  
T. C. Jacobs  
C. M. Lazenby

Miss C. M. Legge  
Mrs. E. F. Livingston-Learmonth  
Mrs. J. M. Macmillan  
Mrs. E. R. Manvell  
M. H. Neale, C.B.E.  
Her Grace Helen, Duchess of  
Northumberland  
Mrs. D. K. R. Ogilvie  
G. Oldfield  
L. J. Osmond  
C. H. Schwind  
A. R. Smith  
C. P. L. Streatfeild  
P. E. Tyhurst, M.B.E.  
J. W. Walker  
Miss M. Wallis  
Mrs. A. H. Walter  
Gunnar Weibull  
E. Whitley-Jones



## The Collections in 1965

S. T. JOHNSTONE

The Wildfowl Trust's collections now contain 172 of the 247 kinds of waterfowl. In addition, there are two of the three species of Screamers (*Anhiminae*) and specimens of all six forms of Flamingos. Three new ducks have been added—Greenland Mallard, Spectacled Eider and the Eurasian stiff-tail, the White-headed Duck.

The Trust now has the finest collection of Flamingos in the country, which numbers over 100 birds. There is a very fine flock of 50 of the Chilean form, 26 Caribbean or Rosy, 14 Greater and 9 Lesser Flamingos. In addition, we now have 5 Andean and 3 James's. These remaining two species are the rarities of the Flamingo world, and come from the High Andes. The Andean is a medium-sized Flamingo, characterised by its yellow legs. The yellow bill is black-tipped with a bright orange bar on the culmen. The wing coverts, neck and breast in the adult are a brilliant magenta. The James's Flamingo is smaller than other species, although not quite as small as the African Lesser. It has less bright plumage. The bill is a bright yellow and the lores are deep magenta. The legs are red.

The breeding season was remarkable in that 125 kinds of waterfowl nested, among them the Light-bellied Brent Goose *Branta bernicla hrota* for the first time in captivity, the Javan Whistling Duck *Dendrocygna javanica* and the White-backed Duck *Thalassornis leuconotus* for the first time at Slimbridge. Unfortunately all the eggs from these three birds came to

naught. Those of the Light-bellied Brent were infertile. The Javan Whistling Duck laid two clutches of six eggs each and only two of the second clutch were fertile and though they hatched, the ducklings were weak and failed to survive more than twenty-four hours. The downy pattern of the young is similar to the White-faced and Red-billed, though the colour is black and white as shown in *Waterfowl of the World*.

A White-backed Duck was found incubating five large dark buff eggs and having regard to the poor results obtained from attempts to hand-rear North American Ruddy Ducks, it was decided to let the parent hatch and rear the young herself. Subsequently three of the eggs were taken by vermin. The remaining two were then placed under a bantam. One of these eggs hatched into a beautiful little black and chestnut stiff-tail. Unsuccessful attempts were made to join it to a brood of newly-hatched North American Ruddy Ducks and the duckling died after five days.

In all, some 1,200 birds of 101 kinds were reared in the two collections. Among the less common species were three Trumpeter Swans, three King Eiders, four Hooded Mergansers, eight Smew and one Crested Screamer.

The most regrettable losses during the year were the male Salvadori's Duck and the female New Zealand Blue Duck. The last male Harlequin, after thriving on the waterfall pond for four years, died in the spring.

## Breeding Results 1965: Slimbridge

	<i>Date of first egg</i>	<i>eggs incu- bated</i>	<i>eggs hatched</i>	<i>young reared</i>
Magpie Goose	10.7	14	6	4
Spotted Whistling Duck	17.7	1	0	0
Javan Whistling Duck	6.6	12	2	0
Fulvous Whistling Duck	1.3	20	9	9
N. Red-billed Whistling Duck				6
S. Red-billed Whistling Duck				6
Black Swan		12	0	0
Mute Swan	4.4	1	1	1
Black-necked Swan	3.2	14	2	1
Whooper Swan	17.4	4	4	0
Trumpeter Swan	13.4	3	3	3
Swan Goose	6.4		8	7
Western Bean Goose	24.4	6	0	0
Russian Bean Goose	24.4	10	1	0
Pink-footed Goose	20.4	7	1	1
European White-fronted Goose	4.5	11	0	0
Greenland White-fronted Goose	10.4	24	8	7
Lesser White-fronted Goose	20.4	24	15	9
Western Greylag Goose	4.4		16	16
Eastern Greylag Goose	17.3			3
Bar-headed Goose	16.4		6	6
Emperor Goose	29.4	23	4	0
Lesser Snow Goose:				
(white phase)	16.4	19	13	11
(blue phase)		10	6	4
Greater Snow Goose	25.4		25	24
Ross's Goose	13.5	14	12	9
Atlantic Canada Goose	20.3		6	6
Moffitt's Canada Goose	9.4	3	0	0
Giant Canada Goose	25.3	6	6	5
Taverner's Canada Goose	15.4		2	2
Dusky Canada Goose	11.4		2	2
Cackling Goose	27.3	8	2	2
Ne-ne, or Hawaiian Goose	14.2	80	22	17
Barnacle Goose	25.4			22
Light-bellied Brent Goose		3	0	0
Black Brant	25.5	12	8	5
Cape Shelduck	3.4	2	0	0
New Zealand Shelduck	16.5	2	0	0
Common Shelduck		20	15	12
Egyptian Goose				7
Abyssinian Blue-winged Goose		5	0	0
Ashy-headed Goose	7.4		5	5
Ruddy-headed Goose	11.4		4	0
Lesser Magellan Goose	15.4		15	11
Greater Magellan Goose	26.4	5	0	0
Cereopsis Goose	7.1		4	4
Patagonian Crested Duck	27.2	22	17	15
Andean Crested Duck	18.3	8	3	3
Marbled Teal	18.4	65	54	47
Cape Teal	6.6		8	6
Versicolor Teal	27.3	25	15	7
Red-billed Pintail		2	0	0
Bahama Pintail		48	34	30
Chilean Pintail			20	20
Northern Pintail		18	15	13
Kerguelen Pintail		6	1	1
Chilean Teal			4	2
Sharp-winged Teal		6	3	3
American Green-winged Teal			2	2
Falcated Teal	22.5	44	13	9
Australian Grey Teal		9	9	9
Chestnut Teal		19	12	12
North American Black Duck				2

*Breeding Results 1965, Slimbridge, continued*

	<i>Date of first egg</i>	<i>eggs incu- bated</i>	<i>eggs hatched</i>	<i>young reared</i>
Indian Spotbill		12	5	1
New Zealand Grey Duck	18.4			10
Philippine Duck	20.4	37	18	15
African Yellowbill		6	6	2
Abyssinian Yellowbill		19	7	7
African Black Duck	26.3	18	12	9
Gadwall			15	15
European Wigeon	9.5	4	3	3
American Wigeon			17	17
Chiloe Wigeon		17	1	1
Cinnamon Teal		8	7	2
Garganey	18.4	2	0	0
Red Shoveler	29.5	7	4	2
Cape Shoveler	9.4	25	9	7
New Zealand Shoveler	29.4	13	6	4
Common Shoveler	1.5	38	23	20
Ringed Teal	30.4	48	20	6
European Eider	10.5	14	10	9
King Eider	21.5	9	7	3
Red-crested Pochard		71	43	34
Rosybill		26	5	5
African Pochard	9.4	14	5	5
European Pochard	1.5	36	25	21
Redhead		16	3	3
Common White-eye		13	12	12
Baer's Pochard	21.6	13	12	10
Australian White-eye	3.4	25	18	10
New Zealand Scaup		34	28	28
Tufted Duck		19	17	17
Lesser Scaup		22	6	5
Greater Scaup		6	0	0
Brazilian Teal	1.6	8	7	4
Mandarin Duck			58	32
Carolina, or Wood Duck	8.3		108	74
Comb Duck		22	8	4
Hartlaub's Duck	3.4	11	8	5
Muscovy Duck				16
Spur-winged Goose	9.4	6	0	0
European Goldeneye		9	0	0
Smew		13	12	8
Hooded Merganser				4
North American Ruddy Duck			17	15
African White-backed Duck			1	0

## Breeding Results 1965: Peakirk

	<i>Date of first egg</i>	<i>eggs laid</i>	<i>eggs hatched</i>	<i>young reared</i>
Black Swan	29.1	9	5	5
Black-necked Swan	30.3	5	3	2
Swan Goose	10.4	19	8	7
European White-fronted Goose	5.5	10	2	2
Western Greylag Goose	27.3	16	9	8
Emperor Goose	7.5	26	4	2
Barnacle Goose	27.4	13	1	1
Red-breasted Goose	25.5	10	6	6
Common Shelduck	20.4	16	13	12
Cape Shelduck	4.3	13	12	4
Cape Teal	9.5	66	12	12
Red-billed Pintail	17.6	16	11	9
Bahama Pintail	16.5	50	32	27
Northern Pintail	8.4	47	14	12
Chilean Teal	30.5	11	10	8
European Green-winged Teal	20.6	5	2	1
Falcated Teal	16.6	6	2	1
Chinese Spotbill	29.4	37	16	9
African Yellowbill	28.4	5	3	3
Philippine Duck	20.5	18	12	8
Laysan Teal	2.5	38	23	17
American Wigeon	27.5	27	12	12
Cinnamon Teal	9.5	37	9	5
Blue-winged Teal	30.5	18	6	3
Cape Shoveler	25.4	26	3	3
Red-crested Pochard	8.4	91	49	15
Rosybill	30.5	52	16	9
Redhead	10.5	13	9	8
Tufted Duck	26.5	45	13	9
European Greater Scaup	30.5	18	7	5
Brazilian Teal	9.5	32	10	4
North American Ruddy Duck	22.5	67	25	9

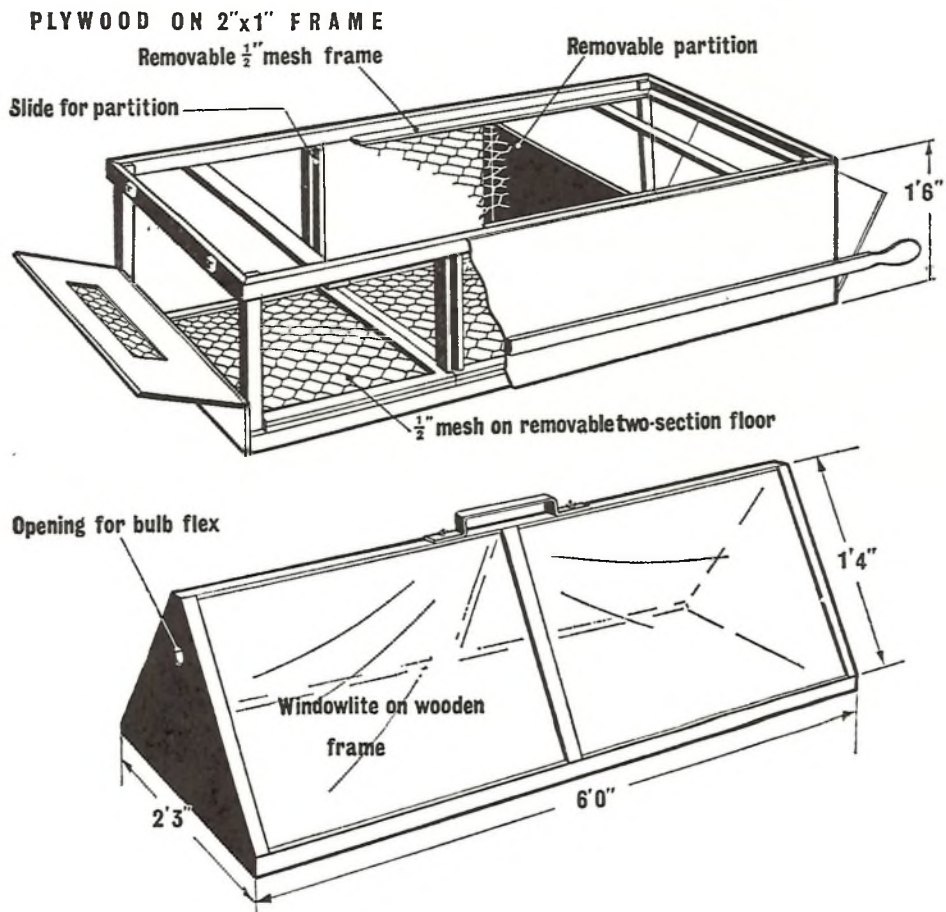
A total of 238 birds of 32 species were reared. Birds of the following species laid eggs but unfortunately none were successfully hatched: Fulvous Tree Duck, Pink-footed Goose, Greenland White-fronted Goose, Lesser White-fronted Goose, Lesser Snow Goose (blue phase), Greater Snow Goose, Hawaiian Goose, Abyssinian Blue-winged Goose, Ashy-headed Goose, Andean Crested Duck, Cereopsis Goose, North American Black Duck, New Zealand Grey Duck, African Black Duck, Chiloe Wigeon, New Zealand Shoveler, Ringed Teal.

No attempt was made to hatch eggs of the following species: Marbled Teal, Chestnut Teal, Gadwall, European Wigeon, Common Shoveler, Common White-eye, Australian White-eye, New Zealand Scaup, Mandarin Duck, Carolina Duck.

## The Wildfowl Trust Brooder

S. T. JOHNSTONE

The principal functions of the rearing brooder that we have in use at the Wildfowl Trust are that it should protect the young against wind and rain and that it should be vermin-proof. From experience in use the existing type has been much modified from the prototype of fifteen years ago. Its shape, size and weight are now such that it can be used with comparative ease by a single individual. Built of plywood on a frame of 2 in. x 1 in. deal, it is light in weight, facilitating easy daily moves to fresh grass. The floor consists of a large and a small removable wire mesh frame. There is a similar wire net cover and for wet weather there is a hood covered in Claritex or Windowlite, with provision for fitting an infra-red lamp. Internally the brooder is fitted with two sets of slots and a movable ply partition. Thus the young birds can be confined to three different sizes of compartment according to numbers and age. The brooder is equally suitable for rearing either ducks or geese, with or without a bantam foster mother. For ducklings, both sections of the floor are left in position. For goslings, the larger section is removed to give the babies a stretch of grazing, the partition being placed at night so as to give a vermin proof compartment. Both ends are hinged, one has the lower four inches fixed to allow easy access without the risk of crushing the occupants. The other end opens fully to form a ramp for use when the young are given free range in their pen. We have been successful in rearing over 100 different kinds of waterfowl in this type of brooder.



## Research and Conservation, 1965

At the beginning of February the Research Unit moved into the fine set of work-rooms, financed by a grant from the Nature Conservancy, on the first floor of the new Research and Educational Centre. The seven work-rooms not only provide more space for the workers (and their paraphernalia) but bring them into constant, stimulating contact with the wild birds and with those in the Collection. The library, already appearing rather full, serves also as a much-needed Committee Room and it was appropriately first used as such by the Scientific Advisory Committee in March. Another important gathering there was during a weekend in October when various working parties of the Wildfowl Conservation Committee of the Nature Conservancy met to review the progress made and future plans for the network of wildfowl refuges, the whole question of shooting licences, and particular aspects of the new Protection of Birds Act. The meeting symbolised the remarkable degree of accord that exists between the Wildfowlers' Association of Great Britain and Ireland, the British Field Sports Society, the Conservancy and the Trust on matters of common interest.

The Trust has always stressed that Conservation will only succeed if backed up by Education as well as Research. It is therefore appropriate that the ground floor of the new building should be given over to facilities for telling the public in general, and school-children in particular, what wildfowl conservation is all about. The Lecture Hall seats 50-60 people and has excellent projection facilities. The new film about the Trust, *Wild Wings*, forms an essential introduction to our work. An outline of the Trust's research and conservation activities has been set out in the form of a permanent wall-panel exhibition. The sixteen panels in the Foyer and the Lecture Hall, designed by Dr. Matthews with advice on lay-out by Mr. D. Barton, were executed by Carol Furness, Michael Harvey and Leslie A'Court, and became available to the public in July. Temporary exhibitions were made for the Royal Highland Show in Edinburgh and for the Game Fair near Oxford. At the latter the Prince of Wales and Princess Anne were among the many visitors fascinated by a display of colour discrimination by naive ducklings.

Research at Slimbridge has from the beginning benefited by the presence of Bristol University and we have received much encouragement and facilities there-

from. The need for closer association of our research programme with the relevant Departments of the University was fully recognised, and the building of the Research Centre put us in a position to offer facilities for research students and for undergraduate teaching hitherto lacking. It is pleasing, therefore, to be able to report further steps towards a closer association with the University. The new Vice-Chancellor, Dr. John E. Harris, who, as Professor of Zoology, had long taken a most helpful interest in our activities, has joined the Trust's Council. Following discussions and visits to inspect our new facilities, Professors G. M. Hughes (Zoology), C. W. Ottaway (Veterinary Anatomy) and E. W. Yemm (Botany) have all agreed to help guide our future development by serving on our Scientific Advisory Committee. Dr. H. D. Crofton, Reader in Parasitology, and Dr. J. E. Crook, Lecturer in Psychology, were already members. It is our great loss that the Professor of Psychology, K. R. L. Hall, who was very actively concerning himself with these matters, died tragically in July. At the beginning of the year Dr. Matthews was accorded the formal status in the University of Special Lecturer in Animal Behaviour in the Departments of Zoology and of Psychology.

Another move of significance to the Trust's future plans was that of Mr. Boyd to Edinburgh in August. We have long felt that our research on goose populations would be better and more economically served with officers permanently based in Scotland, close to the main concentrations. An assistant will join Mr. Boyd and together they will work in close collaboration with the Nature Conservancy, Scotland, who are very kindly providing office accommodation. There will also be collaboration with the team which is to investigate the biological productivity of the Loch Leven area under the International Biological Programme. Censuses of Greylags and Pinkfeet were carried out in March, October and November, the latter yielding the highest totals yet, 45,000 and 67,000. In the spring, too, haunts of Barnacle Geese in the Hebrides were surveyed from the air; together with ground checks elsewhere the population was at least 13,000. In June, round-ups of flightless Greylags for ringing were made, both of the feral birds in Galloway and of the native stock in S.Uist. The continued withdrawal in recent years of Pinkfeet from England was

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## Wild geese at the New Grounds, 1964-65

European White-fronted Goose *Anser albifrons albifrons*.

The first arrivals were eight on 1st October, 1964. Numbers built up slowly to 101 on 20th November and 165 on 9th December. There was an influx on 20th/21st December with 735 present on the latter date. Further increases took place in late December and early January and counts were made of 1,730 on 1st January, 1965, and 2,000 on 10th. The maximum numbers recorded were 3,500 on 25th January, a rather low peak and much earlier than has been usual in recent years. There were about 3,000 birds present for most of February, departures starting at the end of the month. The final emigration was very swift with 1,950 birds present on 12th March and the last 300 leaving on 18th.

The breeding success in 1964 was about average for the second year running. As is usual, most of the first arrivals were successful breeders and in a small sample in November the proportion of young birds was 41%. By the end of December, however, this was down to 27.6%, with an average brood-size of 2.3, and in early February to 24.1% young, average brood-

size 2.4. Shortly before the geese left in March, the figures were 25.0% young, average brood-size 2.3.

For the second time in the last three winters no Lesser White-fronted Geese *Anser erythropus* were seen at Slimbridge.

Bean Goose *Anser fabalis*.

A single adult male appeared on 5th October, 1964. It was paired to an adult female Whitefront and with them was a hybrid Bean/Whitefront in its second winter. This trio was seen constantly throughout the winter, being last recorded on 10th March, 1965.

Pink-footed Goose *Anser brachyrhynchus*.

Seven arrived on the Dumbles on 21st September, 1964, but had gone by the next day. It seems that the New Grounds has ceased to be a regular wintering place for this species. A single adult seen on 10th March, 1965, was the only other record.

Barnacle Goose *Branta leucopsis*.

A single juvenile was first seen on 31st December, 1964. It stayed for the rest of the winter, the last record of it was on 10th March, 1965.



## Ringling, 1964-65

**Ducks.** The number of ducks ringed by the Trust and its helpers in 1964-65 was 5,715. This shows a slight increase over the previous season due principally to a very large catch of Mallard at Borough Fen Decoy, operated by Mr. W. A. Cook, which more than compensated for reduced catches at Abberton Reservoir and at Slimbridge. Major General C. B. Wainwright, C.B., did not repeat last season's exceptional catch of Wigeon at Abberton, but did ring useful numbers of other less commonly ringed species including Shelduck, Shoveler and Pochard. At Slimbridge the catch of Mallard was again pegged to a low level by a reduction of the catching effort in the early part of the season.

Other trapping stations had good success, particularly a new one at Valley, Anglesey, where ringling is being organised by Mr. R. Palethorpe, resulting in a catch of 165 Mallard and 10 Teal. Mr. J. E. A. Lambert continued the catching started last season at Dersingham, Norfolk, ringling 55 Mallard, 50 Teal and 1 Shoveler, and Messrs. C. A. and M. R. Boardman caught 37 Mallard and 44 Teal at Ludham, Norfolk. In Scotland, Mr. D. R. Anderson, operating at Duddingston Loch, Mid-

lothian, caught 38 Mallard and 7 Teal, and Mr. R. H. Dennis ringed 12 Teal and 26 Wigeon during a short spell of trapping near Inverness.

**Geese.** There was no rocket-netting of geese during 1964-65. Mr. J. G. Young again organised a round-up of flightless Greylag Geese in Wigtownshire and, assisted by his helpers, including members of the Trust staff, caught 98 birds on 27th June, 1965. This most successful effort was immediately followed by a much less well rewarded attempt to catch Greylags on Loch Druidibeg, South Uist, Outer Hebrides, when only 22 geese were caught. 55 Canada Geese were rounded-up at Frampton Gravel Pits, Gloucestershire, on 16th June, 1965.

**Swans.** The ringling of Mute Swans in England has been boosted over the past five years by the Trust paying for all rings used. This programme was stopped in July, 1965, when over 15,000 rings had been supplied. In future only particular projects or ringling in certain areas will continue to receive support.

One Bewick's Swan was ringed at Slimbridge during 1964-65.

### Ducks ringed 1964-65

<i>Species</i>	<i>Abberton Essex</i>	<i>Borough Fen Decoy</i>	<i>Slimbridge Glos.</i>	<i>Other Stations</i>	<i>Total 1964-65</i>	<i>Total 1963-64</i>
Shelduck	51				51	30
Pintail	3	2	13		18	7
Teal	1333	154	6	150	1643	1860
Mallard	467	2591	431	342	3831	3200
Gadwall	1				1	4
Wigeon	4	2	1	26	33	259
Garganey	19				19	25
Shoveler	42	24	4	1	71	52
Pochard	14		1		15	18
Tufted	33				33	17
	1967	2773	456	519	5715	5472

## The Bewick's Swans at Slimbridge

PETER SCOTT

The study of individual birds in the wild has been made possible by capture and marking techniques followed by further catching or by close observation, as well as the normal flow of information through recoveries. Observation of breeding birds has been the easiest because of their strong attachment to a limited area. Some work has been done outside the breeding season using conspicuous marks in the form of harness or collar attachments. Individual variation in birds of one species has been recognised for many years but it has been exploited for research purposes only in a limited way—for instance in observing family behaviour in the White-fronted Goose, and in the recording of occurrences of the Lesser White-fronted Goose, at Slimbridge, both concerned mainly with the variation in the black belly bars, and in differences in the shape and extent of the white frontal shield.

The exceptionally favourable circumstances for observation from my studio window of birds on the studio pond in the Rushy Pen (now re-named 'Swan Lake') at Slimbridge have enabled very close observations to be made on wild Bewick's Swans *Cygnus columbianus bewickii* and considerable variation in their yellow and black bill markings were immediately apparent. The intricate patterns over the culmen and behind the nares form the most ready means of distinguishing individuals but this can be combined with the underbill colouring and pattern, with shape, size and stance, with eye and eyelid colour, and with other characteristics such as missing feathers, plumage stains or behaviour. The last are only useful as additional confirmation and of limited value over the long term.

It has been possible to devise a formula by which any Bewick's Swan can be described using the variable features and listing them in a conventional order. The diagram shows these eleven characteristics. Five refer to the meeting of yellow and black on the upper mandible, two to the extent of pink or red on the lower mandible, plus the eye and eyelid colour, bill shape, head shape and carriage, and lastly general size. Within the main headings there are up to nine sub-divisions giving 56 separate points that can be described. This makes a total of combinations of something over 23,500,000!

Whilst this formula can be used by anyone to describe in letters and figures

the facial pattern of a swan that can then be converted into a recognisable drawing, the day-to-day identification of individuals of the Slimbridge flock is nothing like so laborious as the formula might imply. A detailed drawing (see front cover) is used to ensure the correct recording of new arrivals but once a bird is being seen daily its most obvious features soon assume a prominence in the observer's memory that enables almost instant recognition of any bird. Additional items are of course used in confirmation in the daily recording, one of the most useful here being the presence of a mate or family.

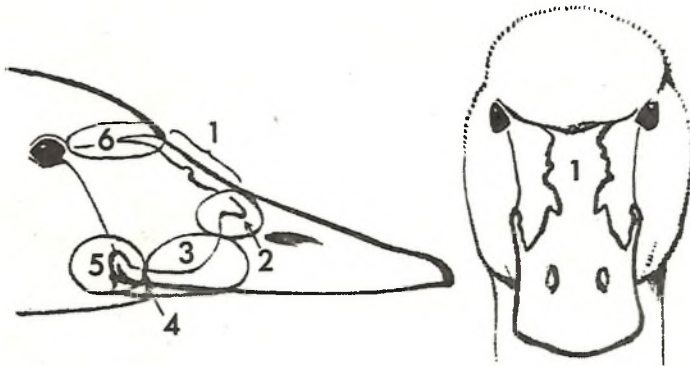
It has proved possible for someone coming new to the swans to master the characteristics of the birds quite quickly, assisted by the drawings.

The face patterns of cygnets present additional problems, particularly early in the winter. The black markings appear progressively over the reddish pink areas of the bill and the limits of the yellow are ill-defined at first. The drawings are made of them as late in the season as possible to get the best picture of what they may look like the next year. In their second winter it is usually obvious from a bird's behaviour whether it has been to the pond before (new birds start upending for food in deep water and away from the feeding place). There is a tendency for siblings to associate, and also to consort with their parents, even if new cygnets of the year are also with them. All these points help to confirm identification if the bill pattern is not immediately recognisable. There is no doubt that this is a possible difficulty in future. Another difficulty is that the patterns of the adults are subject to minor changes from year to year. Some change more than others, and the changes may involve more yellow or more black.

In only three winters experience of these changes no system of prediction has emerged but after a further period it may be possible with greater knowledge of the physiology involved to discover certain rules governing the changes.

Bewick's Swans were not very frequently recorded on the Severn Estuary in the early years of the Wildfowl Trust but by 1956 the occurrence of the species had become regular and up to 16 birds were visiting the Big Pen in the late winter. The numbers increased slowly until by the winter of 1963-64 more than 20 were present for a considerable period. In

# FORMULA FOR IDENTIFICATION OF BEWICK'S SWANS



## 1. Shield on top of culmen:

A. "DARKY" All black from feathering, along culmen, to tip of bill.

- (i) No spots anywhere on shield.
- (ii) Some small yellow spots on black of shield. (Conspicuous yellow spots in this area constitutes a "Shieldy").



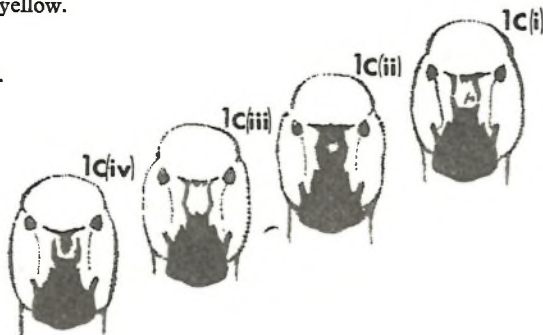
B. "YELLOW NEB" A straight line can be drawn over the culmen connecting the yellow on each side along yellow pigment.

- (i) Bland. Relatively few black spots.
- (ii) Peppery. Yellow heavily spotted.
- (iii) Y-fronted.



C. "SHIELDY" Some patterning of black and yellow on shield of upper culmen:

- (i) Shield area predominantly yellow.
- (ii) Shield predominantly black.
- (iii) No connecting yellow between one side and the other.
- (iv) Winding connection on yellow pigment.



2. Edge of black and yellow immediately behind nostril:

A. "TOOTHY"

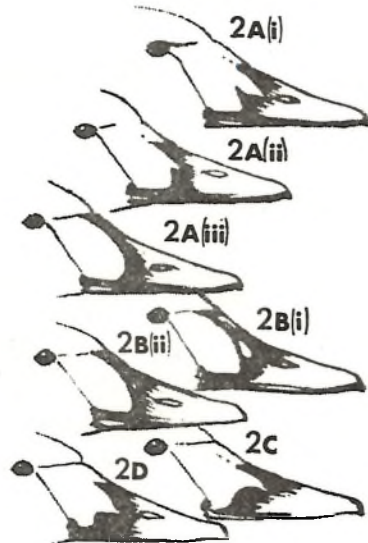
- (i) Prominent 'tooth' mark—yellow pointing down, black behind it, pointing up.
- (ii) Small yellow 'tooth'.
- (iii) No 'tooth' at all.

B. "TEAR-DROP"

- (i) Large yellow spot near nostril.
- (ii) Small yellow spot.

C. "WAVY" Edge of black conspicuously waved.

D. "STEPPY" Edge of black conspicuously shaped in a square black step.



3. Forward lower edge of yellow:

A. "ROUNDY" Forward lower edge of yellow rounded.

B. "SQUARE" Forward lower edge of yellow making a sharp right angle.

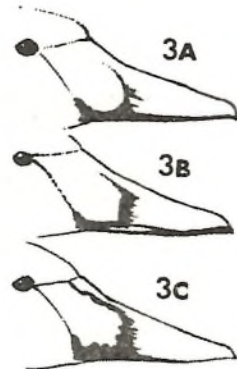
C. "NOBBLY" Black edges broken by black markings encroaching on yellow or yellow on black.

4. Side of lower mandible showing when bill is closed:

A. "POSY" Very prominently pink.

B. "ROSY" Some pink visible.

C. "BLACK-JAW" No sign of pink.

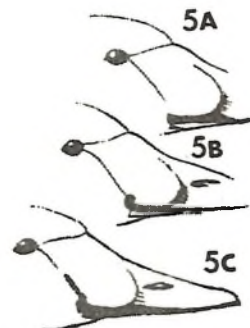


5. Corner of the gape:

A. "STRAIGHT-FACE" No noticeable upward curve.

B. "SMILER" Corner curled up.

C. "MOUSTACHIO" Black extending upward along edge of feathering.

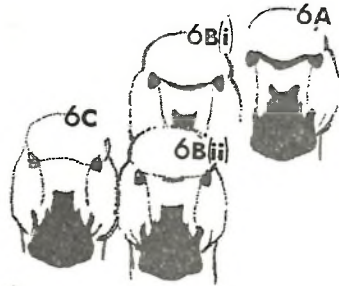


6. Brow—edge of feathering between eyes:

A. "BLACK-BROW"

- B. (i) More than half brow black.  
(ii) More than half yellow.

C. "YELLOW-BROW" No Black whatever.



7. Eyes:

A. EYE-LIDS:

- (i) Both yellow. (iii) Lower one yellow.  
(ii) Top one yellow. (iv) No yellow.

B. IRIDES:

- (i) Dark. (ii) Conspicuously paler.



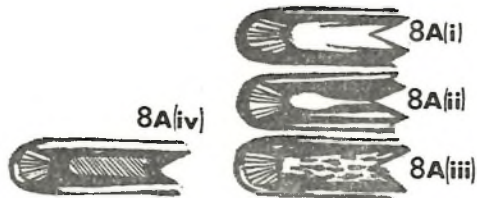
8. Under-bill:

A. PATTERN

- (i) Large pale patch.  
(ii) Small patch.  
(iii) Spotted.  
(iv) All black.

B. COLOUR OF UNDER-BILL:

- (i) Pink.  
(ii) Orange.



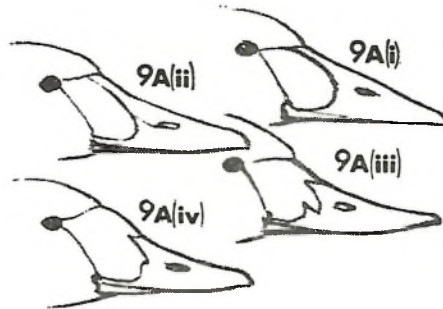
9. Bill:

A. SHAPE:

- (i) Droopy.  
(ii) Straight.  
(iii) Turned-up.  
(iv) Bulgy.

B. COLOUR:

- (i) Dull or pale.  
(ii) Lemon.  
(iii) Bright.  
(iv) Orangey.



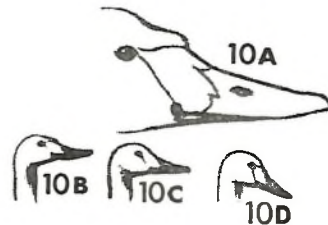
10. Head shape and carriage:

A. "CAT-FACE"

B. "HEAD-IN-AIR"

C. "NORMAL"

D. "SLEEPY-HEAD"



11. Size of Swan.

A. LARGE.

B. AVERAGE.

C. SMALL.

February 1964, by dint of moving 3 pinioned Bewick's Swans and 4 pinioned Whistling Swans (which the wild Bewick's do not apparently differentiate from their own race) into the Rushy Pen, 24 wild birds were persuaded to come regularly to the pond in front of my studio window where they were liberally fed. In the following winter of 1964-65 there were 55 wild Bewick's at the peak time, and 68 were recorded during the winter. During the winter of 1965-66 the pond for a considerable period held over 120 swans with 125 as a peak and 147 different swans were recorded in the season.

Detailed drawings of the facial patterns of 188 different swans have now been made, and each bird has been named for easier reference. The names are used as aide-memoires in identifying the birds and may refer to a particularly well-marked facial characteristic (Two-spot, Shieldy, Freckles), to unusual colouring (Lemon, Amber, Pink) or to a behavioural feature (Caesar, a very aggressive male).

Given the possibility of individual identification it follows that after the second complete winter of the study we must already have learnt something. The most important fact so far is the confirmation in yet another species of Anatidae of the strong traditions inherent in the birds in their choice of winter quarters. This is borne out by the return year after year of the same birds, bringing their young of the year, thus leading to a part of the increase taking place, and guaranteeing a continuing increase in years to come. However, the arrival here of adult birds that have not previously wintered, and these form a considerable proportion of the increasing flock, does argue that this tradition can break down under certain circumstances. What these circumstances are we can only guess at, though we would perhaps be justified in thinking that the unlimited food (wheat)—and to a lesser extent the security—at Slimbridge must be the principal attractions. We cannot be sure how these attractions are discovered by new swans, though we suppose that some attach themselves to swans who know the place at earlier staging posts during migration. Others meet up at nearby places when our birds wander and are subsequently brought in by them. A third method may be the actual sighting of the flock by passing migrating birds.

The return of birds in succeeding years has been most encouraging. Even before the start of facial recognition we had evidence of this from ringing. An adult caught in the pens on 2nd April, 1961, was subsequently recaptured on 21st November,

1961, and again on 10th February, 1963. Of the 24 birds identified in winter 1963-64, 16 returned during the next season 1964-65. These were five established pairs, one of which brought two cygnets, and another which brought three of the previous year's four cygnets, having apparently failed to breed in 1964. The single young of the only other successful breeders of 1963 did not reappear. Of the three unattached birds of 1963-64 which returned, two brought mates with them.

The first birds to arrive in 1964-65 were a pair (Pink and Rebecca) that had been here the previous year, and they brought two cygnets with them. This was on 4th December. The next arrivals were not for a fortnight, and then all the next eight (Maria, Pop, Mom, Ranger, Sis, Big Bro, Owl, Pussycat) were from 1963-64. In early January some new birds started trickling in, not all staying very long. Some longer lasting influxes took place in the middle of January and in early February with up to 55 swans regularly using the pond. A mass departure took place on 15th and 16th March, 1965, a single family (Pink and Rebecca) hanging on for another week. Altogether 52 swans were identified in addition to the 16 from the previous year, so that the total number that came to the pond was 68, 13 above the maximum reached on any one day.

On 21st October, 1965, the same pair that arrived first and left last the year before (Pink and Rebecca) arrived on the pond with three cygnets, together with a single new adult. They were six weeks earlier than in the previous autumn. In the next three days 14 more swans came: two pairs (Kon and Tiki with three cygnets, and Pepper and Amber with two cygnets) that had been last year, a single old adult—originally paired but a widow during the previous winter (Maria) and four second winter birds all of which had been before as cygnets. Two of these were Reuben and Rachel, the young of Pink and Rebecca in the previous year. They immediately joined up with their parents and the new cygnets making a flock of seven. By 1st December 86 birds had arrived and stayed, of which 27 were cygnets (one of these was killed in November flying into a tree). Of the 59 adults or two-year olds, 29 had been in 1964-65, and 11 of these in 1963-64 as well. During the rest of the winter a further 61 swans, of which 15 were cygnets, came for shorter or longer periods, but only four of these had been in 1964-65, and none from 1963-64. The maximum on any one day was 125 and the total for the season 147. Thus there is a very strong tendency for the birds, having

once learnt of the place, to come here fairly early in the winter.

The duration of stay of the swans varied in the two seasons, mainly because of the greatly differing dates of arrival. In 1964-65 most of the birds stayed in the area once they had arrived, occasionally missing a day in visiting the pond for food. The main exception to this pattern was the first family to arrive (The Pinks) which came on 4th December, departed on 19th January and did not return until 9th February. They then stayed without a break until a week after all the other birds had departed. Eight single birds that arrived in late December or early January stayed for short periods only, from one to 27 days, one other stayed for 17 days, departed for three weeks, and came back for two days more before departing for good.

The longest continuous stay was 87 days (by Maria) with several more families or individuals between 60 and 80 days. The mean stay of all 68 birds was 48 days, and of those which stayed until the general departure in mid-March, 55 days.

In 1965-66, there were two important differences from the previous winter. First the arrival of the birds started six weeks earlier, 86 birds having arrived by early December, and secondly, the very wet period in December with widespread floods in the Severn Valley and elsewhere caused many birds to depart for up to four weeks; though, with the exception of two birds (Romeo and McJuliet) which never reappeared, they had all returned by the second week in January when ice covered many of the flood waters. There were other shorter or longer gaps in the attendance on the pond of some other birds, but none more than a few days in duration, and not necessarily indicating that the birds had wandered far. The goose shoots in January had temporary effects of this nature.

The longest continuous stay was by the Pink family, which had again been the first arrivals and this year had scarcely an interruption in their stay, even during the floods, though they were missing for some odd days at this time. They stayed in all for 154 days. There were many more stays of over 100 days. The mean of all 147 swans was 79 days, and for those which stayed until departure time in March the mean was 89 days. Thus the swan usage of the pond was very considerably higher than in the previous winter, roughly 11,700 days compared with 3,250 days, or an increase by a factor of 3½.

The maximum numbers of swans regularly using the pond over a period also went up enormously, from 50-55 main-

tained for the period 11th February, 1965, to 15th March, 1965 (33 days), to 110-125 almost continuously from 19th January, 1966, to 10th March, 1966 (51 days). This kind of usage of a small pond raises the question of when the birds will begin to feel overcrowded. The other more frequent limit of numbers, namely food supply, will not arise in this case as the amounts of wheat fed twice a day can be increased in proportion to the number of birds. For 120 swans 2½ cwt. of wheat were fed daily, with a much smaller amount of biscuit meal. There is some observational evidence that the more birds there are on the pond, the greater the frequency of aggressive encounters between families or individuals, but so far there have been few records of birds being prevented from reaching the ample food supply because of the presence of either too many or too aggressive birds. It may be necessary in the future to enlarge the area over which the food is scattered, but the water area now seems adequate, both for landing and taking off (for which it has been enlarged already) and for the normal bathing and resting activities. It seems possible that 'Swan Lake', as it is now called, could accommodate up to 500 Bewick's Swans.

The normal pattern of day to day usage of Swan Lake is as a daytime feeding place. During each winter, however, there have been periods when the birds have roosted there all night instead of flying out to the river mudflats; this despite the floodlighting of the pool. The habit was particularly pronounced in January 1965 and again in November 1965. As these were both times when swans were arriving almost daily, this may well be a reflection of their desire for food and sleep. The 'tired' appearance and behaviour of recent arrivals has frequently been noted.

The timing of the morning flight from the river seems to be greatly dependent on the weather, being delayed by rough or cold conditions. Once in, the birds often stay until late afternoon, until after the arrival of the barrow bringing the second feed of the day. A disturbance during the morning will tend to induce for several days a pattern of flying out in mid-morning, with a return a few hours later. In March there is more variation in behaviour and a more regular evening flight caused partly by longer daylight and partly perhaps by migratory restlessness.

The occasional disappearance of birds apparently settled in the area has led us to wonder about casualties occurring during the winter. The only times we can be fairly certain about these are when the lost birds are members of a family party. In

1964-65, the father of a family of four 1963 cygnets still consorting with their parents a year later (Pop) disappeared in mid-January, after the whole family had stayed away for four days. In November 1965 during a night-time fly round by several birds in fog a cygnet (belonging to the Major and Ethel) hit a tree near the pond and got hung by its neck in a fork. Another parent bird (Poet) failed to return after the December floods, though its mate and two cygnets did.

We have so far ringed 23 Bewick's Swans, catching all of them in the pens, usually when they have got into a confined space where take-off is difficult. Two recoveries have been made away from Slimbridge. The first was an adult male caught on 10th February, 1963, and kept in the pens until the following September. It was found dead on 19th May, 1964, in the Nenetsk National Okrug, U.S.S.R., within the known breeding range of the species and about 2,300 miles from Slimbridge. The second recovery was of Elmer who arrived on 11th January, 1965, and was ringed the next day when he hit a chimney and fell into the garden. Although injured at the time, he made a complete recovery and departed on 16th March with his mate (Petula). He was found dead at Frodsham, Cheshire, about 25th November, 1965. His mate has not returned. It is hoped in future to use rings with large numerals so that they can

be read with binoculars and positively confirm identification of birds on the pond.

The behaviour of the birds and the relationships between them are being closely studied. The pattern of aggression between families and individuals is noted each time it is observed, and a nominal order of dominance is being drawn up. Already there are nearly 200 records of aggressive encounters and a peck order can be worked out. As in the geese, the larger families tend to dominate the smaller, but not so rigidly, and a really aggressive male (such as Caesar) with only two cygnets can defeat parents of larger broods. Pair-formation behaviour has been noted many times and in 1965-66 seven pairs were apparently formed during the winter. The two-year-old birds spend quite a lot of time in courtship display, often to different birds within a few days. There are some indications that birds pair with others having a similar bill pattern to their own, but this must be the subject of further work, possibly using the formula method of description. The inheritance of the various features of the bill pattern is also under study, and so is the degree of change from year to year in each bird's pattern.

We believe that the discovery of this method of individual recognition may in the course of a few more years lead us to a number of new discoveries about the biology of the Bewick's Swan.





# White-fronted Geese at the New Grounds, 1946-47 to 1963-64

M. A. OGILVIE

The White-fronted Geese, *Anser a. albifrons*, wintering at the New Grounds, Slimbridge, Gloucestershire, have probably been counted more regularly and for a longer period of years than any other comparable flock of geese in Britain. Counts at frequent, often daily, intervals have been made for the past eighteen years. These figures are examined below for changes or trends in the numbers and seasonal behaviour of the birds.

The main method of analysis has been to find the average number of geese present in half-monthly periods of each winter season (see Table I). These goose/half-months give a more reliable picture than the actual counts because of the great variation in frequency of the counts at different times of the year. The pattern of arrivals, peak numbers and departures shown in the table have clearly changed in three, probably connected, ways. The arrivals during October and November were a little higher in the middle years than in the early part of the period under consideration but have now dropped well below previous levels. The peak numbers were present in early January in the late 1940's but the timing of them has shifted steadily later until they are now here in the second half of February. Finally the numbers of birds staying in March, particularly the last half, have shown a marked and continued increase. These tendencies have been illustrated in Figure

1 with the figures combined into six three-season periods. To make the periods directly comparable one with another, the maximum value in each is taken as 100 and the other values scaled accordingly. September and April are omitted because of the irregular occurrences in these months.

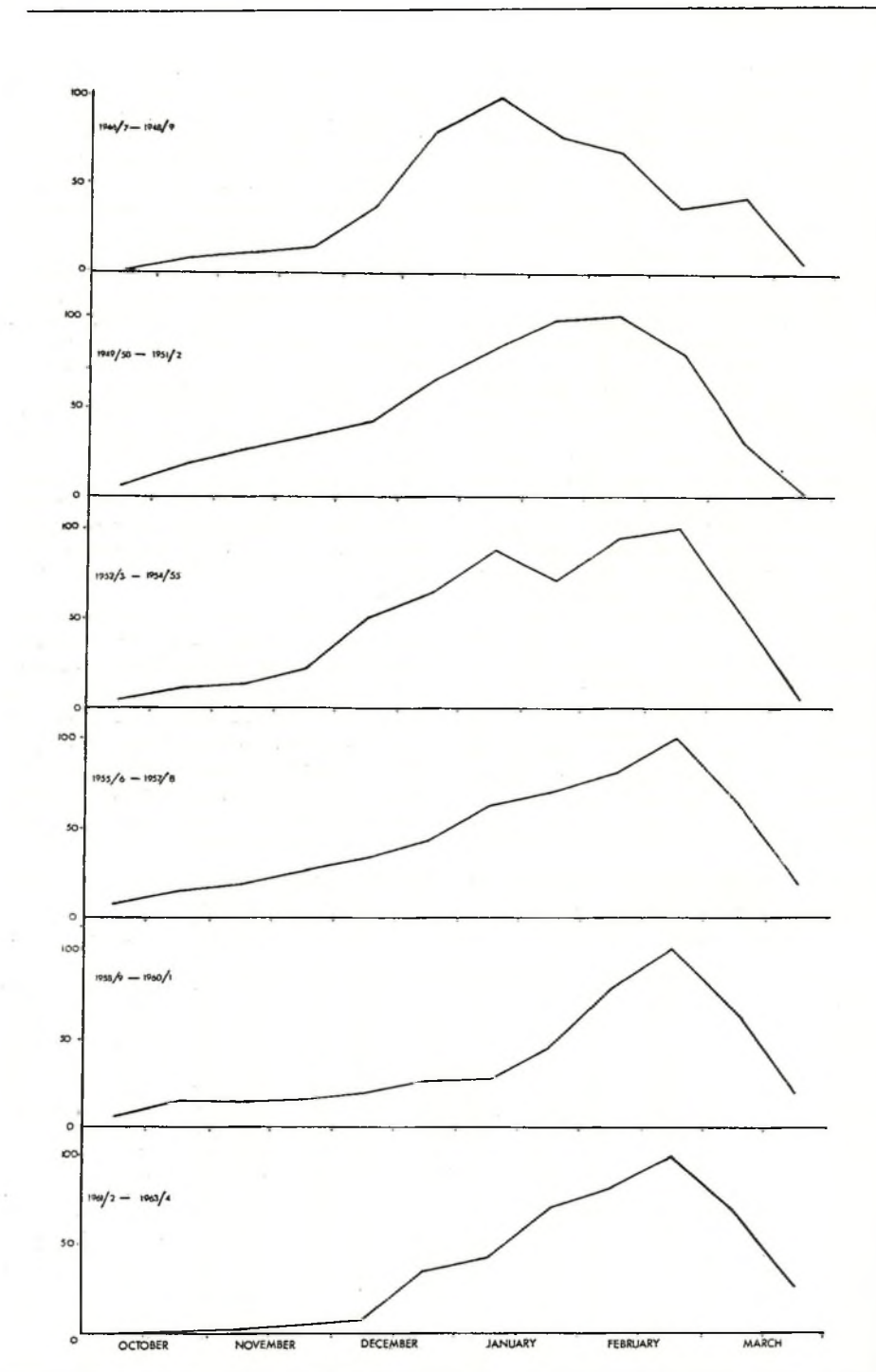
If the goose/half-months for each season are summed (see last column of Table I) the numbers give an indication of the total goose-usage of the resort. Figure 2 plots these goose-usage amounts for all eighteen seasons and also shows the maximum number of geese recorded in each. There are fluctuations, but no discernible trend. The two largest variations from the mean are 1957/58 when there was a very high proportion of young birds in the flock (45 per cent), and 1962/63 when the effects of the severe weather were coupled with the lowest-ever recorded proportion of young (8 per cent). The mean percentage of young over the years is 28.7.

Figure 3 shows the total number of days each season when geese were present (excluding single pricked birds remaining in the spring), and the number of days, not always consecutive, when over 1,000 and over 2,000 birds were believed to be present. Variations between years are mostly small. The closer approximation in recent years between the 'over 1,000' and 'over 2,000' figures is a reflection of the slower

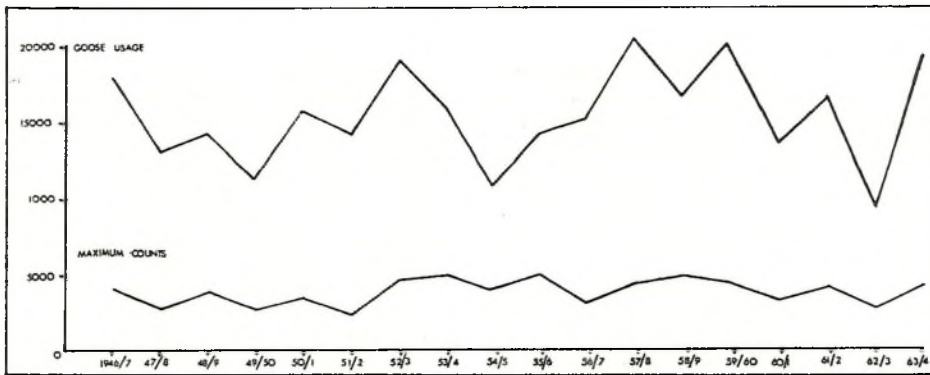
**Table 1. White-fronted Geese at the New Grounds. Average number of geese present per half-month, and sum of "goose-half-months" per season.**

	Sept.		October		November		December		January		February		March		Total
	II	I	II	I	II	I	II	I	II	I	II	I	II		
1946/47		155	295	300	365	1620	3730	3400	2500	2375	500	2100	615	17955	
1947/48		55	370	710	765	1200	2310	2800	2150	950	1120	710	21	13161	
1948/49		2	65	130	245	700	1340	2910	2440	2700	2000	1460		13992	
1949/50	1	135	355	385	470	550	645	1540	2290	2790	2220	910		12291	
1950/51			160	470	810	1120	2500	2610	2770	2600	1950	610	20	15620	
1951/52	18	370	830	1060	1220	1330	1520	1680	1960	1730	1575	660	2	13955	
1952/53		160	370	440	840	2950	2950	3700	1930	2350	1910	1280	90	18970	
1953/54	15	230	510	540	730	910	1260	1670	1760	2610	3800	1400	450	15885	
1954/55		14	55	66	230	550	920	1460	1810	2800	2150	1550	63	11668	
1955/56	2	9	27	320	585	970	1110	1530	1200	2330	3330	2600	800	14819	
1956/57	110	300	360	455	690	970	1375	1920	2540	2650	2500	1290	2	15162	
1957/58	10	465	1010	1050	1300	1150	1650	2530	2915	2650	3600	2170	1000	21502	
1958/59	3	70	135	125	220	550	940	1200	1200	3400	4000	2850	750	15443	
1959/60		300	750	750	775	875	1300	1100	1600	2750	3900	3500	1420	19023	
1960/61	50	330	560	500	505	700	750	875	2360	2720	3450	1005	4	13809	
1961/62	4	61	135	180	370	420	1060	1080	3500	4150	4000	1420	5	16385	
1962/63		15	52	60	150	300	1430	500	60	555	2200	2750	1035	9107	
1963/64			13	29	32	160	1060	2900	3300	3320	3525	2575	1640	18554	
mean	12	150	335	420	570	945	1550	1970	2130	2520	2650	1715	440	15405	

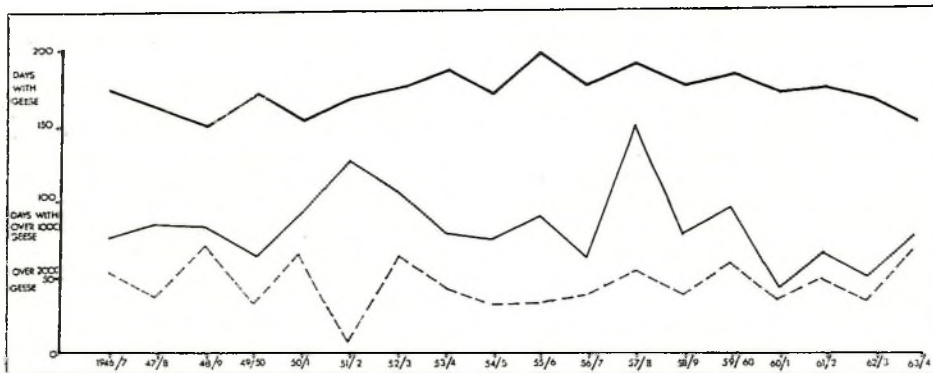
**Figure 1. Relative numbers of White-fronted Geese present at Slimbridge during the course of the seasons 1946/7 to 1963/4. Average goose-half-months in three-season periods scaled so that the highest value in each period equal 100.**



**Figure 2. White-fronted Geese at Slimbridge. Maximum seasonal counts and total usage (in goose months).**



**Figure 3. Days with White-fronted Geese present at Slimbridge in seasons 1946/7 to 1963/4.**



autumn build-up and subsequent faster increase to peak numbers. The shapes of the plots in Figure 1 show this equally well. There has been no detectable trend in the arrival and departure dates. Variations have been slight with only four autumn and four spring dates ten days or more different from the means of 3rd October and 24th March.

The main conclusion to be drawn from this investigation is that the total annual goose-usage of the New Grounds has remained roughly the same throughout the Trust's tenancy. The changes in timing of this usage that have occurred are more probably due to changing conditions on the Continent than to activities at the New Grounds. By the same token, the apparent limits to the goose-usage of the New Grounds (possibly imposed by food availability) means that we have not benefited by the massive increase in the numbers of Whitefronts in the Low

Countries. The only possible local effect was in the immediate post-war period when the land was returning to its normal pasture state after the war-time cultivation which ceased in the autumn of 1947 (G. Bishop, *in litt.*). There was also probably better protection after the establishment of the Wildfowl Trust than immediately before. It may be that the increased totals recorded in March since the establishment of a later peak are the result of large numbers arriving after the end of the shooting season and avoiding the consequent disturbance.

The later incidence of the bulk of the geese should be of benefit to Wildfowl Trust members and the public because more people visit Slimbridge in February and in March than in January. The only drawback is that the geese are by then feeding in the fields rather than on the Dumbles, which has necessitated the development of new observational facilities.

## Birds at Borough Fen 1965

W. A. COOK

The winter passed with no change from the established pattern of many finches and thrushes in the Decoy when snow covered the fields, forsaking the cover of the wood as the weather eased. A leaf-strewn glade near the House pipe was used as a feeding area, where tail corn, weed seeds and old apples were scattered liberally.

The last record of winter Turdidae was a party of 22 Fieldfares on 14th April. These had overlapped by eight days the first warbler, a Chiff-chaff on 6th, followed by Willow Warblers on 13th and Cuckoo together with a late first Swallow on 30th. The big rush came on 3rd May with Turtle Dove, Nightingale, Sedge Warbler, Blackcap and Whitethroat. Reed Warblers appeared on 8th May with Spotted Flycatchers rounding off the immigration on 14th.

One bird recorded for the first time at the Decoy was a Peregrine which stooped over the pond on 17th May.

Sand Martins were seen feeding over the pond in greater numbers than before, the largest flock being 150 on 27th August. Much of the emigration was missed due to other commitments but a late Reed Warbler was seen on 12th October.

### Ringling 1965

1,429 birds were ringed in 1965 (Table I), including 502 pulli, making a grand total of 6,804 since small-bird ringling started in 1960. One new species was ringed, this being a Magpie in November. Two Kestrels ringed in December are a sign of the re-emergence of this species, and it is hoped they will stay and breed hereabouts. Fewer warblers were ringed than in 1964 as no mist nets were set in either August or September, the two best months for catching them.

Ten recoveries reported during the year (Table II) and the recaptures of emigrants (Table III) included none of remarkable interest.

### Nesting 1965

312 nests were recorded at Borough Fen Decoy on standard B.T.O. cards (Table IV). This brings the total recorded since 1961 to 820 cards. It would appear that nest records indicate population changes more accurately than trapping with mist nets, providing the time spent and the area covered are constant each year. There is still a bias in that many of the nest sites are traditional both in actual position and type of habitat.

Over one period in May 70 nests were being observed at the same time, a complete circuit taking about four hours. As it is desirable to visit each nest twice a week and it was not practicable to set aside two four-hour periods each week, the following system was evolved. Each nest position is described and given a number, all details being entered into a notebook to be transferred to cards later. Current cards are kept in two boxes and after each visit are transferred from A to B until A is empty, being replaced B to A on the next visit. This ensures that each nest is visited only once in a four-day period and none are missed. If pulli are due to be ringed on a non-visit day the card is placed in a special clip. Despite these precautions a number of Linnet and Greenfinch young were dangerously large and fledged unringed.

The honour for the first recorded nest in 1965 must be shared between a Song Thrush (nest built 17th March, first egg 24th) and a Moorhen at the traditional No. 1 nest site with six eggs on 3rd April.

Song Thrushes were very much in evidence and 21 nests had been discovered by 12th April, against nine by this date in 1964. These figures indicate a remarkable recovery from the 1963 season when only nine nests of this species were recorded for the whole year. Allowing for predation and replacement nests plus those found with young after 12th April, the breeding population was estimated at not less than 24 pairs.

Twelve new nestboxes were placed in the Decoy during the winter, all of which were inhabited by Tree Sparrows. 11 clutches of eggs were taken from these boxes over one weekend, no shells were left or spilled yolk. Could a Magpie have discovered that this type of box contained food, and searched out each one? The boxes were scattered haphazardly throughout the wood. Or was it some small rodent tempted by easy pickings? The proportions of nests remaining unattacked by predators in the past three seasons have been 51 per cent in 1963, 64 per cent in 1964 and 52 per cent in 1965.

Two new breeding species for 1965 were Nightingale and Garden Warbler. Both had been suspected breeders in previous years. The young of Garden Warblers were seen in 1961 and 1964 but were quite strong on the wing and could have flown in. Although Nightingales sang in the wood

**Table I. Number of birds other than ducks ringed at Borough Fen Decoy, 1965.**

<i>Species</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>June</i>	<i>July</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Total</i>
Heron								3					3
Kestrel												2	2
Water Rail											2		2
Moorhen	3	5	4					2	3	2	5		24
Wood Pigeon			1				5	12	1	2	2		23
Turtle Dove						4	11	3					18
Cuckoo						2	1						3
Swallow					2	1		1					4
Magpie											1		1
Great Tit		1				8	2			5			16
Blue Tit		1	2		1		2		6	6	2		20
Marsh Tit										1			1
Willow Tit							2	1	1	1		1	6
Long-tailed Tit										2	5		7
Tree-creeper									1				1
Wren				1		1	1						3
Fieldfare	2	1	6								2		11
Redwing			7							4	1		12
Song Thrush	1	6	3	40	67	29	6	1	12	5	7		177
Blackbird	9	8	21	22	61	17		2	3	25	54		222
Robin	1	1	3		14	2	3	2	3	1	3		33
Reed Warbler					2	1				1			4
Sedge Warbler					5	6	4						15
Blackcap					1	6	7	3					17
Garden Warbler						4							4
Whitethroat					2	7	10						19
Lesser Whitethroat					1								1
Willow Warbler								1					1
Nightingale					2								2
Spotted Flycatcher					1	6	4						11
Duncock	2	6	5	1	19	6	4			3	4		50
Starling	1	2	21			2							26
Greenfinch	62	144	31			29	13	13	2	6	1		301
Goldfinch					1	35	10	4		1			51
Linnet			1	2	8	69	47	1			2		130
Bullfinch	2		4		1	10	7		2	1	5		32
Chaffinch		3	24	1			2		3	2	9		44
Brambling			2										2
Yellowhammer			4			1	1						6
Reed Bunting			1								2		3
Tree Sparrow	2	6	5	11	9	23	16			9	40		121
Totals	85	184	145	78	197	269	158	49	37	77	147	3	1429

**Table II. Recoveries, over 5 miles distant, of birds other than ducks ringed at Borough Fen and reported in 1965.**

3080677	Wood Pigeon	FG	24.1.63	Fyfield, Ongar, Essex.	15.1.65	65m.SSE
3068318	Wood Pigeon	Juv	13.8.60	Deeping St. Nicholas, Lincs.	1.7.65	6m.NNE
CA41407	Blackbird	1st w.	23.12.63	Nr. Alesund (Møre og Romsdal) Norway.	1.1.65	62.28N 6.11E
CA41485	Blackbird	1st w.	26.2.64	Nordborg, Als (Jylland) Denmark.	30.4.65	55.03N 9.45E
CB35460	Blackbird	1st w.	4.3.65	Upplands-Väsby, Stockholm, Sweden.	6.4.65	51.39N 17.55E
40807S	Greenfinch	FG	31.12.61	Ailsworth, Northants. Controlled	3.3.65	6m.SW
CB35029	„	FG	25.1.65	„	„	6.3.65
CB35213	„	Ad	6.2.65	„	„	2.3.65
CB35248	„	1st w.	9.2.65	„	„	12.2.65
CB35316	„	1st w.	14.2.65	„	„	7.3.65
47841S	„	1st w.	26.2.62	Luton, Beds.	„	29.12.64 52m.S

prior to 1963 there has been no previous indication of their breeding.

21 nests were examined for parasites by M. J. Worms. The nests were examined for mites and fly larvae as soon as the young had flown, then kept in a warm room

for a few weeks until the fleas emerged. It is hoped to continue this research in 1966 using nests that have had eggs incubated in them for over seven days and not just successful nests as in 1965.

**Table III. Migrants previously ringed at Borough Fen and re-trapped in 1965.**

<i>Ring No.</i>	<i>Species</i>	<i>Date ringed</i>	<i>Age when ringed</i>	<i>Date re-trapped</i>
AB44178	Whitethroat	10.5.61	Ad. M.	10.6.65
AK87188	Whitethroat	28.6.63	Juv.	8.7.65, Male
AK87041	Spotted Flycatcher	23.5.63	Ad.	15.7.65

**Table IV. Success of nests found at Borough Fen Decoy 1965.**

<i>Species</i>	<i>No. of nests found</i>	<i>Deserted</i>	<i>Eggs lost</i>	<i>Young died</i>	<i>Some reared</i>	<i>Complete success</i>
Mallard	3	2 (1 sat 40 days)			1	
Moorhen	4		1			3
Wood Pigeon	19	3	5 + 1 not visited after laying	2	1	7
Turtle Dove	13	2			2	9
Cuckoo (in Reed Warblers' nests)	3					3
Swallow	2		2			
Great Tit	1				1	
Wren	1				1	
Song Thrush	63	5	15	8	13	22
Blackbird	42	2	12	6	9	13
Nightingale	1		1			
Robin	3				3	
Reed Warbler	3		1	1	+ 1 not followed up	
Sedge Warbler	2					2
Blackcap	4	1	2		1	
Garden Warbler	1				1	
Spotted Flycatcher	3	1			1	1
Duncock	12	1	2	2	6	1
Greenfinch	22		9	3	3	7
Goldfinch	11			3		8
Linnet	72	3	23	17	15	14
Bullfinch	4		1	1		2
Tree Sparrow	23	1	13 from boxes	3	4	2
<b>Totals</b>	<b>312</b>	<b>21</b>	<b>87</b>	<b>46</b>	<b>61</b>	<b>97</b>

# Blood parasites of ducks in the British Isles

M. J. WORMS and W. A. COOK

## Summary

243 birds of 16 species of Anatidae have been examined for blood parasites. Microfilariae were found in Teal, Smew and Pintail and Leucocytozoon in Scaup, Wigeon, Pochard and Teal. Parasites in the Smew, Pochard and Wigeon are considered new host records. Attempts at transmission of the Teal filaria were unsuccessful.

During 1964 and 1965 the blood of a large number of wild birds has been examined as part of a survey for avian microfilariae. In the course of these examinations, the presence of other blood parasites has been noted and this report records those found in the family Anatidae.

The birds were obtained from Borough Fen Decoy, Peakirk, Northants and Benington Marsh near Boston, Lincs. Dr. James Harrison kindly provided lung blood smears of birds collected or found dead in Kent or elsewhere. The majority of the samples were collected during the winter months, a single blood smear being taken from the wing vein of the living birds prior to release after ringing. Slides were stained with Giemsa stain and examined at both high and low magnifications for parasites.

Tables I and II show the results for living and dead birds respectively. It should be noted that the proportion of Teal found infected with microfilariae was much higher when lung blood was examined than when venous blood was examined. In mammalian and some avian filarial infections the microfilariae are present in the peripheral blood only at

certain times during the day or night, usually coincident with the maximum activity of the arthropod vector, a phenomenon known as periodicity. During the periods when they are absent from the peripheral blood they accumulate in the vessels of the lungs and it is therefore to be expected that more infected birds will be discovered by examination of this blood. In addition to this diurnal periodicity there may also be a seasonal periodicity. Several authors have noted a lower incidence of detectable parasites during the winter months than in the summer, apparently correlated with the sexual cycle of the host. These phenomena make the incidence of blood parasites in a population difficult to estimate and a survey such as the one here reported serves merely to establish the presence or absence of any parasite in a host species.

There have been few studies on the blood parasites of British birds and our knowledge is largely surmised from foreign records of birds on the British list. Table III lists those parasites so far recorded from British Anatidae. Most of the records in this paper are thought to be new additions to the British Fauna and the presence of microfilariae in Smew, and Leucocytozoon in Wigeon and Pochard are new host records.

Morphologically, all of the Leucocytozoon found resemble *Leucocytozoon simondi* Mathis and Leger, a common parasite of the Teal which has gametocytes in

**Table I. Living birds examined for blood parasites.**

Species	Number positive for		
	Number examined	Micro-filaria	Leucocytozoon
Mallard	37	0	0
Teal	109	6	-
	65	-	7
Wigeon	10	0	3
Pintail	3	0	0
Shoveler	26	0	0
Mandarin Duck	1	0	0
Scaup	1	0	1
Pochard	5	0	1
Tufted Duck	11	0	0
Eider	2	0	0
Shelduck	2	0	0
Brent Goose	3	0	0
Mute Swan	2	0	0
	212	6	-
	168	-	12

**Table II. Lung blood smears examined for microfilaria.**

Species	Number examined	Number positive
Mallard	7	0
Teal	15	4
Wigeon	1	0
Pintail	2	1
Tufted Duck	1	0
Shelduck	1	0
Garganey	1	0
Smew	2	1
White-fronted Goose	1	0
	31	6

**Table III. Blood parasites recorded from Anatidae on the British list.**

	<i>Plasmodium</i>	<i>Haemoproteus</i>	<i>Leucocytozoon</i>	<i>Trypanosoma</i>	<i>Microfilaria</i>
Mallard	+	+	+		+
Teal			+		+
Wigeon			+	*	
Pintail	+	+	+	+	+
Shoveler	+(1)	+	+		+
Mandarin	+		+		+
Scaup			+		
Pochard			+	*	
Goldeneye			+		
Long-tailed Duck		+	+		
Common Scoter					+
Red-breasted Merganser			+		+
Smew					+
Greylag Goose			+		+
White-fronted Goose			+		
Canada Goose	+(2)	+	+	+	+
Mute Swan					+(3)
Bewick's Swan					+(4)

\*This study  
(1) Manwell and Kuntz (1965);  
(2) Herman (1965);  
(3) Boughton (1965);  
(4) Rhizikov (1959).  
All other records from Lapage (1961).

elongate host cells. There are however slight differences in size. Microfilariae have previously been reported from the Teal in Scotland (Anderson, 1954). Those found in the present study are of approximately the same size in all three host species and may represent a single new species of parasite. A detailed description of all the parasites found will be published elsewhere.

Several of the infected Teal have been studied in the laboratory and attempts have been made to transmit the parasite using both wild-caught and laboratory-bred blood-sucking insects. No success has as yet been achieved with *Anopheles stephensi*, *Aedes aegypti*, *Aedes geniculatus*, *Simulium ornatum*, *Culicoides* spp. or *Ceratophyllus gallinae*. These studies are continuing.

#### Acknowledgements

We are most grateful to Dr. James Harrison for providing the lung blood smears of the dead birds used in this study.

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#### Appendix - Scientific names of birds mentioned in the text.

Mallard <i>Anas p. platyrhynchos</i>	Common Scoter <i>Melanitta n. nigra</i>
Teal <i>Anas crecca</i>	Shelduck <i>Tadorna tadorna</i>
Wigeon <i>Anas penelope</i>	Red-breasted Merganser <i>Mergus s. serrator</i>
Pintail <i>Anas a. acuta</i>	Smew <i>Mergus albellus</i>
Shoveler <i>Anas clypeata</i>	Eider <i>Somateria m. mollissima</i>
Garganey <i>Anas querquedula</i>	Greylag Goose <i>Anser a. anser</i>
Mandarin Duck <i>Aix galericulata</i>	White-fronted Goose <i>Anser a. albifrons</i>
Scaup <i>Aythya m. marila</i>	Canada Goose <i>Branta canadensis</i>
Pochard <i>Aythya ferina</i>	Brent Goose <i>Branta b. bernicla</i>
Tufted Duck <i>Aythya fuligula</i>	Mute Swan <i>Cygnus olor</i>
Goldeneye <i>Bucephala c. clangula</i>	Bewick's Swan <i>Cygnus columbianus bewickii</i>
Long-tailed Duck <i>Clangula hyemalis</i>	



## Further congenital malformation in birds bred at Slimbridge

JANET KEAR

Over the past five years all live young birds and any eggs that failed to hatch have been inspected for gross malformation. Set out in the table below are the number of specimens examined and the type of deformity found. 21 deformities have appeared in a total of 8,878 downies and dead embryos, an incidence of 0.24 per cent, or 2.52 per cent of dead-in-shell alone. Included were 10 abnormalities of the beak or skull, 10 of the limbs and one case which involved a Muscovy Duck egg *Cairina moschata* containing twins. These Muscovy embryos (see page 7 of photographic section II) were apparently perfectly formed but shared the same yolk sac; since neither could absorb the yolk, both failed to hatch. Detailed descriptions of the deformities have been published

(Harrison & Kear 1962; Napier 1963) or are in preparation.

Incidence has fluctuated from year to year and further data are required before the cause of abnormal embryonic development can be established. Because of the possibility that certain foreign chemicals might be implicated (Kear 1964) a number of infertile eggs laid in 1965 were sent for analysis to the Infestation Control Laboratory of the Ministry of Agriculture. None of the usual organo chlorine insecticides were detected at a level of 0.01 parts per million. In view of the very wide distribution of some pesticides, in particular DDT and its metabolites, the results are gratifying.

We are grateful to Dr. A. Taylor for carrying out analysis of infertile eggs.

**Table. Incidence of congenital malformation in birds bred at Slimbridge.**

Year	Young Birds		Total	Abnormalities			Total
	live downies	dead embryos		head	limb	extra embryo	
1961	1593	174	1767	6	4		10
1962	996	117	1113*				
1963	2220	239	2459				
1964	1712	107	1819		3	1	4
1965	1524	196	1720	4	3		7
<b>Total</b>	<b>8045</b>	<b>833</b>	<b>8878</b>	<b>10</b>	<b>10</b>	<b>1</b>	<b>21</b>

\* Not 934, as published earlier in error.

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# Movements and flock behaviour of Barnacle Geese on the Solway Firth

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The Nature Conservancy.

## Summary

Caerlaverock National Nature Reserve is described in relation to its importance to wintering Barnacle Geese. Barnacle Geese arrive in the Solway Firth, from the north or north-east, in late September or early October, though 40 days may elapse before the flock is at full strength. Immigration reaches its peak during the first 20 days of October. Northward migration may be more abrupt and occurs most often in late April. In winter quarters Barnacle Geese occupy three main types of habitat – saltmarsh, farmland and tidal sand. Factors which appear to limit feeding areas are discussed. Changing conditions in the Solway and the incidence of bright moonlight apparently affect Barnacle movement to some extent. Amongst recognisable causes of disturbance, the geese react most often to passing aircraft, moderately often to man, and least often to other birds and farm stock. Barnacle Geese spend most of their daylight hours in feeding, except when occupying tidal foreshore. Their observed activities, including flock segregation and characteristics of flight, are described and discussed.

## Introduction

As the first full-time Warden of Caerlaverock National Nature Reserve, Dumfriesshire, the writer has been in a position to observe and record, almost daily, the numbers, local movements and general behaviour of wintering Barnacle Geese *Branta leucopsis* in the inner Solway Firth over the eight seasons from 1957–58 to 1964–65. Over this eight-year period an average daily time of four hours in each of a total of 818 days was spent in observing the geese. On a further 334 days the birds were absent from Caerlaverock though known to be elsewhere in the Solway.

In order to understand much of what follows it is necessary to briefly describe Caerlaverock National Nature Reserve and explain its management from the point of view of wildfowl conservation. On 4th April, 1957, the Caerlaverock meres and offshore tidal sandflats were declared a National Nature Reserve by agreement with His Grace the Duke of Norfolk, for the meres, and the Crown Estate Commissioners, for the foreshore. On 21st August, 1957, a full-time Resident Warden was appointed, and on 12th September, 1957, 22 bye-laws came into force.

One reason for the declaration of the Reserve was the fact that for very many years the Caerlaverock meres have been the most important wintering grounds of Barnacle Geese on the mainland of Great Britain. The Solway flock had become much reduced during the first half of the present century. It was desirable that disturbance to at least a small part of the wintering grounds should be reduced by the creation of a National Wildfowl Refuge as an integral part of the Nature Reserve, in addition to the total legal protection given to the species in Great

Britain from 1st December, 1954, by the Protection of Birds Act (1954).

Caerlaverock was also a traditional wildfowling area, and so that an important and increasing section of the community should not be prevented from continued enjoyment of their sport, provisions were made under the byelaws whereby permits to shoot wildfowl on a portion of the Reserve between one hour before sunrise and one hour after sunset, and subject to the Protection of Birds Act (1954), could be issued to a limited number of applicants.

The Nature Reserve comprises about 12,000 acres of tidal sandflats known as the Blackshaw Bank, a very important roost for grey geese as well as Barnacle Geese, and about 1,500 acres of grazed merse (or salt marsh above high water mark ordinary spring tides), the whole Reserve being bounded to east and west by the deep water channels of the Lochar Water and the River Nith.

Under the Nature Reserve Agreement with the Duke of Norfolk the meres were apportioned as follows:

(i) About 580 acres at the east end to form a sanctuary or refuge (East Park) into which public entry is restricted under the byelaws.

(ii) The shooting area, a central section of about 470 acres.

(iii) The western area of merse (Lanton-side), where shooting rights are retained (though seldom exercised) by the owner.

No shooting is permitted on the tidal foreshore, though the public have unrestricted access to it, as well as to all meres excepting East Park. In practice, however, the tidal sandflats are unfrequented by the public during the winter months and are potentially dangerous at all times.

The agricultural land adjoining the Reserve's northern boundaries belongs to the Duke of Norfolk, who only very infrequently exercises his shooting rights thereon. On the tidal sandflats east of the Lochar Water there is no restriction on shooting, though the shootings over the adjoining meres (Priestside and Powhillon) are leased to the Solway Wildfowlers' Association, who actively discourage 'sand-crawling' by wildfowlers.

Thus the East Park sanctuary, which is the area most resorted to by Barnacle Geese, is flanked to east and west by areas where shooting pressure is usually quite intense; is bounded to the south by an undisturbed roosting area; and, excepting Powhillon, abuts to the north upon agricultural land where shooting is virtually non-existent.

### Migratory movements

#### *Migration in autumn*

Gladstone (1910) claimed that the first appearance in autumn of Barnacle Geese in Dumfries occurred on 28th–30th September and that the geese 'always arrive on our shores during the afternoon or evening'. He subsequently reported (Gladstone, 1923) the exceptional arrival of 12 Barnacles on Lantonside on 6th September, 1912. Blezard (1943) records another early gaggle on 15th September, 1913, and Laidlaw (1904) three crossing Maxwelltown from the north-north-east at sunrise on 18th September, 1903. Since 1957 arrival dates at Caerlaverock have ranged between 22nd September and 7th October. Build-up to full strength may thereafter occupy as little as eight days or as much as 40 days (Table I). It must be borne in mind, however, that the full complement of birds may have arrived in the Solway Firth prior to the date on which they are first seen at Caerlaverock, having spent the intervening days at Rockcliffe

or elsewhere. The same, of course, could possibly be true of the first arrivals, though there is no known case in recent years of Barnacles being seen in Cumberland before their appearance at Caerlaverock.

It should, perhaps, be mentioned that in 1965 numbers had attained 3,000 by 11th October and remained at this level until 5th November, when the peak figure of 3,700 was reached for one day. There was a second, similar peak in mid-December, but the first appears sufficiently early in the season to be included in the initial build-up period.

In three years there has been good evidence of newcomers arriving in Solway from the north. At midday on 3rd October, 1957, the first 40 Barnacle Geese were seen flying in at a great height from a northerly direction. On 1st October, 1958, the first 24 were similarly seen very high and approaching from the north, to be followed by a further 24 which R. T. Smith reported flying due south over his house, 12 miles north-east of Caerlaverock, at 07.30 G.M.T. on 4th, on which date an influx of 450 occurred at Caerlaverock. At dusk on 12th October, 1962, only 200 Barnacle Geese were present at Caerlaverock, but at 23.30 G.M.T. on the same date R. T. Smith heard a large pack of Barnacles passing over his house and at daybreak on 13th, 2,000 birds were present at Caerlaverock.

Most Barnacle Geese have left Spitsbergen by the end of August, and birds have never been recorded there later than 22nd September (Løvenskiold, 1964). During the last week of August, 1964, M. Norderhaug (unpublished report) found only 60–70 Barnacles in the Kapp Berg – Kapp Borthen area, where there had been 600 six weeks earlier, and only a very few birds elsewhere. The breeding localities were deserted, and sightings of Barnacles at Isbjornhamna and a flock of

**Table I. Arrivals of Barnacle Geese at Caerlaverock N.N.R., 1957–65.**

Year	First arrival		Completion of flock		Number of days from first to last arrivals
	date	number of birds	date	number of birds	
1957	3rd Oct.	40	29th Oct.	1,000	27
1958	1st Oct.	24	8th Oct.	1,250	8
1959	24th Sept.	60	13th Oct.	1,650	20
1960	28th Sept.	50	9th Oct.	2,500	12
1961	7th Oct.	400	1st Nov.	2,800	26
1962	27th Sept.	17	15th Oct.	2,700	19
1963	1st Oct.	17	30th Oct.	3,300	30
1964	22nd Sept.	28	12th Oct.	2,500	21
1965	27th Sept.	2	5th Nov.	3,700	40

60 passing south near Hyttevika on 25th August indicated that southward movement had begun. The first arrivals in Solway in 1964 were 28 at Caerlaverock on 22nd September.

About four weeks elapse between the desertion of the breeding grounds and the first arrival in Solway. It seems probable that the birds proceed in a leisurely fashion down the Norwegian coast, thence crossing the North Sea to strike the British coast usually somewhere between the Shetlands and north-eastern England. Various observers have reported small numbers of Barnacle Geese in autumn at points between Fair Isle and Yorkshire. G. Bolam (1912) suggested that small flocks seen at Holy Island might be on passage to or from the Solway, and R. A. H. Coombes confirms that he has seen Barnacles arriving in the Solway from the north-east (Bannerman, 1957). Several other observers have reported movements from the north-east in autumn and a reverse movement in spring (Bleazard, 1943; Bannerman, 1957). The statement by Gladstone (1910) that 'they come down in a direct line from the Clyde, probably from the Hebrides' does not now appear correct and may refer to some of the East Greenland population. Gladstone subsequently quotes one observer as having seen Barnacle Geese resting on moorland near Moffat (about 25 miles due north of Caerlaverock).

Recent recoveries of Barnacle Geese ringed at Caerlaverock and in Spitsbergen amplify these observations (Table II). The number of islands off the Norwegian coast capable of sustaining Barnacle Geese for a few weeks in autumn is large, and the number of people visiting them and liable to report rings from geese shot is small, so that the distribution in Norway is not likely to be fully understood for some years.

A search in local journals for autumn records of Barnacle Geese seen in southern and eastern Scotland and northern England has yielded few, though they occur annually in Northumberland and in most years in the Lothians. Table III shows that most records refer to the first three weeks of October. In the seven years 1957-63 arrivals were detected at Caerlaverock on 34 days out of a possible 245 in the period between 22nd September and 26th October. Sixteen reported instances of arrivals or passage elsewhere occurred on those 34 days, and only 22 on the remaining 211 days. More intensive observations would be needed to demonstrate whether the extent of 'fall-out' of migrants is related to the time of immigration or to particular weather conditions.

#### *Migration in spring*

Barnacle Geese leave the Solway Firth for the north usually during the second half of April: from 18th-20th according to Gladstone (1910). Bleazard (1943) stated that they 'leave, usually in a body, generally within the week following 21st April'. In 1962, 300 were present at Caerlaverock up to 8th May, and in 1965, 450 remained until 5th May. The main departures often take place from Rockcliffe, to which the majority of the Solway flock resort late in the season. Exceptions were 1959 and 1960 when all or most of the Solway population were present at Caerlaverock on 29th and 14th April respectively. In both cases all the birds had departed within 48 hours.

Barnacle Geese do not arrive in Spitsbergen until late May or early June, so that, as in autumn, their migration must be interrupted. Though there are as yet no recoveries from Norway in the spring, a Spitsbergen-ringed goose (Stavanger 307024) was found dead at Rolfsuy, Finnmark (71.00N, 24.00E) about 10th

**Table II. Recoveries in September, October and November of Barnacle Geese ringed in Spitsbergen and near Caerlaverock N.N.R.**

Ring	Where found	When found
<i>Ringed Spitsbergen July 1962 (Stavanger Museum and Statens, Viltunpersøkelser rings)</i>		
20164	Burgh Marsh, Cumberland	2.11.64
20190	Coquet Island, Northumberland	17.10.62
20289	Solway Firth	10.11.63
309575	Sandvaer, Helgeland, Norway (65.54N, 11.58E)	26.10.64
309586	Vigra, Ålesund, Norway (62.33N, 6.06E)	23.10.62
310445	Fair Isle, Shetland	12.11.62
<i>Ringed Store Dunøy, Spitsbergen, 27.7.64 (stat. vilt. rings)</i>		
21626	Sandvaer, Helgeland, Norway	2.10.64
21655	Sandvaer, Helgeland, Norway	12. 9.64
<i>Ringed near Caerlaverock, February 1963 (B.T.O. rings)</i>		
101.1351	Florø, Norway (61.36N, 5.04E)	8.10.64
101.1446	Druridge Bay, Northumberland	12.10.64
101.1565	Walton, Brampton, Cumberland	12.10.64
101.1585	Irvine, Ayrshire	20.10.64
101.1633	Blaydon-on-Tyne, Durham	17.10.63

**Table III. Frequency of records of Barnacle Goose migration over eastern and southern Scotland and northern England in autumn, 1950-64. (Records from Caerlaverock excluded.)**

	Period	Number of records
	before Sept. 15	1
	Sept. 15-20	4
	21-25	7
	26-30	2
	Oct. 1-5	12
	6-10	12
	11-15	12
	16-20	14
	21-25	5
	26-30	4
	Oct. 31-Nov. 4	1
	Nov. 5-9	1
	10-14	1
	after Nov. 14	2

July, 1961, and a British-ringed one (101.1419) was found shot at Sandnessjoen, Helgeland (66.01N, 12.40E) on 7th July, 1963. A hint that the spring migration may be more complicated is given by the recovery of Stavanger 20265, found dead near Harboore, Jylland, Denmark (56.37N, 8.15E) on 14th June, 1963.

#### Local movements

Once the Solway Barnacle Geese are established in their winter quarters, their movements are very local and of a simple pattern. The diet of the Solway Barnacles has yet to be investigated, but Campbell (1936) found that the food of Barnacle Geese wintering in North Uist was very largely green grasses (93.2 per cent), including *Festuca rubra*, which is the dominant vegetation of the Caerlaverock meres (Marshall, 1962). By day, and occasionally in bright moonlight by night, the Barnacle Geese spend much of their time on the merse, flying to and from the sandflats at dusk and daybreak. At some periods all or part of the flock will

resort to farmland - almost invariably pasture-land, though stubbles are very occasionally visited. In the eight-year period during which Barnacle Geese were under observation, it was computed that during daylight hours they spent 65 per cent of their time on the merse, 28.5 per cent on farmland and 6.5 per cent on tidal sandflats (Table IV).

These figures must, however, be treated with reserve as they do not necessarily represent a true pattern of 'natural' movements. Some farmers have complained of damage when Barnacle Geese have resorted to farmland, and the birds have often been moved from fields to merse or sandflats by using bird-scaring devices. Other farmers did not object to Barnacle Geese resorting to their land, and sometimes the flock has used such ground for protracted periods.

It is difficult to assess whether or not there exists a correlation between flock size and a tendency to resort to farmland. The farmland most favoured - that immediately to the north of the Wildfowl

**Table IV. Proportionate use of different habitats by Barnacle Geese at Caerlaverock N.N.R. during daylight, 1957-65.**

Season	Numbers of geese		Farmland	Merse	Sandflats	Bird-scaring intensity
	Max.	Average				
1957-58	1150	500	20%	68%	12%	Nil
1958-59	1300	900	47%	39%	14%	Very low
1959-60	1650	1000	23%	70%	7%	High
1960-61	2500	1400	19%	74%	7%	High
1961-62	2800	1600	18%	79%	3%	Very high
1962-63	2700	1000	10%	89%	1%	Very high
1963-64	3300	1400	47%	51%	2%	Low
1964-65	2500	1200	44%	50%	6%	Low
Average:			28.5%	65%	6.5%	

Refuge – was also that which was the subject of most complaints of damage. There have been periods, however, when bird-scaring measures were not employed there with any regularity, and observations indicated that at such times the Barnacles tended to resort to the farmland more persistently (Table IV).

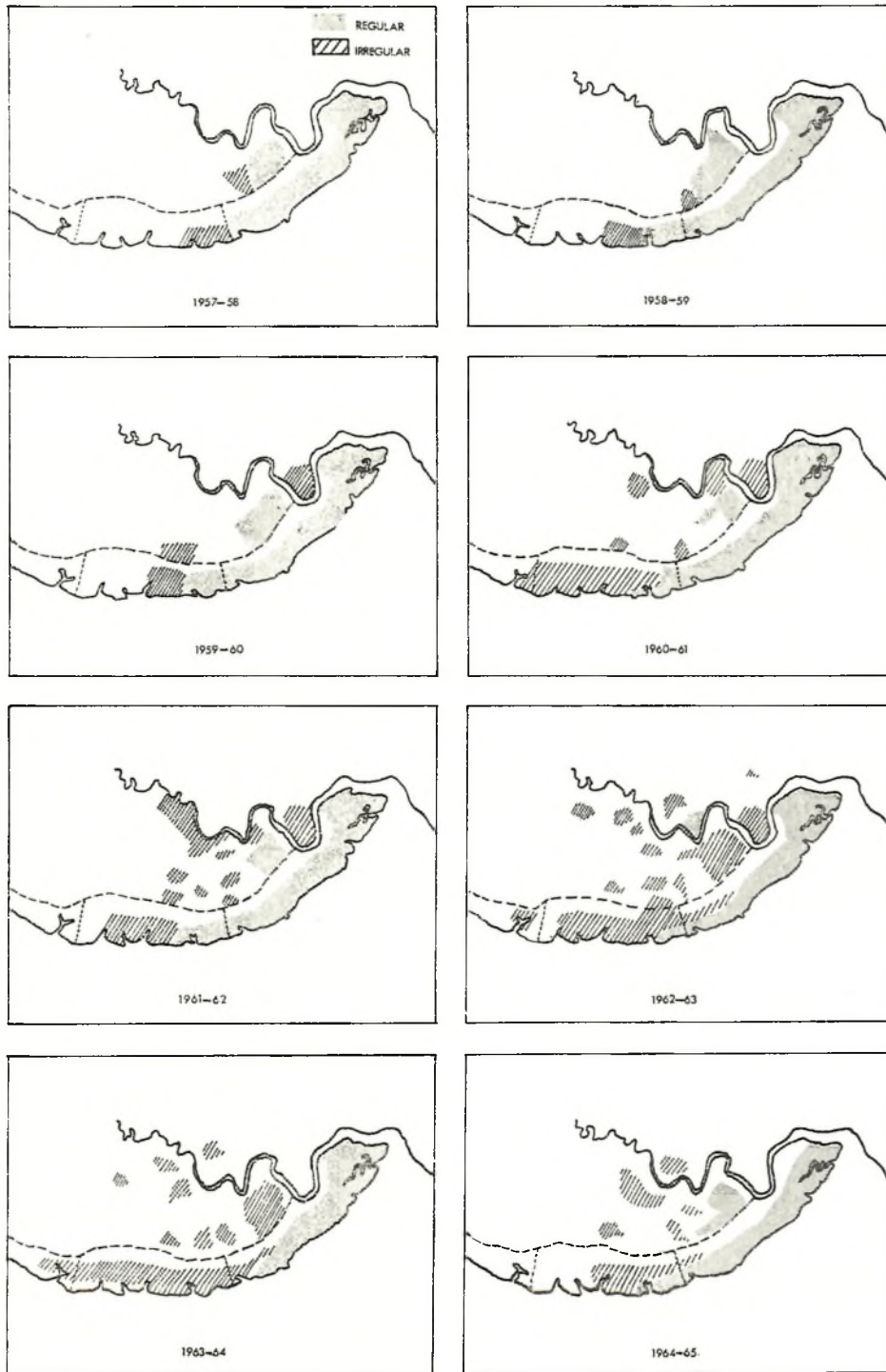
Some likely reasons for the Barnacle flock confining itself to a large extent to the Wildfowl Refuge have already been mentioned. However, a given acreage of grazing habitat will support only a given number of geese for a given period, though conditions obtaining in this habitat are not static and may vary from year to year. There is the strong possibility of competition for food with farm stock, as the Refuge area is heavily grazed by cattle and sheep throughout the year. Both quantity and quality of the vegetation may vary depending upon weather conditions. For instance, a very wet summer and autumn in conjunction with heavy demands upon grazing by stock may well result in ‘puddled’ conditions which Barnacle Geese do not appear to like. Again, hard weather following flooding by either rain or tides can result in the merseland becoming virtually a sheet of ice with food almost unobtainable. Gales accompanying the highest tides will also result in the merses being inundated for longer periods and to a greater depth than at other times.

The feeding distribution maps (Figure 1) indicate a marked tendency on the part of the Barnacle flock, as it has increased since 1957, to spread westwards along the merse and northwards into farmland. The spread into farmland has been to some extent deterred, as has been mentioned, by the use of bird-scarers. Undoubtedly, were it not for the existence of the controlled shooting area immediately to the west of the Refuge, the Barnacle flock would spread out westwards along the merse. It would almost certainly also resort much more than it does at present to other Solway salt-marshes were it not for shooting pressure in those areas. Evidence in support of this contention has manifested itself in three ways: (a) On Sundays, when wildfowling is prohibited under Scottish law, the Barnacle Geese have not infrequently resorted to the Shooting Area to graze. They have behaved similarly when for various other reasons shooting pressure has been negligible. The Barnacles also attempt to enter the Shooting Area at other times, but are quickly deterred by the sound of shots or the sight of wildfowlers, and return to the Refuge. (b) Due to outbreaks in the district of foot-and-mouth disease during the winter of

1960–61, shooting was suspended at Caerlaverock Nature Reserve between 26th November and 11th December (16 days), and between 25th December and 20th January (27 days). Human disturbance during these periods was at an absolute minimum. Throughout the first period the movements of the Barnacle Geese appeared to be unaffected, but after eleven days of the second period had elapsed the birds suddenly moved *en masse* over the whole of the Shooting Area and beyond, remaining there daily until the end of restrictions. Thereafter, such was the birds’ attachment to this ground that, despite the resumption of shooting, considerable and persistent ‘herding’ was necessary in order to move them back to the safety of the Refuge. (c) All legal wildfowl shooting ceases after 20th February. On six occasions all the Barnacle Geese have left Caerlaverock within seven days of this date for marshes in Cumberland – chiefly Rockcliffe – where they could resort unmolested to untapped food supplies. On one of the remaining two occasions the geese did not leave Caerlaverock until 8th March, 16 days after the cessation of shooting. The other occasion was in 1963 when the Barnacle flock remained at Caerlaverock until 10th March, a date which marked the end of a slow thaw following a very prolonged spell of severe arctic conditions. The actual timing of some of these movements may also be influenced by the phase of the moon, a factor to be discussed later.

If merse grazing on the Refuge is inadequate and the birds are deterred from overflowing on to farmland and adjacent merses, the flock must extend its range in some other way. This has been achieved by all or part of the Caerlaverock flock spending varying periods of the winter elsewhere. As has already been described, the entire Caerlaverock population absents itself annually after shooting has ceased, for periods of from 20 to 37 days. Fluctuations in numbers ranging from shorter periods of total absence to the presence of the entire flock have occurred every season, but it was not until 1961, when the numbers of Barnacles had risen to 2,800, that the flock displayed a marked tendency to divide into two main units of approximately equal size, though this did not take place until about 10th February. From that date onwards, however, numbers at Caerlaverock never rose above 1,800 and were sometimes as low as 1,200. In the following season, 1962–63, the flock, numbering 2,700, divided into approximate halves before the end of October, and thereafter the birds were present at Caerlaverock in full strength for only 36% of the total time

Figure 1. Distribution of Barnacle Geese over feeding areas on and near Caerlaverock N.N.R.



they were under observation. The absent half-flock, often in two or three subdivisions, were reported on several occasions in the Southernness area by W. Austin and others, at Rockcliffe and Moricambe by R. Stokoe, and on sandflats near Rockcliffe by R. T. Smith. In 1963, half of the flock of 3,300 birds left Caerlaverock on 1st November, within two days of the completion of the initial build-up of the flock. Five days later R. T. Smith reported 'a large number' at Rockcliffe. Throughout the remainder of that winter rarely more than half of the original flock of 3,300 was present at Caerlaverock.

It is fortunate that present conditions at Rockcliffe appear to favour the Barnacle Geese. This marsh, which is larger and less liable to tidal inundation than the Caerlaverock Refuge, thus provides a very valuable 'overspill' area, if not an entirely independent 'base', for the Barnacle flocks. In March, 1964, J. G. Harrison and J. Ruxton counted 4,000-4,500 Barnacles at Rockcliffe, including a leucistic bird that had not been seen at Caerlaverock. This suggests that some 700-1,200 Barnacle Geese had never been to Caerlaverock at all. Similarly, J. Ruxton counted 3,300 at Rockcliffe on 28th March, 1965, though the writer, who searched the Solway coasts from Mersehead, Kirkcudbrightshire, to Moricambe, Cumberland, between 26th and 30th March, located no more than 2,500 at Rockcliffe on the latter date.

It is interesting to note (Table IV) that as the maximum numbers of Barnacles at Caerlaverock have steadily risen between 1957 and 1965, the average number present has on the whole shown a tendency to 'level down' to a mean figure of about 1,100. This 'average' is calculated by dividing the sum of all counts made at Caerlaverock throughout the season by the number of days on which the birds were known to be in the Solway. Thus, in 1964-65, 214,700 Barnacles were counted during a wintering period of 158 days:

$$\frac{214,700}{158} = 1,358 \text{ (= 1,400, rounded to the nearest hundred).}$$

#### **The possible influence of moonlight on movements**

During the season 1958-59 it was first noticed that certain marked movements or fluctuations in numbers of the flock of Barnacle Geese at Caerlaverock occurred simultaneously with periods of bright moonlight, during periods extending from the first to the last quarter of the moon. It was already known that Barnacles, like other geese, will often continue to feed during bright moonlight, and that their

normal fighting rhythm thus becomes temporarily disrupted. It was also appreciated that the high spring tides of full-moon periods would inundate sandflat roosts to a greater extent than usual, and that at times the merse feeding grounds would also be affected.

However, over this and succeeding seasons a series of moonlight movements apparently unassociated with tide heights has been observed and recorded. In the 51 periods of bright moonlight involved in the survey there were 41 marked migrational or local movements of the Barnacle Geese compared with 17 similar movements during phases of the moon between last and first quarter, 'marked movements' being defined as known movements of a substantial number of birds between Caerlaverock and other parts of the Solway, and also main arrivals in autumn and departures in spring.

Over a period of seven years, six first appearances or main arrivals in autumn coincided with bright moonlight. Two cases are especially noteworthy. In October, 1960, 2,000 birds arrived within 48 hours following the full moon, and the remaining 500 three days later. In October, 1962, the main arrival of 2,000 birds occurred during the night of the full moon. There is no evidence of comparable migratory movements on dark nights.

It is often difficult, if not impossible, to obtain precise spring departure dates because the Barnacle flock invariably moves from Caerlaverock to other parts of the Solway soon after the close of the wildfowl shooting season. In April, 1959, however, there was a final departure of the whole population of 1,300 birds within the 48 hours following the full moon. Similarly in April, 1960, the total population of 1,650 returned to Caerlaverock from Rockcliffe after a five-weeks absence within the 48 hours following the full moon, and almost immediately departed on northward migration. On the other hand, in May, 1962, 300 birds left Solway on the date of the new moon; 400 did likewise on the day following the new moon of April, 1963; there was a similar final departure of 1,150 birds within the 48 hours preceding the first quarter in April, 1964; and in 1965, 450 birds which had returned to Caerlaverock on the fifth day following the April full moon after an eight-week absence, did not depart north until the new moon of May.

The only reason for these movements, particularly the migratory movements, to suggest itself to the writer is the possibility that Barnacle Geese prefer to travel by night, particularly where moonlight may perhaps aid navigation across the North



Sea. Passage overland and along the Norwegian coast may be less strongly related to moonlight.

#### Reactions of the flock to disturbance

Close observation of the flocks of Barnacle Geese wintering at Caerlaverock has revealed the immediate reactions of the birds to various forms of disturbance. During a sample study involving one complete winter season there were 203 witnessed disturbances of the flock:

By man on the ground	33 (16.2%)
By aircraft	71 (35%)
By other birds	15 (7.3%)
By farm stock	3 (1.5%)
Cause unknown	81 (40%)

The general effects upon the Barnacle Geese of these various forms of disturbance may now be summarised.

#### *By man and stock*

Disturbances in this category were caused directly by occasional trespassers, by the Reserve Warden in pursuance of necessary work, by the occupying farmer or his workers tending stock or repairing fences, and indirectly by the noise of tractors, close gunshots and bird-scaring detonators. Stock, notably sheep, occasionally take fright for some unknown reason, and when they run towards the geese they may flush them. When disturbed by people or stock the geese tended to move right away from the source, sometimes quitting the Wildfowl Refuge entirely. If the occurrence took place towards dusk, premature fighting was precipitated, the birds moving in a body to the sandflats and remaining there until dark. At other times the general tendency was for the birds to drift back to more or less their original position in somewhat leisurely fashion, moving in small parties at first until about half or two-thirds of the flock had moved, the remainder then rising in a body and joining those which had already returned.

On 2nd February, 1963, a Wildfowl Trust team rocket-netted 316 birds out of a flock of at least 2,000 on a field adjacent to the Wildfowl Refuge. Uncaptured birds departed in a flock towards the sandflats. After sexing, weighing and ringing, captured birds were of necessity released singly because the holding cages normally used to ensure a mass release could not be used. Many of these birds were released after darkness had fallen and each flew straight out towards the sandflats. On the following day Barnacle Geese were widely scattered, several hundreds being in fields near that where the catch was made<sup>c</sup> but some mixing with flocks of Pink-footed Geese *Anser brachyrhynchus*

on fields up to two miles inland. On 4th February, however, the Barnacles had reintegrated themselves. A flock of 2,000 containing many newly ringed birds was then seen feeding normally on the merse.

#### *By aircraft*

Nearly all visible aircraft at any height almost invariably flush the Barnacle Geese though, in general, the lower the aircraft, the greater seems to be the panic engendered in the geese. Aircraft at low altitudes, even when concealed by mist or cloud, may also often flush the geese. In practically all cases the geese settle within a few minutes and resume feeding or resting in approximately the same area as that from which they were flushed. Low-flying helicopters, which are rare, cause considerable alarm and can scatter the flock quite widely. Some birds sometimes then leave the vicinity altogether, and it may not be until the following day, or even later, that they reassemble. In February, 1961, the Barnacle flock was very badly disturbed by low-flying helicopters and large search aircraft which patrolled the Caerlaverock area for two consecutive days following the crash on Blackshaw Bank of an American fighter aircraft. However, the birds did not leave the locality and settled down normally on the third day, after this activity had ceased.

Because of their much higher speeds, jet fighter aircraft cause much less apparent disturbance of the flock than do propeller-driven aircraft, which are in view for longer periods.

#### *By other birds (excluding geese)*

Exceptionally Barnacle Geese will rise when a Heron *Ardea cinerea*, or Great Black-backed Gull *Larus marinus* passes over or close to them, and usually, though not invariably, upon the appearance of a Peregrine *Falco peregrinus*, Merlin *Falco columbarius* or Hen-Harrier *Circus cyaneus*. The reaction to this type of disturbance closely follows the pattern of aircraft disturbance, both factors probably producing similar stimuli in the geese. The number of records of disturbance by birds may be too low, as some of the disturbances attributed to unknown causes may in fact have been caused by hawks invisible to the observer at a distance.

#### *By other geese*

Small parties of grey geese moving about by day had little or no disturbing effect upon Barnacle Geese. However, when a sizeable skein flighted over, calling, the tendency was for the Barnacles to rise and move in the same general direction as the

grey geese, though at a much lower altitude. This was seen to occur only during late afternoon in winter, and when this 'premature fighting' of the Barnacle Geese was precipitated the birds usually flew to the sandflats and remained there, presumably to roost. During morning flight, when grey geese may flight landwards either earlier or later than the Barnacles, this sympathetic behaviour has not been seen. Barnacle Geese normally roost much nearer to the shore than do grey geese and have never been seen to mix with them on the roosting grounds.

#### *By unknown factors*

40% of disturbances were of unknown origin. They might have included an unseen predator such as a fox or falcon, the calls of distant geese of either the same or different species which were beyond the observer's range of hearing, or some inexplicable tension or nervousness on the part of individual Barnacles which infected the rest of the flock. It is not thought that distant gunshots enter this category, as the geese appear quite accustomed to the desultory firing that takes place more or less continuously from about October to February. In practically all disturbances of this kind the results were not far-reaching. The flock seldom moved very far and settled down again within a few minutes. Normal fighting movements have not, of course, been included in the figures for this type of disturbance.

#### *Panics*

Some forms of disturbance, such as shooting, bird-scaring detonators, helicopters or low-flying aircraft, and the presence of a falcon, occasionally produce a type of panic reaction within the Barnacle flock. When this occurs, the geese rise in a body, often to a considerable height, and begin to wheel and dive at high speed and sometimes in complete silence, in a manner strongly reminiscent of a pack of waders. The geese then may or may not move away from the source of the disturbance, and in some cases will, after a few minutes, abruptly cease their swift, wheeling flight, resume calling and quietly alight at or near the point from which they originally rose.

#### **General flock behaviour**

Studies of the daylight activities of the Barnacle flock covered two complete winter seasons and were accomplished by the selection of 100-bird samples watched closely for periods of up to 45 minutes. These activities fell into four main categories: feeding, resting, preening and

bathing, and aggression. The type of activity depended to a major extent upon the type and condition of the ground on which the flock was stationed at the relevant time. Thus, when the flock was on the merse, 87.2% of its time was spent in grazing, with the remainder of the time divided between resting (8.9%), preening and bathing (3.3%), and quarrelling (0.6%). When on farmland 94% of the birds' time was occupied by feeding, 4.8% in resting, 1.1% in care of the plumage and only 0.1% in hostile activities. When on the sandflats during periods between normal morning and evening fighting, 95% of the flock's time was spent in resting, standing idly, squatting or dozing. The remaining 5% of the time was spent mainly in preening or bathing.

The total time spent in aggressive activities was small. Aggression was never long sustained and consisted usually of a few wing-flaps accompanying a desultory peck or a short, darting run at a near neighbour. Nothing remotely resembling actual fighting was ever witnessed. As the flock was invariably absent from Caerlaverock from late February until final departure occurred, evidence of any increased aggressive activity in spring is lacking.

Barnacle Geese usually keep up a continuous low chatter while feeding, and it is thereby often easy to detect their whereabouts even when they cannot be seen. Very occasionally, however, the flock will feed for lengthy periods in almost complete silence. On rising into the air, for whatever reason, the flock usually breaks into a loud clamour of calls, though one notable exception to this rule has been discussed. After evening flight, when the birds have settled to roost on the sandflats they quickly fall silent.

When moving between roost and feeding-ground, or when moving locally about the Solway, Barnacle Geese almost invariably fly in a compact though formless mass and seldom exceed an altitude of about 2-300 feet. Migratory flight, however, appears to occur at much greater altitudes and, as with other goose species, the characteristic skeins are then formed.

Barnacle Goose flocks show a marked disinclination to mix with other geese. In the weeks preceding spring migration it is commonplace for flocks of Greylag *Anser anser* and Pink-footed Geese to resort to merses where Barnacles are feeding. The latter, however, retain their identity as a flock, continually edging away from any encroaching outliers of grey goose parties. Similar separation of the Barnacle Geese from others on the roosts has already been mentioned.

It may be of interest, however, to add that stray individual Barnacles are occasionally found with flocks of other geese, especially Greylags and Pink-footed. The writer has also noted that geese of all species, when unable to undertake northward migration through injury, will join forces during the summer months. In the summer of 1964, for example, two Barnacles, two Greylags and one Pink-footed Goose formed an almost inseparable unit which was temporarily supplemented in September by one Brent Goose *Branta bernicla*.

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## Wildfowl Survey in south-west Asia: progress in 1965

CHRISTOPHER SAVAGE

### Summary

In this first full year of the survey, information and observations have been collected from Jordan, Iraq, Iran, Pakistan and India, and two working papers have been prepared. The reconnaissance of wildfowl habitats in West Pakistan was continued with special attention to those in Sind and a visit was made to Chitral to study the incidence of trapping during the spring migration. The ringing of ducks in West Pakistan was got under way and special efforts have been made to improve the rate of reporting Russian rings. Of special interest during the year were the protection of the White-headed Duck *Oxyura leucocephala* at its principal habitat in West Pakistan, and news of the Falcated Duck *Anas falcata*, Chinese Spotbills *Anas poecilorhyncha zonorhyncha*, and the White-winged Wood Duck *Cairina scutulata* from Assam.

### Introduction

The survey has continued to develop as outlined in the 16th Annual Report (Savage, 1965a), and has benefited from valuable information contributed by several new observers. The Central Ringing Bureau in Moscow and the Institute of Zoology, Academia Sinica in Peking have shown interest in the project with promise of future co-operation and exchange of information. Liaison with the Game Departments of Iran and Pakistan, and with the Bombay Natural History Society has also been developed as corner stones of the project.

Plans for 1966 include intensification of the project with the help of the World Wildlife Fund, to which a gift for wildlife conservation in Pakistan has already been

made by Volkart Brothers. A plan has also been submitted to the British Government for providing a training course in wildfowl conservation and management for selected Game Inspectors from Iran and Pakistan. The trainees on return would be expected to train staff to implement conservation programmes and ringing schemes in both countries.

### Distribution of species and habitat

In addition to the author's own observations, valuable notes have been received from Jordan, Iraq, Iran, East and West Pakistan, and India. As a result it has been possible to complete a preliminary assessment of the wildfowl situation in West Pakistan (Savage 1965b) and information for a similar study of the situation in East



Pakistan and West Bengal is not far behind. The greatest dearth of information remains in respect of the Ganges - Jumna basin in northern India as well as central and southern India. Information of any kind, particularly any old records and game bags would be welcomed from Members who should forward them direct to the author, c/o IIF Gulberg, Post Bag 704, Lahore, West Pakistan or, c/o the Wildfowl Trust, Slimbridge.

The main conclusions in regard to West Pakistan are that though numbers of most wintering species have decreased greatly in recent decades, this decrease is largely explainable by loss of habitat. Some signs of distribution changes have been found within West Pakistan but further information from adjacent areas is required before conclusions can be drawn. The most serious decrease has been in the Greylag Geese visiting the Punjab but this again may be due to a change in distribution. It is interesting to note that the Mir of Hunza's records of Greylag shot during the autumn migration show no such signs of decrease and the numbers seem consistent with the small flocks still wintering in the Punjab. If there is a correlation here, then the decrease is possibly related to a separate population which used to spend part of the winter in Kashmir and which used to be found in large numbers (a thousand have been shot in a day!). The small numbers of Greylag wintering today in the coastal areas near Karachi have been seen on migration north-westwards and possibly belong to the breeding population in Sistan referred to in last year's report.

Studies of habitat in West Pakistan have shown the important role played by private

preserves, particularly in a season such as 1965/66 when the whole continent is suffering from drought. These areas are mostly preserved for a 'V.I.P.' shoot in late November, or early December, after which they are seldom shot over more than two or three times a month till the birds depart in February and March. Irrigation water is used to maintain water levels and often rice is grown specially to attract and hold the birds. Such marshes are often characterised by small islands of vegetation, usually *Tamarix articulata* or bushes of *Suaeda sp.* which give rise to a topography of potholes much favoured by most species. These areas thus provide refuge conditions for vast numbers of duck which otherwise would be continually harried by hunters. One such preserve near Larkhana in Sind, covering an area of six square miles, has five hundred acres of rice specially cultivated as duck food, and teems with duck (before the first shoot) at a density comparable with the pens at Slimbridge in winter.

Arising from these studies the most promising conservation projects seem likely to be associations with owners of preserves in setting aside part of these as permanent sanctuaries with provisions for observation of wintering flocks and ringing. At the same time by analogy it is possible that similar conditions could be synthesised in rice-growing areas of the Punjab to the benefit not only of the wildfowl but wildfowlers.

#### Chitral reconnaissance

Travellers in Chitral have often remarked on decoy pools in the river valleys which were said to be used for catching ducks on

their northward migration. Others, on third-hand information, have suggested that excessive slaughter on these important migration routes may have been one of the causes of the decline in numbers of wild-fowl visiting West Pakistan. This obviously needed investigation.

We flew into Chitral by DC3 on 21st March, 1965. It was the first flight for three weeks due to bad weather and heavy snow falls. We left again on 24th March, the last flight before the service was suspended on the loss of the aircraft en route to Chitral a few days later. We heard that large flights of duck had passed up the valley immediately before our arrival, having presumably been held up by the weather, but no further flights appeared during our stay. The roads were only jeepable near Chitral itself as up the valley landslides and avalanches had not yet been cleared. We therefore had to content ourselves with seeing little, but with considerable opportunities of hearing first-hand accounts which we could check against one another.

Ducks are caught in the upper valleys of Chitral by means of ingenious decoy pools, but it would seem that there are no longer more than about a hundred in existence, many of which are disused. Weather conditions limit the number of days in the short season when they can be operated, but the usual morning's catch is 20 to 100 duck. The decoy pool is a small lozenge-shaped tank, fed from the river, and surrounded by a low dry stone wall. It measures some 50 yards long by 20 yards wide at its widest with a wickerwork funnel constructed over the pointed end of the lozenge. The rivers of Chitral, being torrential in character, provide no resting places for migrating duck which come readily to these decoy pools in the very early hours of the morning, usually before dawn. The hunters lie in wait for them in hides constructed in the perimeter wall. When there are adequate numbers in the pool a man at the furthest end gently waves a horse's tail or a soft broom to look like the tail of an animal, upon seeing which the duck swim towards the wicker funnel. At a given moment the men show themselves and drive the birds up the funnel and into a trap made of large stone slabs. A movable slab is then quickly rolled into place to close the trap. A small hole in the top of the stone trap permits a man to go inside to remove the catch.

Officially, the use of the decoy trap is prohibited in Chitral State as it is thought that too many birds are killed at a time. In practice, however, this regulation is only enforced within 20 or 30 miles radius of

Chitral. The principle of the decoy pond however, is used in constructing flight ponds beside main river courses throughout the State. To judge by the number of butts round a small 'shikargah' and the admitted fact that the birds are 'browned' on the water it is questionable whether the lives of many ducks are saved by the banning of decoy traps.

An interesting feature of all these decoy ponds and shikargahs is the use of extremely rudimentary but effective decoys made of mud and pebbles. The decoys are nearly twice life size but of course are intended to entice migrating ducks during the hours of darkness or very early morning. The ducks are consumed locally where the softer feathers and down are saved and woven into homespun 'undercoats' which are much valued for their warmth in winter. An example of this was obtained subsequently from one of the upper valleys and has been presented to the Trust.

From the scanty information obtainable and from impressions gained from discussions with residents of Chitral, the author estimates the annual kill to be of the order of 10-25,000 duck. These numbers are high in proportion to the small human population of the State and important on account of their occurrence so late in the season. It is certain that hunting in Chitral should be curtailed but this must await a national policy as the annual duck 'harvest' is of undoubted economic importance to the peasantry of the area.

#### **Ringling programme**

A start was made on ringling wintering ducks in West Pakistan in the name of the Game Department. Various methods and places were tried with a view to selecting a procedure suitable for regular ringling in significant numbers. After trying various expedients and discussing methods with professional trappers throughout the length of the country it became clear that the most appropriate general method would be by means of the 'dhubbi' net (pronounced Dubby). This is an underwater clap net particularly suited to conditions in Pakistan. It can be operated in water up to 12 inches deep and when closed forms a trapezoidal tent over the birds. The trap needs to be baited with rice paddy and in favourable conditions can catch a hundred or so in a throw.

Up to 31st December, 1965, over two hundred birds had been ringed of seven species - Pintail, Common Teal, Garganey, Shoveler, Common Pochard, Ferruginous Duck and White-headed Duck. A review of all available data on migration of ducks and geese in S.W. Asia was prepared

(Savage 1965c), of which the most important conclusion is that there is a need for a 'crash programme' for ringing in all countries of S.W. Asia, with a target of 50,000 over the next five to ten years. In addition, it is necessary to secure the reporting of all rings recovered in this region so that the maximum advantage may be taken of the valuable ringing being done in the U.S.S.R.

#### White-headed Duck

*Oxyura leucocephala*

As a result of the attention drawn in the 16th Annual Report (Savage 1965b) to the numbers of White-headed Duck visiting West Pakistan and of subsequent investigations, arrangements have been made for local protection of the species at Khabbaki Lake in the Punjab Salt Range. This lake is the only important permanent habitat of the species within a 500 mile radius of their believed breeding grounds in Sistan. A watcher (recently the chief predator) resident nearby has been appointed full-time guardian. These arrangements are expected to be very beneficial, since the White-headed Duck is particularly vulnerable due to its habit of feeding by day in shallow water near the shore.

#### Notes from Assam

A correspondent in Assam, M. J. S. Mackenzie, reports that Falcated Duck

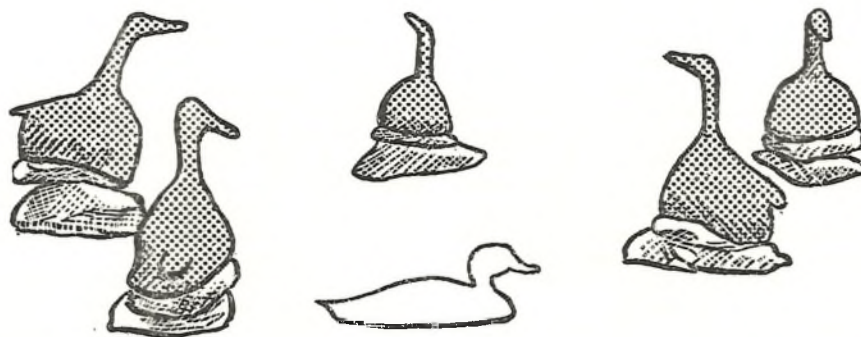
*Anas falcata* are now regular visitors to upper Assam and occur in greater numbers than formerly supposed. Falcated Duck commonly associate with Gadwall and are often shot in a ratio of one in twenty.

It has also been found that the migratory Chinese race of Spotbill *Anas poecilorhyncha zonorhyncha* occurs regularly in the bag. The absence of the red spot and the presence of a well marked 'moustache' stripe distinguishes it readily from the resident Indian race. This race has been recorded before from Assam, but bag records over a number of years have shown it to be more than a vagrant. An intermediate specimen was seen but unfortunately was not available for preservation. Such intermediates have also been found in the past and are to be expected where two races mix.

Lakhimpur District of Assam has long been known as an important habitat of the White-winged Wood Duck *Cairina scutulata*. These now occur only in a certain forest reserve where in spite of protection they are still hunted by the local population. Only a tiny population remains which urgently needs conservation, but the species though locally endangered is understood to be still numerous in the interior of Thailand and on this basis does not feature in the I.U.C.N. 'Red Book'.

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Decoy ducks formed from clay and stones as used in Chitral - Mallard outline shows size. Drawn by C. D. W. Savage. See page 46.



*AYTHYA* HYBRIDS (see pages 49 to 65). All the photographs (Nos. 1 to 30) illustrating this section were taken by, and are the copyright of PAMELA HARRISON except No. 15 *The Times* and Nos. 16 to 18 ERNEST FIELDER.

(Above) 1. Lesser Scaup *Aythya affinis*, ♂ full plumage. (Below) 2 Lesser Scaup Type Hybrid, ♂ full plumage. Note the difference in the bill tips. The vermiculations of the dorsal area are much finer in the hybrid than in *A. affinis*, though the reproduction does not show this well. See Plate 16.





(Above) 3. Baer's Pochard *A. baeri*. (Below) 4. Baer's Pochard Type Hybrid, ♂ full plumage. Note fine bill tip.

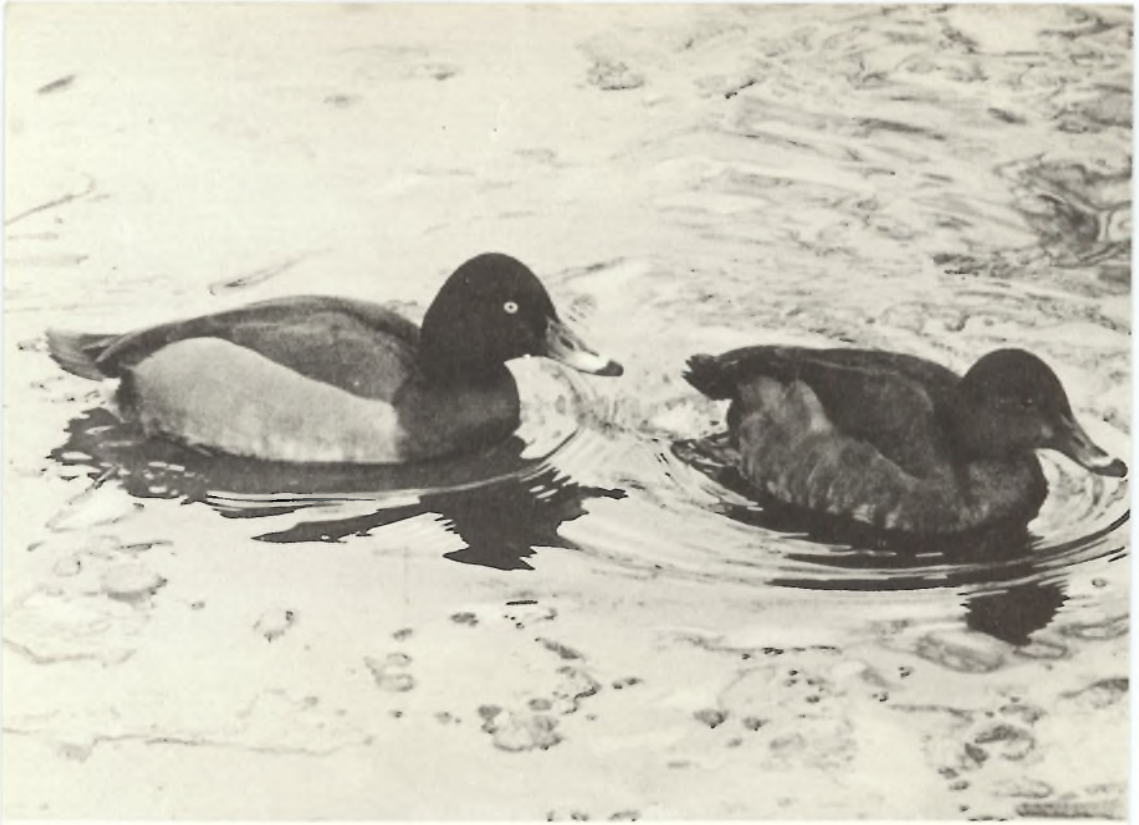




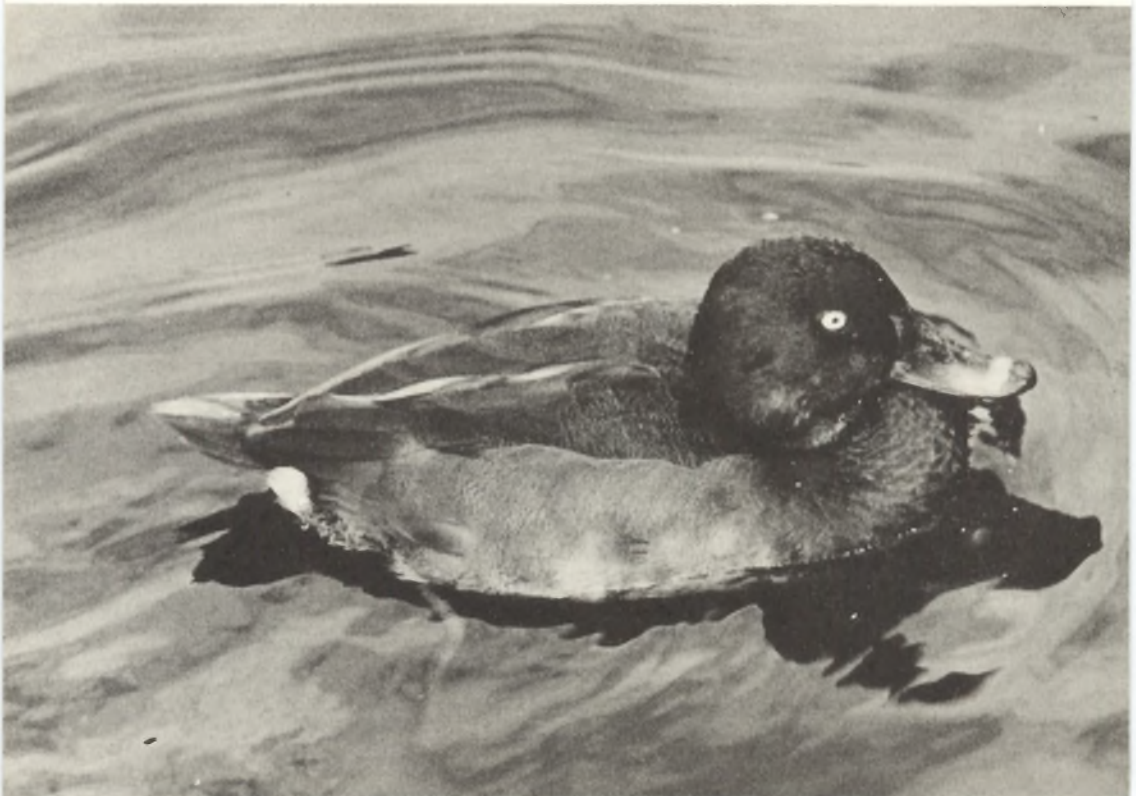


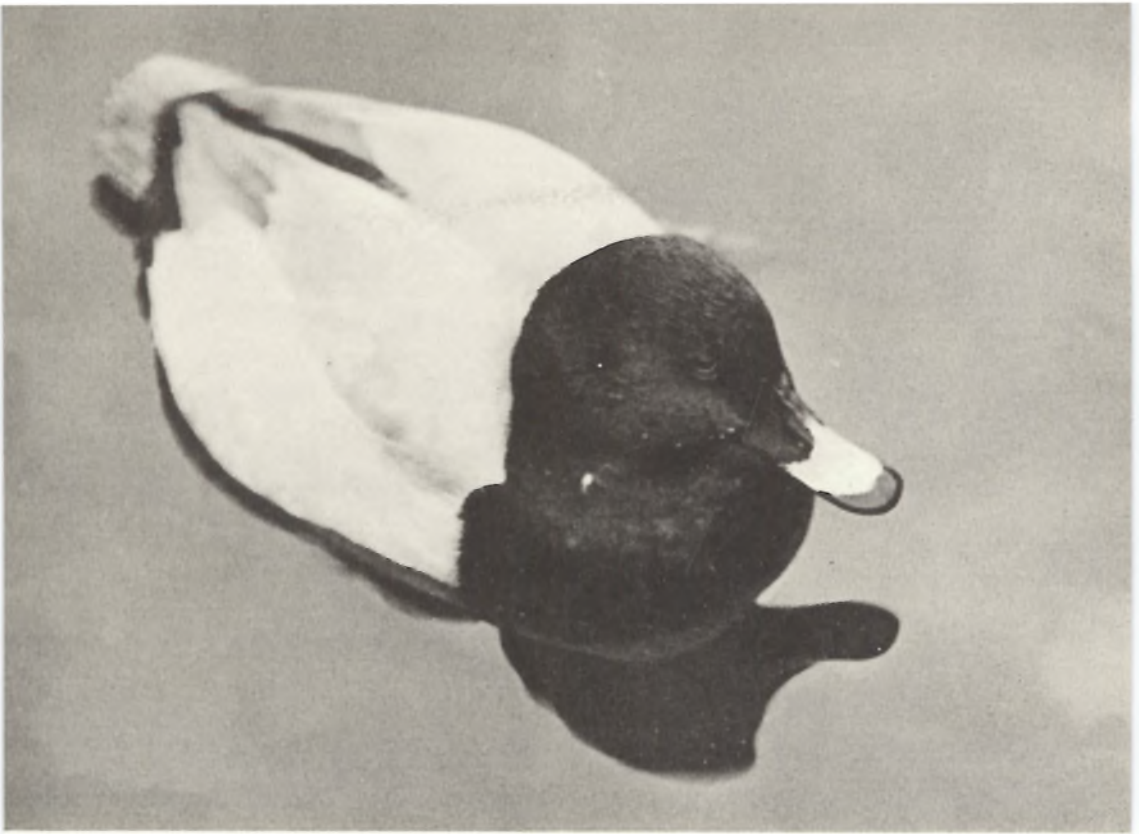
(Above) 5. Baer's Pochard Type Hybrid, ♂ full plumage, with ♂ Tufted Ducks *A. fuligula*. Note the darker side panels of the hybrid and the flush crest. When the crest of this hybrid is elevated, the bird's resemblance to a ♂ Ring-necked Duck *A. collaris* is marked. (Below) 6. Another view of the same hybrid individual as in Nos. 4 and 5.





Ferruginous Duck Type Hybrid, "Paget's Pochard". (Above) 7. ♂ and ♀ in full plumage in captivity in Sevenoaks. Note that bill tips of both sexes are like those of Pochard (see Nos. 9 and 12) and that the undertail coverts are more like those of the Ferruginous Duck *A. nyroca* (No. 11). (Below) 8. ♂ in eclipse. Note the resemblance to a ♂ Ferruginous Duck.





(Above) 9. European Pochard *A. ferina*, ♂ full plumage. Compare bill tip with that of ♂ Ferruginous Duck (No. 11) and Ferruginous Type Hybrid (No. 7). The difference in colour between the edge and the centre of the dark tip is exaggerated in this reproduction. (Below) 10. Tufted Duck Type Hybrid, ♂ full plumage. Note resemblance to ♂ Tufted Duck, particularly in eclipse, with its darker side panels.



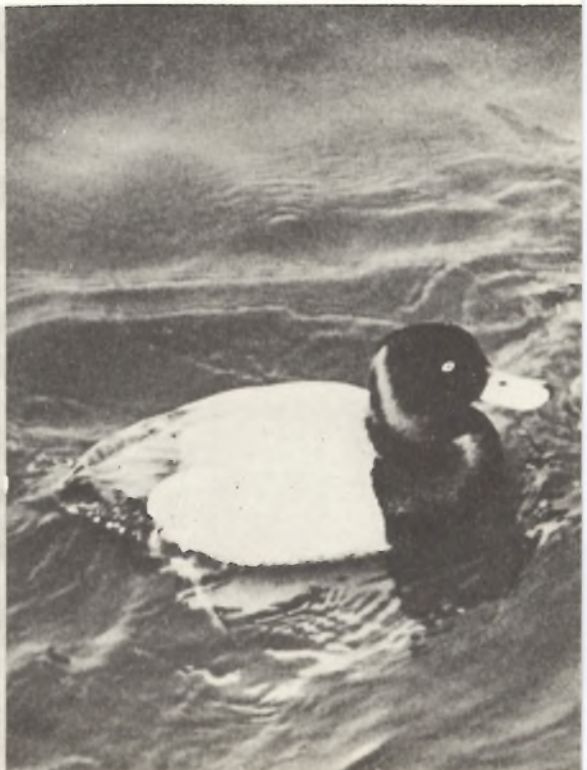


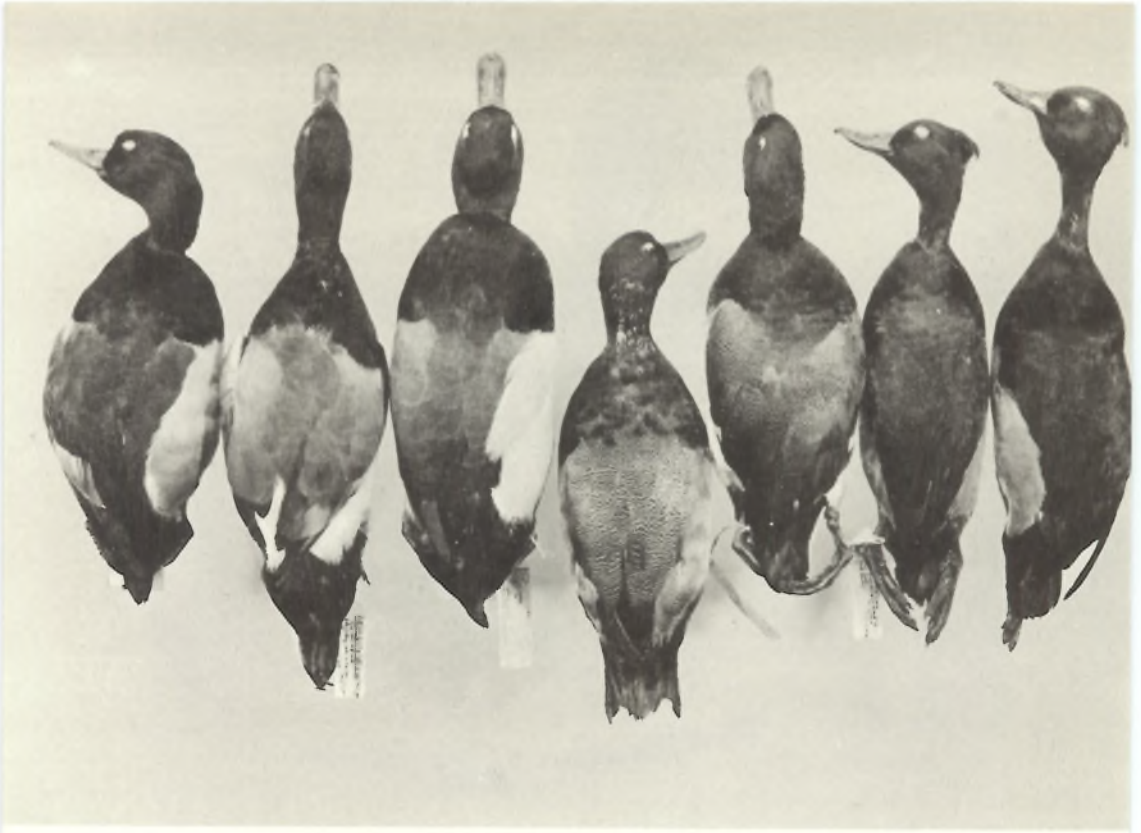
(Above) 11. Ferruginous Duck, ♂ full plumage. The general resemblance to the hybrid in Nos. 7 and 8 is marked. Unfortunately the important difference in the bill tips is scarcely apparent from this illustration. (Below) 12. Pochard, ♀ winter plumage. The ♀ Ferruginous Type Hybrid (No. 7) has a closer resemblance when the Pochard is in summer plumage.



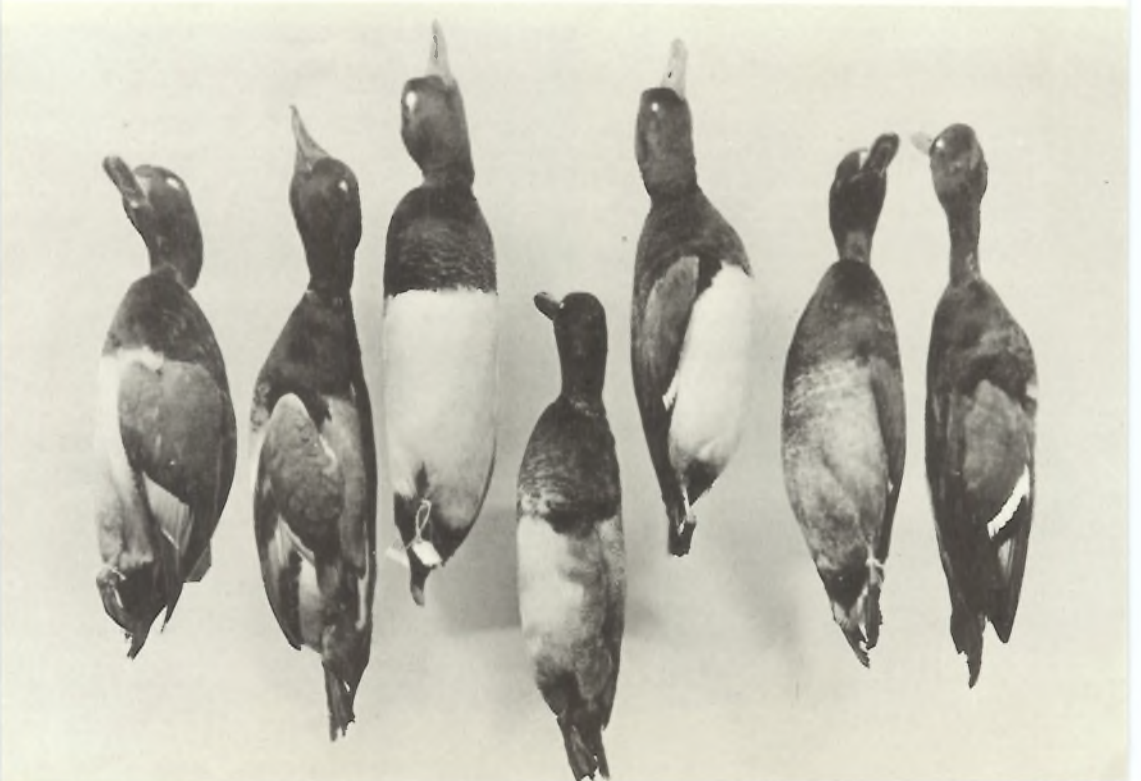


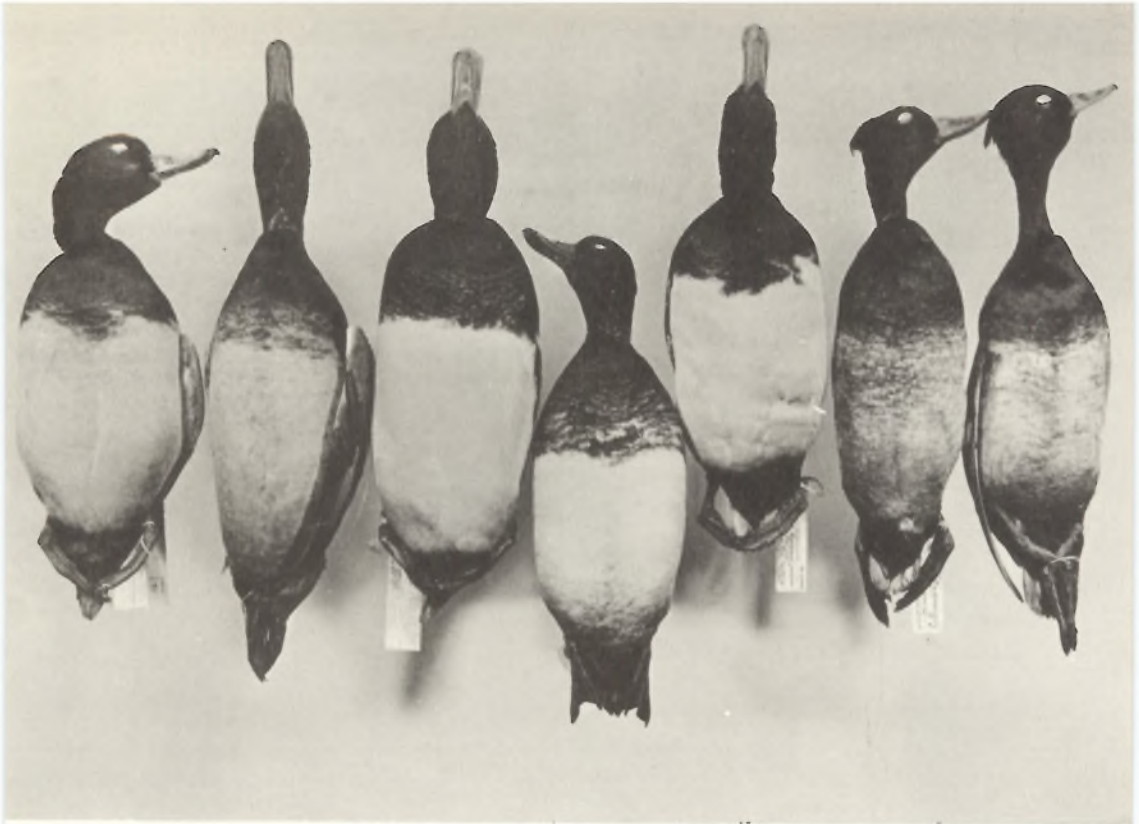
Scaup Type Hybrid, ♂ full plumage. (Above) 13. Amsterdam Museum specimen. (Below, left) 14. At Reykjavik, Iceland. The stubby crest is obvious in these two specimens but not in that of the St. James's Park bird (No. 15, below, right) which resembled a Tufted Duck in the size of its head and bill.





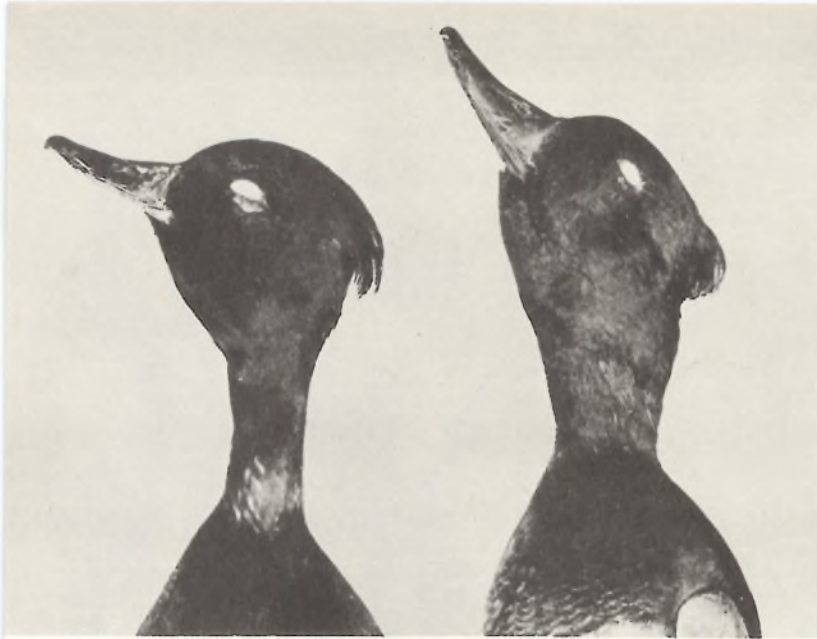
Dorsal (No. 16, above), lateral (17, below) and ventral (18, opposite, above) views of museum specimens of (left to right) (1) Redhead  $\times$  Ring-necked Duck, (2) Lesser Scaup Type Hybrid (Sutton Courtenay bird), (3) and (5) Scaup Type Hybrid, (4)  $\sigma$  Lesser Scaup, (6) and (7) Tufted Duck Type Hybrids.





(Below) 19 and 20. Ventral and side view of skins of Tufted Duck Type and Lesser Scaup Type Hybrids. Note the darker underparts, longer crest and more prominent white speculum of the Tufted Duck Type, on the left in each photograph.



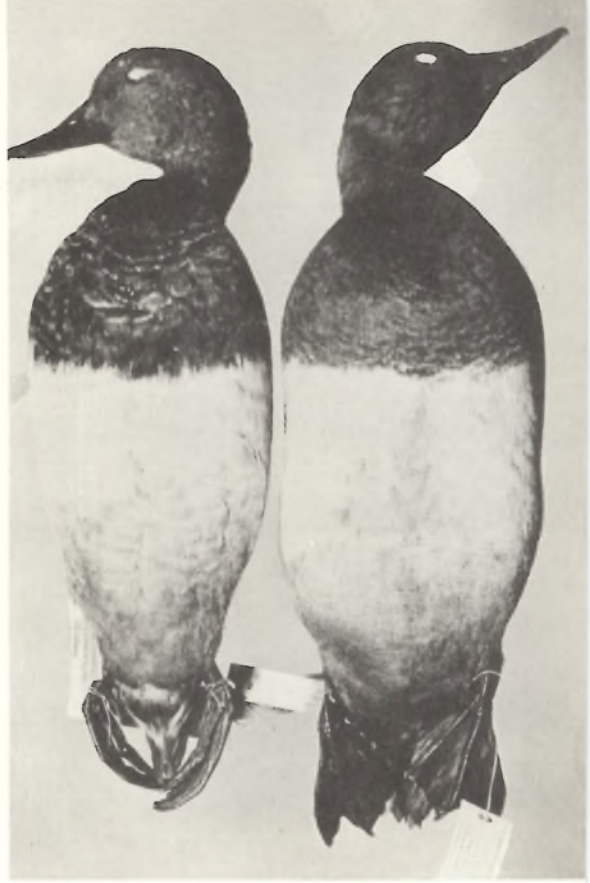
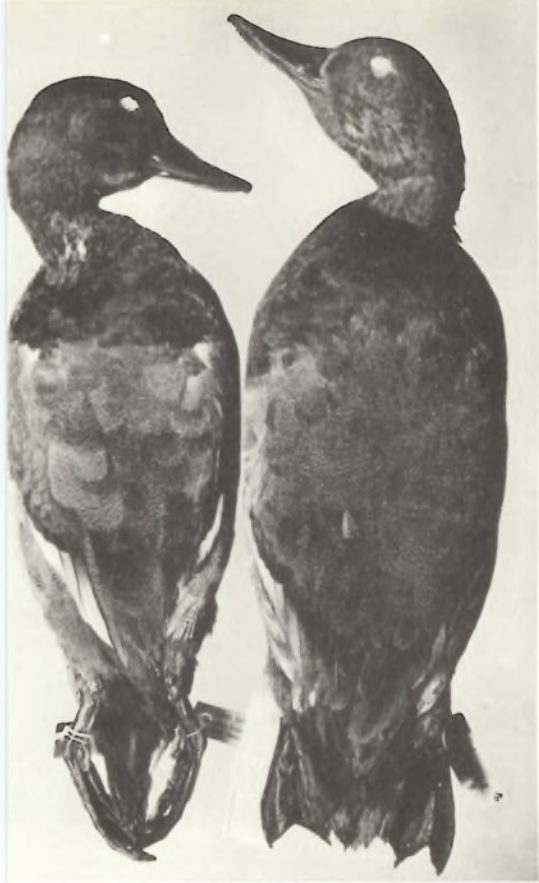


(Left)

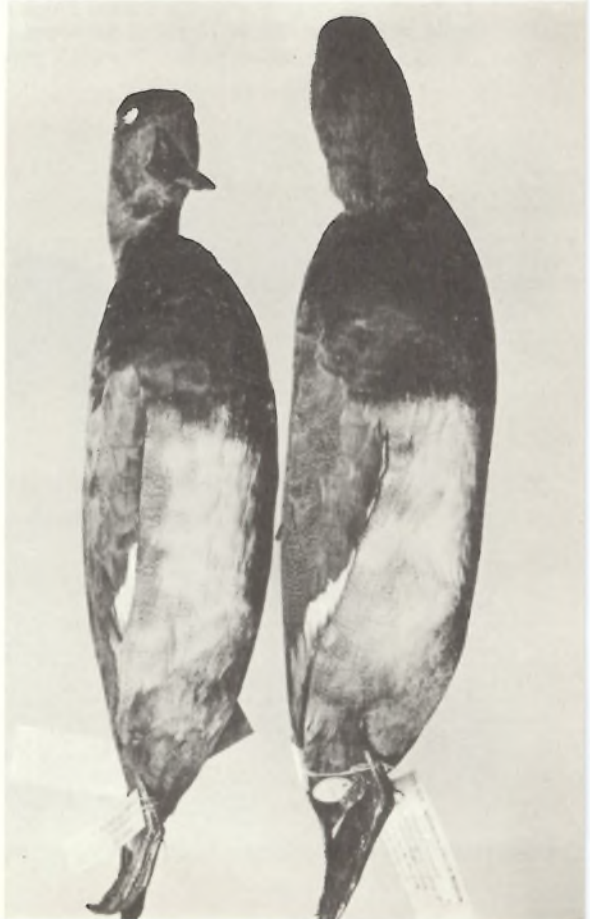
21. Heads of Tufted Duck Type and Lesser Scaup Type (on right) Hybrids, also illustrated in Nos. 19 and 20. Note the differing contours of the crowns, as well as the types of crest.







(Opposite, below) 22, 23, 24. Pochard Type Hybrid. Specimen No. 3, from Munich Museum. Note similar morphology to Lesser Scaup Type Hybrid, shown in Nos. 19, 20, and 21. (Above, and right) 25, 26, 27. Ferruginous Duck Type Hybrids. Specimen No. 12 on the left, Specimen No. 13 (from Norwich Museum) on the right in each illustration.





(Above) 28, 29. Pochard x Tufted Duck Hybrid ♀ Specimen No. 4—an intermediate type of hybrid. From Norwich Museum. (Below) 30. Tufted Duck Hybrid ♂. Same birds as No. 10, after death. Note the wing bar and crest.





TORRENT DUCKS *Merganetta armata* (See pages 66 to 74). With the exception of the upper photograph on the next page, taken by and reproduced with the permission of H. Luthi, the photographs in this section were taken by PAUL A. JOHNSGARD. Their poor technical quality is regretted.

(Above) 31 male and (below) 32 female Colombian Torrent Ducks, Rio Chisbar, Popayán.





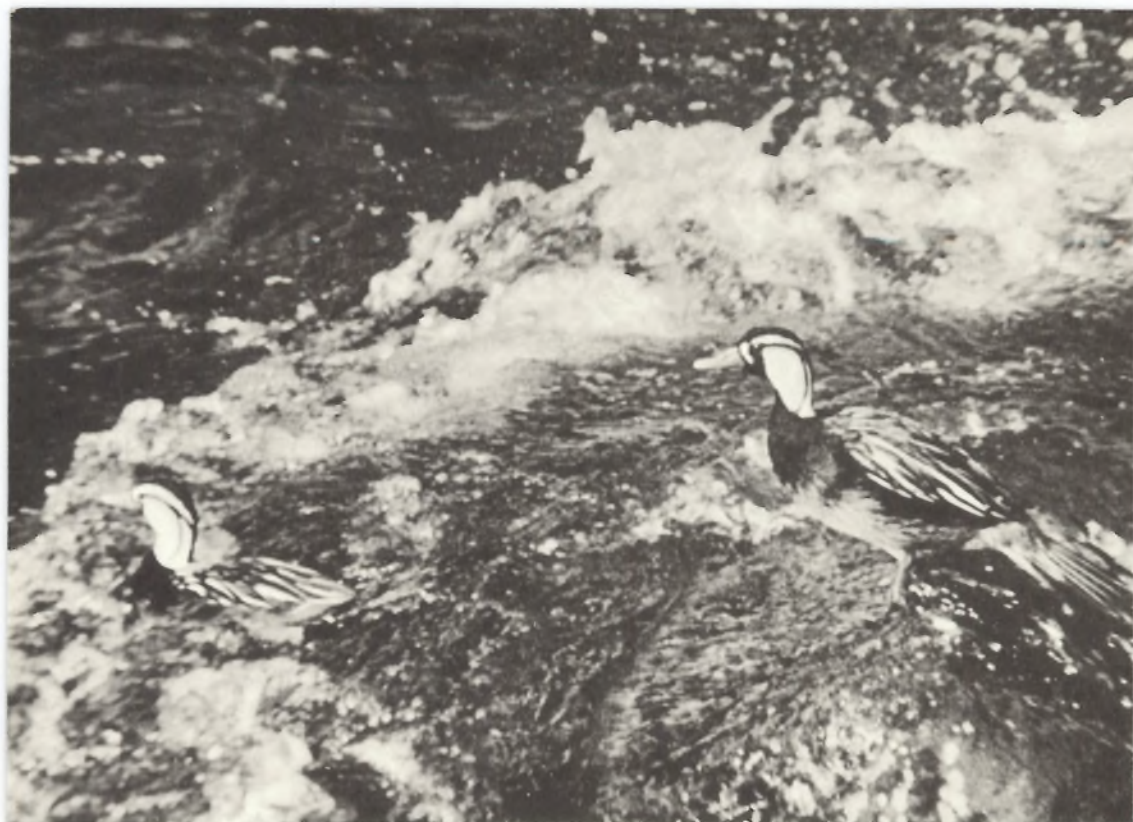
(Above) 33. Two male and a female Peruvian Torrent Duck, Rio Lurin. (Below) Turner's Torrent Duck, Huarcocondo Canyon. (Left) 34. A light-coloured male. (Right) 35. A downy young.





(Above) 36. Male Bolivian Torrent Duck, Rio Zongo. (Below) 37. Male Chilean Torrent Duck, about to dive, Rio Petrohue.





38, 39. Chilean Torrent Ducks.



# A study of certain *Aythya* hybrids

ERIC GILLHAM, JAMES M. HARRISON and  
JEFFERY G. HARRISON

## Summary

Six distinct types of drake *Aythya* hybrids which may be seen in Britain are described both from museum specimens and as seen in the field. These are the progeny of various combinations of four species: Pochard, Tufted Duck, Ferruginous Duck and Scaup. A description is also given of a drake hybrid between two North American species, the Redhead and Ring-necked Duck. Female *Aythya* hybrids must often remain unrecognised: four specimens are described. The relatively frequent occurrence of hybrids resembling species rarely found in Britain necessitates very careful scrutiny of all records purporting to be of Lesser Scaup, Ring-necked Duck and Ferruginous Duck.

## Introduction

The problem of hybridisation among the diving duck of the genus *Aythya* was brought into prominence in this country by the now famous 'Lesser Scaup' dispute, in which a bird, eventually obtained at Sutton Courtenay, Berkshire, was finally identified as a hybrid, probably between a Pochard *Aythya ferina* (Linnaeus) × Tufted Duck *Aythya fuligula* (Linnaeus). The hybrid was described by Perrins (1961), in comparison with a Lesser Scaup *Aythya affinis* (Eyton), but no attempt was made at that time to compare it with other *Aythya* hybrids, of which there are at least six types to confuse ornithologists in Britain today. For this reason we have brought together a series of field observations on these and have linked them with a comparative study of all the specimens we could assemble.

These different types may be loosely defined as a 'Lesser Scaup type' (if one accepts the fact that the Sutton Courtenay bird resembles that species to some extent); a 'Pochard type'; a 'Tufted Duck type'; a 'Baer's Pochard type'; a 'Scaup type', and 'Paget's Pochard' or a 'Ferruginous type'.

As a result of our studies, we are able to confirm the correct diagnosis of the Sutton Courtenay bird, the parentage almost certainly and rather surprisingly being Pochard ♀ × Tufted Duck ♂. When the cross occurs in the reverse direction, a completely different type of hybrid results, as will be seen. We are also able to show that there is a New World equivalent of the 'Lesser Scaup type' hybrid.

## Part One: The museum specimens

Table I sets out the data of the sixteen specimens we have examined comprising all six types of hybrid, the final column on parentage being of considerable importance, when these findings are linked with the field observations.

It will be noted that only four records refer to females. Their resemblance to

one or other of the parent species is so close that they are likely to be overlooked. We have, however, examined one skin of a female Pochard × Tufted Duck and watched female Paget's Pochards in the field.

I. Pochard *A. ferina* × Tufted Duck *A. fuligula*, ♂ 'LESSER SCAUP TYPE'. The Sutton Courtenay specimen. (See Plates 16, 17, 18 in Photographic Section I, opposite page 64.)

The description and relevant comparisons have already been published elsewhere (Perrins, 1961). These include the important differences of colour, pattern and measurements between this bird and the Lesser Scaup *A. affinis*, and also a description of the bill colour, stressing the presence of black at the tip and base, pigmentation which is absent in *A. marila* and *A. affinis*, in which the nail only is black. The importance of the wing-bar is stressed as this reflects the intermediate character of the individual. Similarly the iris is stated to have been intermediate in colour.

There would be little point in repeating the detailed description of the plumage of the specimen which appears in the Appendix to Perrins' paper (*loc. cit.* p. 53). In our opinion the identification of the specimen is correct, *i.e.* it is a presumptive hybrid between *A. ferina* ♀ and *A. fuligula* ♂. (See field notes, numbers 18 to 23.)

We would add the following particulars:

Measurements (in mm.)

Wing:	222
Bill:	
length from feather margin	45
width at nostrils	21
width at widest point	21
nail	9 × 9
Tarsus:	38
Middle toe without nail:	59.5

Our only comment on the description already published is that the black on the tip of the bill appears to be more extensive, 4mm. proximal to the nail and for about

**Table I. Museum specimens of *Aythya* hybrids examined in this study.**

Ref. No.	Hybrid and Type	Data	Reference	Observations re parentage
1.	Pochard × Tufted Duck ('Lesser Scaup type')	3 Mar. 1960. Sutton Courtenay, Berkshire ♂ Oxford University Museum B.4171	Perrins (1961)	An identical hybrid of known parentage Pochard ♀ × Tufted Duck ♂ is alive at the Wildfowl Trust and was bred by J. P. Williams
2.	Pochard × Tufted Duck ('Lesser Scaup type')	23 Nov. 1962. ♂ Sevenoaks, Kent	*	Wild shot
3.	Pochard × Tufted Duck ('Pochard type')	28 Mar. 1937. ♂ Lake near Ismaning. Bezzel Coll. Munich Museum No. 37.106	Bezzel (1960)	Wild shot
4.	Pochard × Tufted Duck	4 Jan. 1939. ♀ Hickling Broad, Norfolk. Norwich Castle Museum No. 119,939	*	Wild shot
5.	Redhead × Ring-necked Duck. ('New World representative of Lesser Scaup type')	2 Nov. 1962. Wildfowl Trust collection. ♂ ad. Bred in captivity	*	This hybrid was thought to be Redhead × Ring-necked Duck. We support this and suggest it results from Redhead ♀ × Ring-necked Duck ♂
6.	Pochard × Tufted Duck ('Tufted Duck type')	30 Mar. 1959. J. M. Harrison collection ♂ Bred in captivity	*	These hybrids were of the same brood of known parentage Pochard ♂ × Tufted Duck ♀ and were bred by T. Jones
7.	Pochard × Tufted Duck ('Tufted Duck type')	2 Mar. 1962. J. M. Harrison collection. ♂ ad. Bred in captivity	*	
8.	Scaup × Tufted Duck ('Scaup type')	- Dec. 1960. B. L. Sage collection. ♂ Bred in captivity	Sage (1963)	Of known parentage Scaup ♂ × Tufted Duck ♀ bred by J. O. D'earth
9.	Scaup × Tufted Duck ('Scaup type')	10 June 1940. Durgedam, Holland. ♂ Coll. Zoological Museum, Amsterdam No. 5050	Voous (1955)	
10.	Scaup × Tufted Duck ('Scaup type')	20 Feb. 1947. Landroost-Ymuiden, Holland. ♂ Coll. Zoological Museum Amsterdam No. 28771	Voous (1955)	Wild shot. Same type as 8 and 9 and therefore probably of same parentage
11.	Pochard × Ferruginous Duck. ('Ferruginous Duck type'). Paget's Pochard	16 April 1909. Hickling, Norfolk. ♂ ad. Norwich Castle Museum No. 208.949	Zoologist (1909)	Wild shot. An identical hybrid of known parentage Ferruginous Duck ♀ × Pochard ♂ was bred by J. P. Williams in 1964.
12.	Pochard × Ferruginous Duck ('Ferruginous Duck type')	- Jan. 1897. Soham Toney Mere, Norfolk. ♂ ad. Norwich Castle Museum No. 7423	Riviere (1930)	Wild shot
13.	Pochard × Ferruginous Duck. ('Ferruginous Duck type')	3 Nov. 1928. Hickling Broad, Norfolk. ♂ ad. Norwich Castle Museum No. 179.928	Riviere (1930)	Wild shot
14.	Pochard × Ferruginous Duck. ('Ferruginous Duck type')	8 Dec. 1933. Heigham Sound, Norfolk. ♂ imm. Norwich Castle Museum No. 66.934	*	Wild shot
15.	Tufted × Ferruginous ('Baer's Pochard type')	'Zoo.Soc.' ♂ by plumage. British Museum No. 1858	Harrison C.J.O. (1963)	Bred in London Zoo
16.	Tufted × Ferruginous ('Baer's Pochard type')	'Zoo.Soc.' ♂ by plumage. British Museum No. 71.3.20.3	Sage (1962) and C.J.O. Harrison	Bred in London Zoo

\*Not previously recorded



12mm. on the edges of the culmen on either side (cf. sketch, *loc. cit.* p.51).

2. POCHARD *A. ferina* × TUFTED DUCK *A. fuligula*, ♂, 1st w. 'LESSER SCAUP TYPE'. (See Plates 19, 20, 21.)

November 23rd, 1962, Sevenoaks, Kent. Harrison collection.

Crown, head and neck: strong purplish-red, darker on the chin and on front of neck; a well marked white chin spot. (The Sutton Courtenay bird is possibly a little brighter on these parts, but has no chin spot.) A distinct but stubby crest, which is also present in the Sutton Courtenay specimen. Upper breast: purplish-black; at lower edge, narrow whitish crescentic markings to feathers. In the Sutton Courtenay bird this area is a little brighter and the white crescentic markings are more pronounced. Over shoulder regions blackish-slate with minimal purplish-red reflections, which are slightly stronger laterally; lower edge wedge-shaped on mantle, the apex somewhat brownish, directed towards the tail. In the Sutton Courtenay bird this area is brighter and shows fairly strong purplish-red reflections; the lower edge is the reverse to that of the Sevenoaks specimen. Breast: whitish, flecked greyish-brown, particularly on the right side; left side less flecked, but a strong slate-coloured spot towards the vent. (Sutton Courtenay bird is more regularly flecked and spotted.)

Vent: barred pale greyish-brown, also finely vermiculated grey (Sutton Courtenay specimen is washed with brownish-grey, but still shows barred effect and paler greyish vermiculations here).

Under tail-coverts: blackish-sepia (Sutton Courtenay bird pale brownish-sepia).

Upper parts: moderately dark grey, very finely and closely vermiculated white (Sutton Courtenay bird a trifle lighter and brighter).

Rump and upper tail-coverts: blackish-sepia with very weak reflections, closely resembling Sutton Courtenay bird.

Rectrices: greyish-sepia, outer vanes and tips a trifle darker. (Sutton Courtenay bird brownish-sepia, outer vanes and tips slightly darker.)

Wing: coverts almost uniform greyish-brown to sepia; greater wing-coverts at speculum darker (Sutton Courtenay bird considerably lighter and greyer, and shows fine greyish vermiculations).

Speculum: whitish, broadly-edged below with strong sepia, extending on to primaries. (Sutton Courtenay specimen whitish, at lower edge greyish-sepia, considerably speckled whitish.)

Long scapulars: innermost uniform dark sepia, longest paler brownish-sepia. (Sutton

Courtenay bird grey, tipped brown.) Axillaries and under wing-coverts, white; fore edge of wing grey. (Sutton Courtenay bird paler.)

Primaries: sepia, outer vanes and tips dusky. (Sutton Courtenay specimen very pale brownish-sepia, outer vanes and tips dusky.)

Flanks: pale grey, vermiculated white.

Measurements (in mm.)

Wing:	224
Bill:	
length from feather margin	44.5
width at nostrils	18
width at widest point	20
nail	9 × 7
Tarsus:	37
Middle toe without nail:	58

Specimens 1 and 2 agree very closely; the difference appears to be due to advancing maturity in the Sutton Courtenay specimen.

3. POCHARD *A. ferina* × TUFTED DUCK *A. fuligula*, ♂, ad. 'POCHARD TYPE'. (See Plates 22, 23, 24.)

March 28th, 1937. Lake near Ismaning, Bezzel Collection, Munich Museum, Registered No. 37.106.

Crown, head and neck: rather deep rich chestnut-red, reflecting some purple, weakly on the face, but strongly on the back of the neck; chin and front of neck dull sepia faintly reflecting green. This bird has a short truncated crest. Upper breast and over shoulders: purplish-black; at lower edge of breast, the feathers narrowly edged silvery-white. Shoulder regions adjacent to mantle rather duller; central area extending on to mantle of pale brownish-sepia. This area is roughly triangular with the apex directed towards the tail.

Lower breast and belly: white merging into grey belly, becoming darker at vent. Under tail-coverts: black.

Upper parts: rather a strong dark grey, closely and finely vermiculated white. Long scapulars similar, but longest darker and more uniform on inner vanes, tone sepia.

Mantle: as upper parts, on sides paler and greyer than rest.

Rump and upper tail-coverts: dull black.

Rectrices: sepia.

Wing: coverts dark grey, very finely vermiculated, contrasting markedly with the edges of adjacent mantle; edges of wing coverts at speculum somewhat darker.

Speculum: white, at lower edge speckled grey; axillaries and under wing-coverts white, fore edge of wing faintly and narrowly grey.

Primaries: buffy-sepia, outer vanes and

tips darker sepia giving the extended wing a light bar.

Flanks: white, very faintly and closely vermiculated pale grey.

*Measurements* (in mm.)

Wing:	217
Bill:	
length from feather margin	44.5
width at nostrils	20
width at widest point	21
nail	6 × 6
Tarsus:	34
Middle toe without nail:	57

There is no record of the soft parts: a pattern is clearly visible on the bill, which was presumably bluish-grey with a black tip and black at the base.

Comments: compared with the other two drake hybrids of this cross, this bird presents much greater contrast. It is closer in appearance, superficially, to a drake Pochard, but has the truncated, but nevertheless noticeable crest. Possibly this enhanced contrast is due to greater maturity, but this is more likely to be a different type of hybrid resulting from the same parentage - i.e. *A. ferina* ♀ × *A. fuligula* ♂ or one of these hybrids × *A. ferina*. It has been found that sibling Wigeon *A. penelope* × Shoveler *A. clypeata* hybrids (Harrison, 1964) can show quite marked individual differences in colour. In this case, the general external morphology of the 'Pochard type' hybrid is so similar to the 'Lesser Scaup types' described, the essential differences being in colour only, that it is reasonable to presume the same parentage. (See also field notes, number 27.)

#### 4. POCHARD *A. ferina* × TUFTED DUCK *A. fuligula*, ♀ INTERMEDIATE TYPE. (See Plates 28, 29.)

January 4th, 1949, Hickling Broad, Norfolk, Norwich Castle Museum No. 119.939 (Lord Desborough Coll.).

Crown, head and neck: dark chestnut brown, crown to nape and cheeks slightly darker; white chin-spot and imperfect whitish facial mask not joining on forehead, i.e. confined to sides of face and freely spotted with chestnut.

Breast: pale Ecru-drab\* (Ridgway, 1886, Pl. III, No. 21), barred silvery-white.

Belly: silvery-white, obscurely barred and blotched with Ecru-drab.

Vent: pale grey, Ecru-drab proximally.

Under tail-coverts: stronger brownish Ecru-drab, speckled grey and white on tips.

Flanks: whitish, barred obliquely pale fulvous and vermiculated grey and white. Upper parts: warm dark chestnut-brown, at shoulders bright chestnut-brown.

\* Capitalized names of colours appearing later in the text are also those of Ridgway.

Lower back, rump and upper tail-coverts: dark purplish-brown.

Rectrices: dark purplish-sepia.

Wing: coverts almost uniform dark brownish-grey.

Speculum: grey, lower border narrowly edged sepia and tipped white.

Primaries: outer vanes and tips dark sepia, rest of feathers palish-sepia, forming a broad pale wing-bar.

Scapulars: as upper parts generally, but finely speckled, grey on proximal series and brownish-ash on tips of next in size, longest dark chocolate-brown.

Under-wing: axillaries and coverts white, fore edge of wing mottled fulvous-grey.

*Measurements* (in mm.)

Wing:	203
Bill:	
length from feather margin	42
width at nostrils	19
width at widest point	20.5
nail	9.5 × 8.5

Tarsus: 37

Middle toe without nail: 58.5

This is an intermediate type of female hybrid.

#### 5. AMERICAN REDHEAD *A. americana* (Eyton) × RING-NECKED DUCK *A. collaris* (Donovan), ♂ by plumage. (See Plates 16, 17, 18.)

It is of more than passing interest to be able to make a direct comparison of the foregoing specimens with a similar hybrid of the New World. The hybrid now discussed was reared at the Wildfowl Trust and was found dead on 2nd February, 1962.

Crown, sides of face and ear-coverts: coppery-red, brighter than in the Sutton Courtenay specimen and as in that example feathers narrowly tipped black. Throat rather dusky and there is a white chin spot, smaller than in *A. collaris*.

Sides of neck: at back and on occiput strong dusky-green reflections, rest of neck as crown and face.

Breast: black, glossed dark purple; this colour extends upwards over the shoulders, where there is a suggestion of a pale crescent as in *A. collaris*. On lower breast, feathers tipped greyish-white.

Belly and sides of body: pale greyish-white, in the centre finely peppered black; on sides and flanks pronouncedly grey, very finely vermiculated greyish-white and black. The flanks are narrowly-edged whitish, more distinctly so at the caudal end. This character is clearly indicative of *A. collaris* blood.

Vent: brownish-black, tips of under tail-coverts finely vermiculated brownish-grey. Axillaries: white.

Under wing-coverts: large innermost white, lightly vermiculated grey-brown, but mostly white; rest white. Fore edge of wing grey, narrowly edged white.

Back: at edge of mantle a triangular area, apex directed towards tail, of dusky-brown, speckled finely with dull greyish-white. Rest of mantle dark dusky-grey, very finely vermiculated greyish-white.

Scapulars: as mantle, but vermiculations more pronounced.

Rump and upper tail-coverts: dark brownish-black.

Rectrices: sepia.

Wing: wing-coverts and bastard-wing sepia.

Speculum: outer vanes of secondaries forming the French-grey speculum paler at bases and more intense medially, where also narrowly tipped white and edged black. Primaries: outer vanes and tips, sepia; inner vanes pale brownish-sepia, forming a pale wing bar.

Scapulars: innermost as mantle and back; longest dark sepia, dully reflecting metallic green.

*Measurements* (in mm.)

Wing: 226

Bill:

length from feather margin 51

width at nostrils 19

width at widest point 21

nail 11 × 8

Tarsus: 38

Middle toe without nail: 64

We would comment upon the following points in this specimen:

1. The broad similarity to 'Lesser Scaup type' hybrids.

2. The presence of a well marked chin spot.

3. Some characteristics referable to *A. collaris* inheritance.

4. The bill colouration which shows the presence of a black tip as distinct from a black nail; this pigmentation extends to a depth of 16 mm.

6 and 7. POCHARD *A. ferina* × TUFTED DUCK *A. fuligula*, ♂♂ 'TUFTED DUCK TYPES'. (See Plates 10, 16-21 and 30.)

The two specimens now to be described are both captive birds of known parentage and age, from the same brood, the male parent being *A. ferina*, the female *A. fuligula*. Both were anatomically sexed male. They were hatched in 1958, one dying on 30th March, 1959, the second on 2nd March, 1962. They are almost identical in plumage and, as can be seen from the plates, present a very different morphology to individuals in which the cross was in the opposite direction.

The description which now follows is

that of the younger bird of 30th March, 1959.

Crown, sides of face and ear-coverts: purplish-black, on sides of face and ear-coverts reflecting green; the crest which is shorter than that of *A. fuligula* males, but longer than 'Lesser Scaup type' hybrids, is of the same purplish-red.

Neck: purplish-red as far as the mantle.

Mantle: dark brownish-ash, very finely vermiculated ashy-white, rest of upper-parts dark sepia, finely vermiculated greyish-white.

Rump and upper tail-coverts: uniform dark sepia.

Rectrices: dark purplish-sepia.

Breast: purplish-sepia, feathers narrowly edged ashy-white.

Rest of under parts: greyish-white, irregularly barred transversely pale sepia, overall appearance dark.

Vent: purplish-sepia.

Under tail-coverts: ashy-white, finely speckled pale sepia.

Flanks: ashy-white, washed pale cinnamon and finely vermiculated ashy-white.

Wing: coverts uniform brownish-sepia.

Speculum: white, extending on to primaries, edges of outer vanes narrowly margined in sepia.

Primaries: brownish-sepia, tips and outer vanes dark sepia.

Scapulars: innermost same as mantle, longest warm brownish-sepia, dully reflecting greenish-bronze.

Axillaries: white, finely speckled greyish-brown.

*Measurements* (in mm.)

Wing: 212

Bill:

length from feather margin 43

width at nostrils 22

width at widest point 23

nail 11 × 8

Tarsus: 39

Middle toe without nail: 63

Specimen of 2nd March, 1962.

Resembles the preceding bird, but is generally brighter from advancing maturity.

The breast-shield lacks the fine white edges to feathers; flanks are a richer shade of cinnamon-brown and sides of face reflect a stronger green; under tail-coverts reflect a stronger purple.

*Measurements* (in mm.)

Wing: 224

Bill:

length from feather margin 40

width at nostrils 21

width at widest point 22.5

nail 10.5 × 9

Tarsus: 37.5

Middle toe without nail: 61.5

Comments: The strikingly different mor-

phology according to which way the cross goes is of considerable interest; in one case the resulting hybrid appears as a 'Lesser Scaup type', in the other direction as a 'Tufted Duck type'. The extremely dark under parts in the latter are also noteworthy. It seems that *A. fuligula* male characters are largely transmitted by the female, while the exposure of the dark under parts is probably reversionary towards other dark-bellied *Aythya* species. This same feature has been revealed in a female *A. nyroca* × *A. fuligula* (see under Baer's Pochard type), and in variant female Tufted Ducks (Harrison 1961) and Scaup (Harrison 1962) in winter plumage. Both species normally have dark or darker under parts in summer.

8, 9 and 10. SCAUP *A. marila* (Linnaeus) × TUFTED DUCK *A. fuligula*, ♂♂. 'SCAUP TYPES'. (See Plates 14, 16, 17 and 18.)

Three individuals of this type of hybrid have been available to us; two of these have already been the subject of a communication (Voous, 1955), and were taken in the wild. The third is a captivity-bred bird of known parentage (Sage 1963), the specimen having been prepared in December, 1960. All three examples present a very similar morphology, differing only within a range of individual and seasonal variation.

In view of this, a detailed description of the captivity specimen (8) will suffice for all three. (See Plates 16, 17 and 18.)

Crown, throat and front of neck: predominantly dark purple with very slight dull green reflections. It is difficult, due to the make of skin, to assess the presence of any crest. Sides of face, ear-coverts and neck: predominantly dark rich green.

Breast: dark sooty-black, reflecting dull purple; feathers on lower aspect finely-edged ashy-white.

Belly: white, lower belly finely speckled with grey.

Flanks: white very finely vermiculated with palest cinnamon. Vent and under tail-coverts: dark purplish-black.

Rectrices: sepia.

Shoulder region: dark purplish-black, extending on to back.

Mantle: whitish-grey, finely vermiculated black, narrow area in centre rather brown above extending into black area of back. Vermiculations finer and duller. Lower back, comprising tips of long scapulars noticeably darker and duller; vermiculations finer and indistinct.

Wing: coverts dark sooty-sepia, indistinctly vermiculated ashy-white; median coverts uniform. Greater coverts and long scapulars, sepia, reflecting dull greenish-bronze.

Speculum: white, extending on to the

innermost primaries and edged with dark sepia.

Primaries: sepia, darker on outer vanes and tips.

Rump and upper tail-coverts: dark purplish-black.

Measurements (in mm.)

Wing:	222
Bill:	
length from feather margin	45
width at nostrils	22.5
width at widest point	25
nail	9.5 × 8

Tarsus: 40

Middle toe without nail: 60.5

9. Amsterdam Museum Specimen Reg. No. 5050.

This specimen, when compared with the preceding bird, is darker on the mantle and the vermiculations of greyish-white and black are a good deal coarser, though not as coarse as in *A. affinis*. The head and neck reflections are very similar. On the flanks the vermiculations of pale cinnamon are faint, but rather more marked than in the last specimen. There is an abortive crest. The white of the speculum extends on to the primaries.

Measurements (in mm.)

Wing:	210
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Bill:

length from feather margin	43
width at nostrils	20
width at widest point	23
nail	11 × 9

Tarsus: 36

Middle toe without nail: 59

10. Amsterdam Museum Reg. No. 28771, Mounted Specimen. (Plate 14.)

Resembles No. 5050 but is browner and duller on the head and neck reflecting less green. An abortive crest is well shown.

The mantle vermiculations are even coarser, but do not match those of *A. affinis* in this respect. The white of the speculum extends on to the innermost primaries and the flank vermiculations are very faint.

Measurements (in mm.)

Wing:	not measured
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Bill:

length from feather margin	43
width at nostrils	20
width at widest point	23.2
nail	10 × 8

Tarsus: 33

Middle toe without nail: 57

11. POCHARD *A. ferina* × FERRUGINOUS DUCK *A. nyroca*, ♂ 'PAGET'S POCHARD' or 'FERRUGINOUS TYPE'.

April 16th, 1909, Hickling, Norfolk. (E. S. Montagu Coll.) Norwich Castle Museum No. 208.949.

Crown, head and neck: rich chestnut-

red, slightly darker on crown and nape; small white spot on chin.

Upper breast and over shoulders: a deep coppery-red.

Above mantle: a broad area of dark purplish-red.

Lower breast: light coppery-brown.

Belly: white, lightly speckled palest grey.

Vent: sooty-grey, finely vermiculated paler greyish-white.

Under tail-coverts: white, vermiculated greyish-brown.

Upper parts: immediately above mantle an ill-defined triangular area of brownish-grey with the apex towards the tail, finely vermiculated white and sepia.

Rump and rectrices: dark sepia.

Flanks: pale brownish-grey, finely vermiculated pale sepia.

Wing: coverts dark grey, almost uniform, but quills darker with slight coppery-purple reflections. Tips of greater wing-coverts at speculum broadly tipped sepia.

Speculum: white, broadly-edged grey and narrowly white, extending on to primaries. Innermost secondaries strong grey.

Primaries: outer vanes and tips dark sepia, inner vanes and quills pale buff forming a broad light wing-bar.

Long scapulars: uniform dark sepia, faintly reflecting purplish.

Underwing: white, fore edge mottled greyish.

*Measurements* (in mm.)

Wing: 210

Bill:

length from feather margin	42
width at nostrils	19.5
width at widest point	22
nail	8.5 × 9.5

Tarsus: 37.5

Middle toe without nail: 59.5

12. POCHARD *A. ferina* × FERRUGINOUS DUCK *A. nyroca*, ♂ 'PAGET'S POCHARD' or 'FERRUGINOUS TYPE'. (See Plates 25, 26, 27.)

January 1897. Soham Toney Mere, Norfolk. (J. H. Gurney Coll.) Norwich Castle Museum No. 74.23. Died at Keswick, 6th July, 1906.

Crown and head: rich coppery-chestnut, on crown and at nape slightly darker; small white chin spot; upper parts of neck as head, rest of neck deep coppery-purple. This colour extends on to shoulders on upper parts. On front, feathers are narrowly edged ash.

Breast: as neck, feathers broadly edged ash.

Belly: white, vermiculated greyish, strongly so on lower belly.

Vent: greyish-sepia.

Under tail-coverts: parti-coloured grey and white, speckled grey.

Upper parts: dark greyish-sepia, vermi-

culated sepia, somewhat uneven in tone due to moult.

Rump, upper tail-coverts and rectrices: rich dark sepia.

Flanks: coppery-brown, mixed with grey and rather strongly vermiculated.

Wing: coverts brownish-grey obscurely vermiculated, quills slightly darker and with darker edges. Coverts at speculum slightly darker.

Speculum: white, narrowly edged grey and white.

Primaries: outer vanes and tips dark sepia, inner vanes and quills buff, forming a broad wing-bar.

Long scapulars: dark brownish-sepia; innermost obscurely vermiculated, those adjacent to speculum reflecting dull green, then becoming grey.

Underwing: white, fore edge mottled grey.

*Measurements* (in mm.)

Wing: 212

Bill:

length from feather margin	44.5
width at nostrils	19.5
width at widest point	21
nail	9.5 × 7.5

Tarsus: 36

Middle toe without nail: 57

13. POCHARD *A. ferina* × FERRUGINOUS DUCK *A. nyroca*, ♂ 'PAGET'S POCHARD' or 'FERRUGINOUS TYPE'. (See Plates 25, 26, 27.)

November 3rd, 1928. Hickling Broad, Norfolk. (Lord Desborough Coll.) Norwich Castle Museum No. 179.928.

Crown, head and neck: rich chestnut-red, with a small white chin spot.

Breast: rich coppery-red, edges of feathers outlined paler.

Belly: whitish, finely vermiculated grey.

Vent: strong smoky-grey, obscurely vermiculated greyish-white.

Under tail-coverts: sepia, slightly paler above and below.

Rectrices: sepia.

Flanks: greyish, vermiculated pale sepia and white.

Upper parts: over shoulders dark coppery-red, edges of feathers paler. Rest of upper parts dark brownish-grey, obscurely vermiculated. Overall, a very dark individual.

Wing: coverts uniform brownish-grey, slightly darker at edge of speculum.

Speculum: white, below edged smoky-grey and narrowly with white.

Primaries: outer vanes and tips sepia, inner vanes and quills buffish-white, forming broad pale wing-bar.

Scapulars: as mantle, but longest uniform rich sepia, reflecting dull purple.

Underwing: white, fore edge mottled greyish.

Measurements (in mm.)

Wing:	212
Bill:	
length from feather margin	43.5
width at nostrils	17
width at widest point	19.75
nail	10 × 8
Tarsus:	39
Middle toe without nail:	57

14. POCHARD *A. ferina* × FERRUGINOUS DUCK *A. nyroca*, ♂ imm. 'PAGET'S POCHARD' or 'FERRUGINOUS TYPE'.

December 8th, 1933. Heigham Sound, Norfolk. (Lord Desborough Coll.) Norwich Castle Museum No. 66.934.

Crown, head and neck: chestnut-red, crown to nape slightly darker; a white chin-spot present.

Breast: dark coppery-red; feathers broadly edged ash.

Belly: white, feathers edged pale coppery-red giving an irregular barred effect.

Vent: grey, washed dilute coppery-red, and faintly vermiculated white.

Under tail-coverts: proximal as vent; distal ash-white, tipped pale coppery-red.

Rump and upper tail-coverts: dark sepia, reflecting coppery-red.

Rectrices: as rump (two outermost faded juvenile, colour ash-brown).

Flanks: a mixture of greyish-white, vermiculated pale sepia, and rather coarse fulvous-brown and coppery-brown.

Upper parts: over shoulders and mantle a warm coppery-brown, paler at edges of feathers. At shoulders coppery-red (rich by contrast). Colour of mantle forms a broad U-shaped area, directed forwards.

Wing: coverts, brownish-grey, becoming greyer and broadly edged sepia at speculum.

Speculum: white, at lower border becoming grey merging into sepia, some of the feathers minutely tipped white.

Primaries: outer vanes and tips sepia, dark on tips; innermost paler, rest of feather a pinkish-buff forming a broad wing-bar.

Scapulars: proximal dark grey, finely vermiculated whitish; longest uniform warm coppery-brown, outer vanes dully reflecting green.

Underwing: white, fore edge mottled grey.

Measurements (in mm.)

Wing:	201
Bill:	
length from feather margin	48.5
width at nostrils	17
width at widest point	20.5
nail	10 × 7
Tarsus:	35.75
Middle toe without nail:	50.5

Note: There is no record of the colour of

the iris or soft parts in any of the above Pochard × Ferruginous Duck.

15. TUFTED DUCK *A. fuligula* × FERRUGINOUS DUCK *A. nyroca*, ♂ by plumage. 'BAER'S POCHARD TYPE'. British Museum Collection, Reg. No. 1858. 'Zoo. Soc.'

Crown, head and neck: crown dark coppery-red with a short crest which hangs over nape. Cheeks are predominantly dark green with slight coppery-red reflections; throat is generally dusky and there is a smallish white chin spot. Rest of neck presumably greenish, but hidden as specimen is mounted with head down on shoulders.

Note: Artificial eye pale orange-yellow; bill has been coloured grey, the nail is blackish; this is almost certainly incorrect and it is more likely that the tip was blackish and that there was also some black at the base of the bill.

Upper parts: the mantle is nearest to Ridgway's Seal Brown (Pl. III, No. 1). It is very finely and obscurely vermiculated fawn. Rest of the upper parts are similar, although the upper tail-coverts are blacker. The rectrices are the same Seal Brown, reflecting a coppery sheen.

Under parts: the breast is a dark coppery red-brown, at the lower edge with some broad whitish fringes. Centre of breast silvery-white, lower abdomen to vent washed pale reddish-brown, finely vermiculated white. Under tail-coverts whitish, mixed with paler reddish-brown, vermiculated palely, with a few feathers tending to white.

Flanks: pale reddish-brown, slightly grey, vermiculated white.

Rectrices: pale sepia.

Wing: (Note: a proper examination not possible owing to the specimen being mounted and fragile.) Upper wing-coverts appear a uniform Seal Brown becoming darker at the speculum, which is white and extends on to primaries.

Primaries: sepia with darker tips and outer vanes.

Scapulars: longest Seal Brown with outer vanes dull oily green; lower edge of speculum dark sepia; fore edge of wing warm brown mottled whitish. (Under surface of wings could not be examined.)

The tarsi and feet have been crudely coloured dark grey.

Measurements (in mm.)

Wing:	214
Bill:	
length from feather margin	47
width at nostrils	20
width at widest point	22
nail	10 × 8
Tarsus:	37
Middle toe without nail:	50.05

Note: this specimen is disintegrating rapidly.

16. TUFTED DUCK *A. fuligula* × FERRUGINOUS DUCK *A. nyroca* (sex not recorded). 'BAER'S POCHARD TYPE'. No data. 'Zoo. Soc.' British Museum Collection, Reg. No. 71.3.20.3.

Crown, head and neck: crown dark coppery-red, short dependent crest of same colour; cheeks similar but less bright. Behind ear-coverts and at sides of nape strong dark irridescent green. Throat and front of neck dusky coppery-red and a small white chin spot (neck has been shortened considerably in make of skin). Upper parts: shoulder regions dark coppery-red.

Mantle: dark Seal Brown, very obscurely vermiculated fawn.

Rump and upper tail-coverts: similar but uniform, the coverts being darker.

Rectrices: dark sepia.

Under parts: breast dark chestnut-red, at lower edge with paler fringes to feathers.

Breast: silvery-white.

Belly and vent: warm brownish-grey, finely vermiculated white.

Under tail-coverts: mostly white.

Flanks: reddish-chestnut, pale, finely and obscurely vermiculated white, more uniform towards tail.

Wing: upper wing-coverts uniform Seal Brown, slightly paler than upper parts generally.

Speculum: white extending on to innermost primaries giving a broad white wing-bar; fore edge of wing mottled warm brown and white.

Primaries: sepia, tips and outer vanes darker.

*Measurements* (in mm.)

Wing: 186 (tip worn)

Bill: length from feather margin 39

width at nostrils 18.5

width at widest point 20.05

nail 10 × 7.5

Tarsus: 34.5

Middle toe without nail: 52.5

Note: bill still shows black tip and some black at base. This latter bird was recorded by Sage (1962) together with a wild shot female, thought to be of the same parentage (Van Oort 1908) from Nieuwkoop, Holland, which we have not seen. The illustration of this bird in Sage's paper shows the dark flecking of the under parts, bearing a remarkable resemblance to some female Ringed-necked Duck and variant female Tufted Duck and Scaup (Harrison, 1961 and 1962) in winter plumage.

**Part Two: Live hybrids studied** (See Table II).

We have observed in the field or in

captivity all of the types of hybrid already mentioned in this paper, and these are now discussed under several headings with special reference to their likeness to parent or different species. For easy identification in the text the live birds are listed and numbered in Table II, the numbering following on that of the museum specimens.

17. 'Baer's Pochard type'. (See Plates 3, 4, 5.)

In full plumage at close quarters, this bird was very much like a drake Baer's Pochard. At a distance, however, and especially when displaying, there was a strong superficial resemblance to a male Ring-necked Duck. This likeness to the latter was mainly due to its dark plumage with lighter flanks and distinctly altered head-shape when the crest feathers were elevated. Our side view photograph, taken in 1962, shows the 'cut-off' crest lying flat. It is of interest to record that this particular bird was reported as a Ring-necked Duck to the editors of *British Birds* in 1962.

In eclipse plumage, its striking resemblance to a Ferruginous Duck was such as to suggest that late summer and autumn records of that species require the closest scrutiny by those responsible for County or National records, and it may be advisable to review all past records of Ferruginous observed between July and October. In passing one may ponder on what the juvenile drake of this type looks like.

In full winter plumage the crown, forehead and crest (tapered to a point), appeared to have a purple-bronze sheen quite distinct from the green sheen on the rest of the head and neck. The side panels appeared dusky with a white edging along the top and there was a small amount of white on the under tail-coverts, especially at the sides. These last two features can be seen in our side view photograph.

In eclipse, the plumage was brownish, the sheen on the head and neck being absent. The under tail-coverts were whiter than earlier on (if, of course, it was the same bird as the one present five months before). Since some adult male Tufted Duck acquire white under tail-coverts at this season an increase of white would not be surprising.

The eyes on *all* occasions were the palest of yellow to white. Almost the same size as a Tufted Duck.

On all occasions Tufted Duck were its associates, and each year it was commonly a member of Tufted Duck courting parties. Pochard were always present on the lake, but it did not associate with them.

This bird was seen to make the 'neck-stretch' and 'head-throw' postures of the Tufted Duck. The crest feathers were

**Table II. Live *Aythya* hybrids observed by the authors, 1959-65**

<i>Ref. No. Type</i>	<i>Where seen</i>	<i>Date</i>	<i>Photographs</i>
17. 'Baer's Pochard type' ♂	St. James's Park, London	Mar.-April and 29 Aug. 1959; 27 April-4 May 1960; 11 Mar.-8 May 1961; 28 April-24 May 1962. Possibly the same bird each year	4, 5, 6
18. 'Lesser Scaup type' ♂	St. James's Park, London	21, 23, 25 Feb. and 11 Mar. 1959	
19. Two ♂♂, pinioned	Slimbridge, Gos.	Various dates in 1962 and 1963	2
20.			
21. ♂ (specimen No. 2)	Sevenoaks, Kent	23 Nov. 1962	
22. ♂	Leybourne, Kent	4 April 1964	
23. ♂	Sundridge, Kent	24-27 Feb; 16 Nov.-21 Dec. 1965	
24. 'Scaup type' ♂	St. James's Park, London	9 Jan.-15 Sept. 1960	
25. 'Tufted Duck type'	Reykjavik, Iceland	9 May 1965	14
26. Two ♂♂ (specimen no. 6 & 7)	Sevenoaks, Kent	In captivity 1958-1962	10
27. 'Pochard type' ♂	St. James's Park, London	27 Jan. 1962	
28- 30. 'Ferruginous Duck type' Two ♂♂, one ♀	Regent's Park, London	From 28 Nov. 1963; bred in park about two years previously. One pair full winged.	
31.- 34. Two pairs Pochard ♂ × Ferruginous Duck ♀	Sevenoaks, Kent	Bred by J. P. Williams, 1964, in captivity	7 and 8

frequently elevated and the cheek feathers fluffed out. The 'hoi' note like that of the drake Tufted was heard.

18. 'Lesser Scaup type'.

This bird was even more like a drake Lesser Scaup than the Sutton Courtenay bird on account of the absence of black at the base of the bill. Apart from this difference it closely resembled the Sutton Courtenay bird, especially in lacking green reflections on the head and having a similar eye colour. It associated closely with Tufted Ducks during its stay, though Pochard were present on the lake.

19 and 20. 'Lesser Scaup types.' (See Plate 2.)

These two Wildfowl Trust birds were very much like other drake 'Lesser Scaup types' but with one important difference. At our request, Dr. G. V. T. Matthews kindly studied their plumage over a period and noted a distinct green tinge towards the back of the head. Dr. Matthews also comments on eye colour which was clearly changing with time. In December 1962, it was chrome yellow, and early in

March 1963, was more reddish, while in April 1962, one of us noted it as orange.

Early in September 1963, these two birds were almost certainly in eclipse - a dull version of full plumage. A third bird, which closely resembled them, was in the same pen, its only apparent difference being a whitish line around the base of the bill as in the male Ring-necked Duck. This bird was probably the American counterpart of our 'Lesser Scaup type'.

The 'head-throw' display posture of the drake Tufted Duck was noted in April 1962.

21. 'Lesser Scaup type.'

Closely resembled the Sutton Courtenay bird. Its eyes, however, were noted as light brown. It was observed swimming with five Tufted Ducks though a party of eight Pochard were on the lake.

22. 'Lesser Scaup type.'

Virtually identical to 21. There were about 25 Tufted Ducks on the same water.

23. 'Lesser Scaup type.'

Also virtually identical to 21. This was the only hybrid of this type to associate



with Pochard. At the time there were 65 Tufted and 83 Pochard on the water, but the hybrid kept exclusively with the Pochard.

24. 'Scaup type.'

This bird so closely resembled a drake Scaup that some observers refused to believe it was anything else! Similar hybrids have already been described (Sage, 1963), and the most important differences between this bird and those described by Sage are (a) the rounded Scaup-like head without any peaked appearance, (b) absence of any purple reflections on the neck in full plumage. At all times this 'rounded-head type' presents an identification problem to the un-critical, especially in juvenile plumage or in eclipse. Size as Scaup and Pochard. It was distinctly larger than any Tufted with heavier build and thicker neck. Head-shape as Scaup without any suspicion of a crest or kink.

Early in July this bird started its wing moult which lasted for 32 days.

It associated exclusively with Tufted Duck and on a number of occasions between 16th April and 26th May was in close attendance on individual female Tufted Duck.

On 21st May it was seen to adopt the 'head-throw' posture of a drake Tufted Duck.

25. 'Scaup type.' (See Plate 14.)

This drake was observed at close range on a pond near Reykjavik airport in May 1965. In size it was intermediate between a Scaup and a Tufted Duck. The head and

neck were black with green reflections and there was a minimal stubby crest. The mantle and scapulars were grey with coarse white vermiculations, the back being much darker than a drake Scaup. The flanks and belly were white, the upper breast black. The wings, tail and tail-coverts were dark sepia and the speculum was white, extending on to the primaries. The bill was all blue with a black triangular tip and the iris pale yellow.

Although both Scaup and Tufted Duck were present, it associated with neither species; in fact it was frequently chased by drakes of both species and by Eiders. When the pond was revisited on 9th and 10th June it was not seen.

General Comments

A bird which appeared in St. James's Park, London, in 1942 was identified, and reported, as a Scaup, and its photograph appeared in *The Times*. Of this bird Bannerman (1958) writes, 'I saw the bird myself on several occasions ...' and, '... to everyone's delight this, or another similar bird, turned up again in a succeeding winter'. Through the courtesy of *The Times* we have obtained prints of their photograph (see Plate 15), and in our opinion it is clearly a 'Scaup type' hybrid closely resembling the bird No. 24. The Tufted Duck-sized bill, definitely not a character of the Scaup, is shown clearly in the photograph. See also bill characters.

In the Royal Parks Report\* a Scaup was reported in St. James's Park every winter

Main plumage points as follows:

	<i>Immature Plumage</i>	<i>Full adult plumage (from 16th April to early August)</i>	<i>Eclipse</i>
Head Colour	Brownish with patches of green sheen	Blackish with green gloss and a little mauve gloss on crown and forehead	Dull dark brown with pale drooping crescent behind eye (as in female Pochard) and a whitish crescent on the cheeks
Neck Colour	As head	As head	As head
Upper parts	Rump and upper breast brown. Mantle and back brownish with odd patches of Scaup grey. Tail brown.	Upper parts blackish. Mantle and scapulars greyish finely vermiculated with blackish-brown. The markings were more like those of a Lesser Scaup than a Scaup. Tail blackish.	Upper parts dull dark brown except for mantle and scapulars which were a little browner than earlier on. Tail brownish.
Flanks	Brownish with some white showing along waterline.	White, as a drake Tufted Duck.	Pale brownish-grey.
Under parts	Upper breast brown mottled black. Under tail-coverts brown.	Upper breast blackish no green gloss. Under tail-coverts black. Rest of under parts white.	Upper breast dull dark brown with some black markings. Under tail-coverts dark brown.
Wings	Wing bar similar to drake just meeting when bird was on water.	Tufted Duck. Primaries were noticeably short, the wing tips	
Eye	Pale yellow.	Pale yellow.	Pale yellow.

\* by Committee on bird sanctuaries in Royal Parks (England).

from 1939 to 1946, whereas in a subsequent period of 11 years covering the time of hybrid notoriety, only hybrids have been reported. In view of this we suggest that past records of single Scaup in Inner London might well be reviewed.

26. 'Tufted Duck type.' (See Plate 10.)

The general posture and appearance of these birds was that of a drake Tufted Duck, in some ways rather like some drake Tufted Ducks in post-breeding moult. In its eclipse plumage this type of hybrid would be virtually indistinguishable in the field from an eclipse drake Tufted Duck.

The head had the full rounded appearance of a Tufted drake, whereas the Pochard tends to have a more sloping forehead. The neck was noticeably thinner than a Pochard and was much like that of a Tufted Duck. In eclipse the crest was totally lost and the whole of the head, neck and breast became a dark sepia-brown. The fine vermiculations were lost on the mantle and this became browner. The belly remained very much as it was in full plumage. The flanks became browner and lost their vermiculations. There was no significant change in iris or bill colour. The former at all seasons was pale yellowish-brown.

Our photograph, taken in February 1962, shows the flanks somewhat lighter than in life. The short, well-defined crest is clearly to be seen.

The 'head-throw' posture of the drake Tufted Duck was seen on many occasions.

27. 'Pochard type.'

Of all the hybrid types we have studied in life, this bird, although seen well, did not come under such close observation as the others. It was present only on one day, during which it remained some twenty yards off-shore. It looked more like a Pochard drake than a Lesser Scaup drake in colour and pattern, but its thinner neck, very short loose crest, and absence of black at the base of the bill, set it apart from the former species. Body size as a drake Tufted Duck or perhaps a trifle larger, but longer in the neck; head-shape also recalled a Tufted Duck because it was more rounded and with a short loose crest. The latter was visible when the bird was alert or dozing. Head colour a dull dark brown with a copper tinge. That part of dorsal area and wings visible when the bird was resting on water was a mousy-grey, similar to the 'Lesser Scaup type'. Upper breast blackish-brown, not as black as in the male Tufted Duck. Flanks whitish, but not as white as in the drake Tufted Duck and recalling the side panels of the 'Lesser Scaup type'. Stern end black as in drake Pochard.

It was seen among a group of 30 Tufted Ducks, though Pochard were present on the lake.

#### General Comments

Our translation of Bezzel's (1960) paper indicates that most hybrids at Ismaning were 'Pochard types', i.e. like the specimen from his collection which we ourselves have examined (our ref. No. 3). Perrins (1961) however, remarks that Bezzel's descriptions differ little from the Sutton Courtenay specimen, which is somewhat confusing, and due, no doubt, to Perrins not having examined the Bezzel skin. 28/29/30. 'Ferruginous Duck type' (See Plates 7 & 8).

The drake hybrid of this type bears a strong superficial resemblance to a male Ferruginous Duck and it is only on the finer points of detail that it can be distinguished in the field. Size as drake Ferruginous and drake Tufted Duck, but head and body shape as a drake Common Pochard. Head, neck and breast are the Pochard's rather than the Ferruginous' rich chestnut with some black feathers on the forehead (as in the Pochard) and on the upper breast. Tail and wings a medium grey-brown, not so dark and rich as in the Ferruginous. Flanks similar to wings but much paler and the tail-coverts a darker brown than the wings. One of the drakes had a little white on the under tail-coverts just below the tail but this was not apparent in the second drake. Belly appeared silvery-white sharply demarcated from the chestnut breast. A broad white wing bar extended on to the primaries as in the Ferruginous. The eyes were orange and the bill similar to a male Pochard—quite distinctive from the male Ferruginous (cf. bill sketches).

In eclipse it was more difficult to separate from the drake Ferruginous as among the differences the eyes were paler, and the under tail-coverts whiter, than earlier on (but under tail not as brilliantly white as in drake and duck Ferruginous at the same time of year). The head was similar to an old drake Common Pochard in eclipse and the flanks and wings still lacked the richness of colour of the drake Ferruginous though this contrast was less obvious than in full plumage. (See Plate 8.)

The 'head-throw' posture of the drake Pochard was given by both drakes (less quick than in the drake Tufted Duck). A second posture, the 'neck-stretch', was like that given by drakes of both Pochard and Ferruginous, as was a third posture, in which the head and neck was extended flat along the surface. This last is not characteristic of drake Tufted Ducks.

#### Adult female:

The separation of this bird from the duck Ferruginous in the field presents an even greater problem; in fact at any distance over fifty feet there could be no certainty unless a duck Ferruginous was on hand for detailed comparison.

In general colour, the likeness to a duck Ferruginous was close, but the loreal area and cheeks were less rich. The breast and flanks were a dusky chestnut brown, again less rich than in the Ferruginous. Wings, tail-coverts and tail dusky brown with a faint grey tinge and a small amount of white was visible just below the tail. Bill colour and shape similar to a duck Pochard. The head was a little more rounded than in that species, a character particularly noticeable when the two were side by side. Size only a trifle smaller than a duck Pochard and as big as, if not slightly larger than, the male hybrid of this type.

In wing moult the duck hybrid still closely resembled the duck Ferruginous, both having almost pinky chestnut foreheads. Apart from the duck Ferruginous' more conspicuous white under tail-coverts the only obvious differences were: (a) body and head shape of the duck hybrid resembled a Pochard, whereas the Ferruginous was more like a Tufted Duck; (b) the duck hybrid was nearer a duck Pochard in size whereas the duck Ferruginous approached a duck Tufted in build.

#### General Comments

The drake hybrid is sufficiently well known in British ornithology to have acquired the name of Paget's Pochard and one cannot help feeling that if the editors of *British Birds* had brought the Paget's Pochard problem to the notice of their readers, the 'Lesser Scaup problem' as such might never have existed, or, at any rate, might not have dragged on for so long. In reviewing their handling of Ferruginous Duck records since the last war, one gets the impression that Paget's Pochard never existed! Warnings concerning the acceptance of sight records of Ferruginous Ducks in these islands given by the editors of *British Birds* dwell on such points as justification for believing birds to be genuine immigrants because few were kept in captivity (about 1949-50) and caution over identification because some duck Tufted have prominent white under tail-coverts. Our examination of eight issues of *British Birds* giving some 20 records of Ferruginous observed between April 1947 and October 1951 failed to produce any reference to the possibility of confusing this species with the hybrids known as Paget's Pochard. Of

the 20 records, 7 appear to us as perfectly satisfactory Ferruginous Ducks, 10 have too few details (or none at all) upon which judgment can be passed, while 3 are unsatisfactory since the birds are not clearly separable from Paget's Pochard. Concerning descriptions of some Ferruginous seen in 1950-51, the editors of *British Birds* say (vol. XLIV, p. 352) 'the white eyes of the drakes did not always show up as conspicuously as might be expected', a statement which causes us some misgivings. As we have expressed elsewhere, a reappraisal of Ferruginous Duck records is not untimely if the high standards of British ornithology are to be maintained. In addition to the specimens we have examined (Nos. 11-14) and the recent sight records we know of another sight record in 1936 (Harrison 1953) making six occurrences at intervals in the past 65 years.\*

The two pairs bred by Jack Williams in 1964, three of which are now at Sevenoaks (Plate 7) are virtually identical with the above.

#### Variable characters in the *Aythya* hybrids

In general, all six types of hybrid described tend to be intermediate in character between their parent species. Only the 'Tufted Duck type' shows a character not present in either parent in winter, that is the dark under parts, which are darker than could be expected if this was referable to a Pochard character. The probable explanation of this is that it is a reversionary character revealed by the hybridisation, as has been strikingly demonstrated in the bimaculated face pattern of Wigeon *Anas penelope* Linnaeus × Teal *A. crecca* Linnaeus and Wigeon × Shoveler *A. clypeata* Linnaeus hybrids (Harrison 1954

\* A drake Paget's Pochard was identified on a gravel pit near Dungeness, Kent, on 16th October, 1965, by R. E. Scott. It was smaller than the accompanying eight Tufted Duck and female Pochard. The body plumage in sunlight was reminiscent of a Ferruginous Duck with reddish head and back, which showed little or no contrast. The flanks were a uniform smooth dark grey. The white under tail-coverts were conspicuous in the rear view with the tail raised, otherwise indistinct and sometimes not visible on side view with tail depressed.

The eye colour was as a drake Tufted Duck—perhaps a little less yellow—certainly not white. The beak was sketched in the field and was typical of Paget's Pochard, as shown in our sketch.

This record gives further support to our views on Ferruginous Duck, if the records are to be put right.

and 1964). In this case, the dark under parts are probably reversionary towards other dark-bellied *Aythya* species.

The remarkably different morphology, according to the direction of the cross in Pochard and Tufted Duck hybrids has already been referred to (see specimens 6 and 7). One has now to consider the 'Lesser Scaup type' hybrids in comparison with the 'Pochard type.'

We have no knowledge of the parentage of the 'Pochard type' hybrids described, but in general, the external morphology is similar to the 'Lesser Scaup type' hybrids, the main difference being the much brighter, more drake Pochard-like colouration. We think that these two types of hybrid will prove to be individual variations originating from the same cross, but possibly the 'Pochard type' might be the result of back breeding with Pochard predominance. In due course this should be solved by hand-reared hybrids of known parentage.

In this respect, it is noteworthy that Bezzel (1960) mentions a surplus of duck Pochard and drake Tufted Duck at Ismaning in April, suggesting that this is the time when pairing may occur between the species. The same conditions apply at St. James's Park, but there has only been one instance of mixed pairing here, during 12 years of intensive observation. It may be that geographical differences in the breeding season of the two species may give rise to a zone where the breeding seasons of the two species coincide, thus favouring hybridisation. The pair involved was a drake Tufted and duck Pochard.

Sage (1963) considers that Scaup × Tufted Duck hybrids show fairly constant characters. However, while they seem to be more Scaup-like in size compared with the slightly smaller 'Lesser Scaup types' the following appear variable:

- (a) head may be either distinctly peaked or rounded in shape.

- (b) head and neck may have either a predominantly green gloss or a predominantly purple gloss.

The flanks and belly of all specimens of this type referred to herein, are whiter than in the 'Lesser Scaup type', a difference not stressed by Sage (1963).

A two-year old bird of this type observed on an ornamental water at St. Neot's, Hunts., on 24th May, 1958, had white flanks, a purple-black head with a green sheen over a very wide area; a distinct kink at the back of the head and lemon yellow eyes (from notes by B. Rose, sent to us by *British Birds*). A similar bird at Theale, Berks., in February and March 1960, also appears to have had a green

glossed head, a kink at the back of the head, white flanks and bright yellow eyes (from notes of R. Gillmor).

Sage (1963) considers that the 'Lesser Scaup type' hybrid lacks the green gloss of the 'Scaup type' and that it always has a black base to the bill. However, in our opinion these characters are variable:

- (a) there may or may not be some green tinge or gloss on the head.

- (b) there may or may not be any black at the base of the bill.

A bird at Barn Elms, Surrey, in February 1958, had a purple head-gloss, a distinct kink at the back of the head, no black at the base of the bill and yellow eyes (from notes by P. Fullager).

One of the curious features about the *Aythya* hybrids described is their resemblance to the six different species of the genus, of which the 'Lesser Scaup' type presented a sufficient problem to deceive several experts, and for one of the latter to produce meteorological evidence in support of a transatlantic drift in explanation!

Perhaps the most striking of the hybrids is the Ferruginous × Tufted Duck, resulting in the 'Baer's Pochard type', resembling *Aythya baeri* (Radde), a far eastern species.

With this in mind, the possibility that some of these species may have arisen by reticulate evolution is worthy of consideration.

Mayr (1942) stated 'Reticulate evolution is possible only where different species, genera and families can hybridize successfully, and this occurs only exceptionally in animals . . .'

Doubtless speciation can arise as a result of inter-specific hybridization, but it is evident that this process must, and no doubt does, take aeons of time to establish a new species.

Most of the Anatidae are very fertile *inter se* and for speciation to result from hybridization it is essential for some additional isolating factor, either biological or ecological to operate in favour of any particular inter-specific cross, otherwise constant gene dilution would effectively prevent or delay speciation arising.

#### Bill comparisons of some *Aythya* hybrids

In his interesting paper Perrins (1961) stresses the diagnostic bill pattern of the Sutton Courtenay bird and gives sketches comparing its bill markings with those of drake Lesser and Common Scaup, Tufted Duck and Pochard. This key to identification would have been valuable if the sketches of the last two species had been both accurate and typical. Neither of the sketches of the bills of Tufted Duck and

Pochard are like those figured in *The Handbook of British Birds*, vol. III, pp. 301 and 292 (a fact not alluded to by the author), and it is extremely doubtful if an adult drake Tufted Duck in full winter plumage ever has a bill tip like Perrins' drawing in *British Birds* 54:51. To focus attention on the importance of bill characters we have reproduced both Perrins' and *The Handbook's* sketches alongside our own diagrams relating to various hybrids, in particular those observed in life (Figure 1).

Based on our material the bill tips of adult drakes in full plumage of five species and six types of hybrid may, generally speaking, be divided into three distinct groups as follows:

(Note: The letter preceding each species or type is the reference to our diagrams.)

*Crescent or 'Mr. Moon' - shape black bill tips.*

(i, j, k, l, m) 'Lesser Scaup type' (with or without black at base).

(o) 'Tufted type' (no black at base).

(n) 'Pochard type' (the St. James's Park bird had no black at base).

(f, g, h) Common Pochard (also extensive black at base. The light area on the bill is sometimes noticeably enclosed by black through black edges of the bill joining the black base to the black tip. cf. Figure 1).

(p) 'Ferruginous Duck type' (with dusky basal  $\frac{1}{4}$  of bill).

*Fan - or inverted cone-shaped bill tips.*

(q, r) 'Scaup type' (black extending over the nail a little way and no black at base).

(s) 'Baer's Pochard type' (black extending a little way over the nail and, apart from a pale area just behind nail, rest of bill dusky. cf. Plate 3).

(d) Tufted Duck (black extending over nail and no black at base).

In the above three the black is confined to the extreme tip and does not extend so far round the edges of the bill as in those with crescent-shaped bill tips.

(e) Ferruginous Duck (dusky area over basal  $\frac{1}{4}$  of bill. The bill of the 'Baer's Pochard types' closely resembles the Ferruginous Duck's).

*Small irregular-shaped or finger-nail shaped black circling on bill tip.*

(a) Lesser Scaup	} Black on bill tip confined to actual nail and no black at base.
(b) Scaup	

Note: rarely, a drake Tufted Duck may have the black confined almost wholly to the nail, recalling a Scaup.

### Conclusions

At the present time too much cannot be

written to warn observers of the identification problems posed by certain known *Aythya* hybrids, because even ornithologists with previous experience of both Scaup and Lesser Scaup have been misled by hybrids of these types. One expert who saw both the Sutton Courtenay and the St. James's Park 'Lesser Scaup types' and who was warned of this hybrid's diagnostic bill tip, still maintained that both were genuine Lesser Scaup. It is all too easy for observers with many years experience to talk themselves into wrong identifications.

It seems that in the case of the Sutton Courtenay bird, the weight of opinion was in favour of a Lesser Scaup rather than a hybrid, which was symptomatic of the rarity hunter outlook. In our opinion the Nature Conservancy were entirely right to issue the licence to collect the Sutton Courtenay bird, but some of the confusion and uncertainty over this and similar birds referred to by Nicholson (1961) could have been resolved had the bill characteristics been better understood.

As knowledge on *Aythya* hybrids accumulates, it is clear that a number of their field characters are variable, so that no identification key could be relied upon to separate them from the species they closely resemble. We feel that for the time being the following precautions should be observed:

1. No sight record of a Lesser Scaup should be admitted to the British List, unless it is a fully adult male showing every field characteristic of the species and seen for a long period at close quarters and confirmed by several waterfowl experts. The same should apply to Ring-necked Duck records.

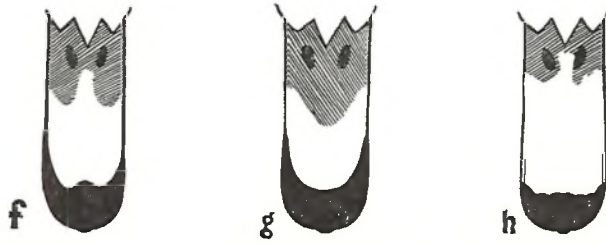
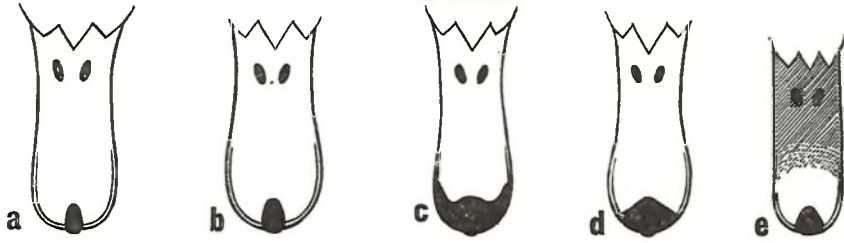
2. More caution should be exercised over the acceptance of Ferruginous Duck sight records. Only fully adult drakes showing all field characters should be dealt with on a county basis. Females and males in other plumages should be considered by experts.

3. Single adult Scaup among Tufted Duck and Pochard flocks well inland, where the Scaup is always a rare visitor, should be treated with suspicion and should be confirmed by experts. Immature Scaup in such localities are essentially an expert's province.

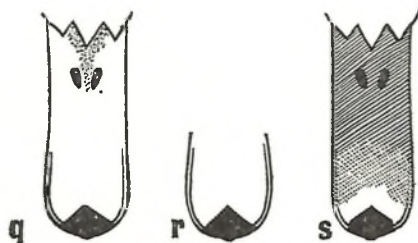
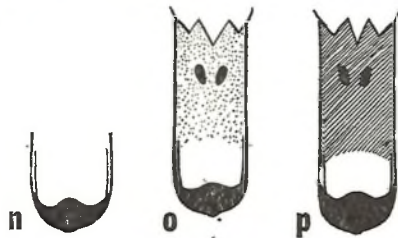
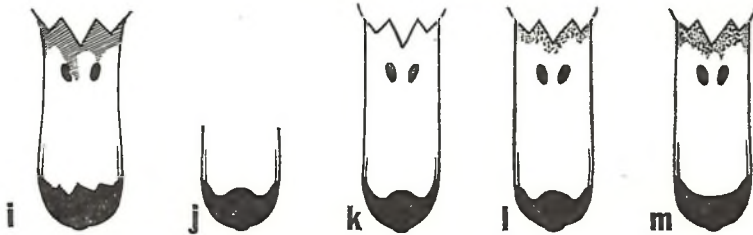
This paper shows the value of co-operation between the museum worker, the wildfowler, the field observer, the photographer and the aviculturalist.

# AYTHYA BILL CHARACTERS

## SPECIES



## HYBRID TYPES



### Figure 1. Key to diagram of *Aythya* bill characters:

- Species:* (a) Lesser Scaup; (b) Scaup; (c) Tufted Duck (after Perrins, see note 1); (d) Tufted Duck (after *Handbook*, and from life); (e) Ferruginous Duck (from life); (f) Pochard (from life); (g) Pochard (after *Handbook*, and from life); (h) Pochard (after Perrins, see note 2).
- Hybrid types:* (i-m) 'Lesser Scaup type'; (i) Sutton Courtenay (after Perrins, see note 3); (j) Sutton Courtenay (from skin and photograph in *British Birds*); (k) St. James's Park bird; (l) a Wildfowl Trust bird, April, 1962; (m) a Wildfowl Trust bird, March, 1963 (after Matthews).  
(n) 'Pochard type' Bezzel's skin (tip only of bill); (o) 'Tufted Duck type' Harrison's bird (from life); (p) 'Ferruginous Duck type' Regent's Park and Harrison's birds (from life); (q) 'Scaup type' St. James's Park bird (from life, and photograph); (r) 'Scaup type' Sage's bird (tip only from photograph in *British Birds*); (s) 'Baer's Pochard type' St. James's Park (from life).

### Notes

1. Tufted Duck (c): in spite of close examination of over 1,000 adult drakes in full plumage, we cannot substantiate this type of bill tip in the Tufted Duck.
2. Pochard (h): this type of bill tip in adult drake Pochard in full plumage is unknown to us in spite of close examination of about 100 adult drakes.
3. 'Lesser Scaup type' (i): questionable whether tip is accurate.

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# The biology and relationships of the Torrent Duck

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## Summary

On the basis of field observations of five of the six described forms of Torrent Ducks, it is concluded that only a single species of *Merganetta* should be recognized, and that probably no more than three sub-species exist, *armata armata*, *colombiana* and *leucogenis*; *turneri*, *garleppi* and *berlepschi* are believed to represent variants of *leucogenis*. The genus *Merganetta* should either be placed in the perching duck tribe Cairinini or given separate tribal status and placed adjacent to the Cairinini.

Although the Torrent Duck *Merganetta armata* occupies a vast geographic range extending some 5,000 miles from the cordilleras of north-western Venezuela to Tierra del Fuego, the species' ecological distribution is limited to the torrential streams that originate in the high Andes and flow downward into the major river systems of both the Atlantic and Pacific drainages. Its altitudinal distribution varies with latitude and local conditions, but the upper limits appear to occur at elevations where the streams become too small to provide adequate foraging opportunities, while the lower limits are probably determined by diminishing stream gradients, since the larger and slower rivers lack the falls, rapids, and emergent rocks which are the heart of the Torrent Duck's habitat requirements. It is not surprising, therefore, that few biologists have seriously attempted to study this remarkable bird, for in most parts of South America its favoured habitats can be reached only with difficulty, and even under the best of conditions the birds are never abundant and are usually extremely wary. As a result, much uncertainty has existed concerning the biology of the Torrent Duck, not only as to its ecology and behaviour, but also regarding the evolutionary relationships of *Merganetta* to other Anatidae and even as to the number of taxonomic sub-units (species or sub-species) within the genus.

Because of these several uncertainties, a trip to South America was made for the primary purpose of investigating as many as possible of the six described populations of *Merganetta*, comparing details of appearance, behaviour and ecology, and attempting to resolve at least some of the more obvious deficiencies in our knowledge of the Torrent Duck. This trip, from 4th July to 28th August, 1965, included stops in Colombia, Peru, Bolivia and Chile, where five of the six populations (all but the Argentine Torrent Duck) were observed. This paper is a summary of the

behavioural and ecological findings of the trip; the taxonomic problems involved are too great to allow anything more than preliminary conclusions at this time. This paper follows the taxonomic interpretation of Delacour and Mayr (1945) and Delacour (1954), which assumes a single species of *Merganetta*. It should be noted, however, that earlier authors accepted as many as five (Phillips, 1926) or six (Salvadori, 1895) species. Conover (1943), who undertook the only thorough specimen analysis to date, concluded that three species (*colombiana*, *leucogenis* and *armata*) and three additional sub-species (of *leucogenis*) should be recognized. He based these conclusions on the considerable differences in the male plumage patterns and on the well-marked geographic separation of the three major population groups, although the latter fact would today be regarded as an argument in favour of considering the forms as sub-species. Phillips and Salvadori regarded the Torrent Duck as a unique form, comprising the sub-family Merganettinae together with the genera *Hymenolaimus* and *Salvadorina* (= *Anas waigiensis*). Delacour and Mayr (1945) separated the genus in a monotypic tribe Merganettini, but Niethammer's (1952) anatomical study convinced Delacour (1954) that *Merganetta* should be included in the dabbling duck tribe Anatini. More recently, however, Woolfenden (1961) has urged that a tribal distinction for *Merganetta* be retained.

## Appearance

In life the Torrent Duck is a singularly beautiful bird, without close similarity to any other anatid with the possible exception of the Salvadori's Duck *Anas waigiensis*. Both species are slim-bodied and long-tailed but, while the Torrent Duck's rectrices are distinctly stiffened and slightly decurved and are used for support when climbing on slippery rocks, this adaptation is lacking in the Salvadori's Duck. However, both species doubtless use their long tails for underwater manoeuvring.

<sup>1</sup> Studies (No. 374) from the Department of Zoology and Physiology, University of Nebraska, Lincoln. Drawings by the author. Photographs in Photographic Section I.



Another unusual feature of the Torrent Duck which is barely indicated in Salvadori's Duck is the presence of a bony spur at the carpal joint, or 'wrist'. Adults of both sexes exhibit this feature, although the spurs are longer on adult males. Unlike the similar spurs of the Spur-winged Goose *Plectropterus gambensis* they are not extensions of the radial bone (Rand, 1954), but rather are somewhat flexibly attached to the first metacarpal. The use to which these spurs are put is still questionable, since through its habitat preference the Torrent Duck is well protected from most terrestrial predators, and no intraspecific fighting among males has been noted to my knowledge. There is no evidence that the spurs are used as an aid in climbing rocks, as has been suggested.

Females of all the populations are similar in appearance, and are a rich ochraceous brown below the grey above, totally lacking the barring of typical female dabbling ducks. The Colombian race differs from the others slightly in that the grey of the head and neck does not extend so far downward, and the body colour may be slightly paler. When swimming, females are often very difficult to see, since only the grey dorsal surface is visible, but when perched on a rock the richly toned brown flanks and under-parts are most conspicuous. As in males, the bright red bill is also highly conspicuous.

Males, unlike the females, differ markedly in different populations, and these plumage variations have been the basis for taxonomic discriminations. In all populations, however, the head patterning is very similar; a black ocular stripe extends back from the eye to the occipital region where it branches and continues down the sides and back of the neck.

This stripe does not actually merge with the crown stripe that extends back from the base of the bill (see photo section), although in the Chilean Torrent Duck the black striping extends down from the eyes and merges with a black throat and neck. This general increase in melanism toward the south is accompanied by a darkening of the legs from a bright carmine similar to that of the bill in the Colombian race to a dusky red, and a blackish culmen area also appears on the red bill in the more southerly forms.

Body plumages of the males differ greatly between populations, and have caused much taxonomic confusion. The Colombian race (*M. a. colombiana*) exhibits the least melanism, having the breast and under-parts nearly a pure white, with only light grey striping, and the edging of the mantle feathers is a light brown. The

Peruvian race (*M. a. leucogenis*) is more distinctly striped below, although at least in eastern Peru near Lake Junin there is distinct variation in the degree of mantle and under-part patterning (Phillips, 1926). In the Cuzcan Andes the Turner's Torrent Duck (*M. a. turneri*) reputedly has the most uniformly dark body of all the races, with black flanks and breast, and black mantle feathers that are brown-edged. However, of at least eleven different males seen by me in the Cuzco area (three skins, eight or more different wild males observed closely), only one bird was almost as dark as the type specimen (illustrated in Phillips, 1926). The remaining birds varied greatly, but most of them could not be readily distinguished from *leucogenis* males (see photo section). These variations in bodily melanism must certainly have minor genetic significance, since the darkest male observed was found in Huarcocondo canyon, where at least four other lighter-coloured males were resident in a six kilometer river distance. In Bolivia (*M. a. garleppi*) the males likewise very closely approach typical *leucogenis*, supposedly differing from it in having white, rather than brownish, edging to the mantle feathers. However, this distinction did not apply to four males observed closely (one of which was collected) on the Río Zongo. Although I did not observe the Argentine race (*M. a. berlepschi*), it is known that males are highly variable in their under-part colouration (Dabbene, 1927). This race is also reported to possess white edging on the mantle feathers, which, if true, would help to distinguish it from *leucogenis*, and suggest some affinities with the Chilean race (*M. a. armata*), although there is a considerable geographic gap between these populations (Johnson, 1963). This last race is the most distinctive of all, with definitely white-edged mantle feathers, brown flanks, and black under-parts extending up the throat to the bill and eyes. In short, it would appear that there exists a light-coloured and fairly uniform northern population (*colombiana*), a melanistic and fairly uniform population (*armata*), and several highly variable intermediate populations with varying degrees of under-part melanism and white to brown mantle edging. Conover (1943) recognized this intermediate group as a distinct species (*leucogenis*) consisting of four sub-species, but considering the individual variation I observed in the Cuzco area and reported elsewhere by Dabbene and Phillips, I would suggest that only a single race, *leucogenis*, should be recognized. Besides the marked gap separating this central group from the Chilean

race, there is probably also a gap in northern Peru and Ecuador separating it from *colombiana* (Conover, 1943).

This unusual degree of individual and sub-specific male plumage variation is unique among ducks, and deserves some attention. It would seem that the absence of closely related, sympatric forms would reduce selective pressures for male uniformity to ensure species recognition by females, and would provide at least a partial explanation for this variability. More important, the fact that Torrent Ducks are confined in their movements within river systems, and may be completely isolated from adjoining populations by lack of connecting river drainages, would tend to result in much local genetic variation. Finally, Torrent Ducks appear to be highly sedentary and monogamous, with relatively permanent pair bonds, further reducing gene flow and increasing variability even within potentially interbreeding populations.

#### Environmental Conditions

As suggested above, water conditions are of critical importance in determining Torrent Duck distribution. In every location where Torrent Ducks were found, the river could be characterized as having rapids and falls (up to 20 feet high), interspersed with stretches of more placid water. The width of the river appeared to be of little importance; ducks were observed on high mountain streams no more than six feet across (e.g., near Pisac, Peru), as well as such streams as the Río Petrohué, which is over 200 feet wide. All, however, had numerous slightly submerged and emergent rocks which produced the falls, rapids, and pools that appear to be of crucial importance for Torrent Ducks. The surrounding vegetation appeared to be of no significance; Torrent Ducks were observed in such diverse vegetational zones as the moist alpine páramo of Colombia, the dry alpine puna zone of Peru, upper and lower montane rainforests of Colombia, coastal xerophytic desert of Peru, and temperate rainforest of Chile.

All of the rivers supporting Torrent Ducks were distinctly cold (the Río Chisbar had an average temperature of 12°C) and thus the water was capable of retaining much of the oxygen to which it is exposed when passing over falls and rapids. Such high oxygen tensions would clearly be of importance in supporting the aquatic animal life upon which the Torrent Duck is dependent.

The altitudinal distribution of *Merganetta* appears to be as varied as its ecological distribution. In Colombia Tor-

rent Ducks were found between the elevations of 1,500 and 2,500 meters on the Río Cauca, Río Chisbar, and Río Grande, near Popayán. However, Dr. F. Lehmann (pers. comm.) has observed them as low as 200 meters on the Pacific slope of the Farallones mountains, near Cali. In Peru we observed *M. a. leucogenis* on the Río Lurin above Santa Cruz de Luya, at approximately 2,000 meters, and Phillips (1953) found them on the nearby Río Cañete at 2,500 meters. Dr. Maria Koepche (*in litt.*) has observed Peruvian Torrent Ducks at altitudes between 800 meters (Río Chancay) and 3,600 meters (Quebrada Yanganuco, Cordillera Blanca). Near Cuzco we observed *M. a. turneri* along the Vilcanota, Urubamba river system from a point just above Yaucat (near Tinta, the type locality of *turneri*), at 3,386 meters, to a few kilometers above Machu Picchu, at about 2,040 meters. Chapman (1921) reports Torrent Ducks in the Urubamba valley at elevations of 9,100 feet (2,770 meters), 10,000 feet (3,050 meters), and 11,000 feet (3,350 meters). In Bolivia on the Río Zongo we observed *M. a. garleppi* from a short distance above Cuticucho station (2,697 meters) to a point two kilometers above the lowest accessible point, Chururaqui station, at 1,830 meters. Niethammer (1953) states that they are found between 1,200 and 3,600 meters in Bolivia, and Phillips (1925) reports that specimens have been taken as high as 15,000 feet (4,500 meters). In Chile, we found *M. a. armata* on the Río Tenó above Los Queñes, at 1,200 meters, and also on the upper Río Petrohué, at 160 meters. Mr. A. W. Johnson (pers. comm.) informs me that there is a definite latitudinal, altitudinal gradient of Torrent Duck distribution in Chile, and that in the extreme north *M. a. turneri* occurs near Arica (lat. 18°S) only at elevations above 4,000 meters. The Chilean race occurs at similar heights as far north as latitude 27°S, but that from that point south the birds occur at gradually lower altitudes, eventually reaching close to sea level in the provinces of Aisen and Magallanes.

As an indication of the typical stream gradients that support Torrent Ducks, a few examples might be mentioned. In Peru, the Huarcoondo canyon enters the Urubamba valley above Ollantaitambo, and the stream which flows through this canyon supports a good population of Torrent Ducks. From the village of Huarcoondo (3,320 meters) to Pachar station (2,800 meters), a distance of 19 kilometers, there is an average stream gradient of 27 meters per kilometer. The middle third of the canyon, from a point six kilometers below

Huarocondo to approximately six kilometers above Pachar station, supported at least five and possibly six pairs of Torrent Ducks during July of 1965, suggesting a maximum population of about one pair per kilometer. Mr. John O'Neill (*in litt.*) observed eleven Torrent Ducks in the lower thirteen kilometers of this canyon in January, 1965, indicating a similar population at that time of year.

In Bolivia, the Río Zongo provided another basis for estimating stream gradients suitable for Torrent Ducks. Between Cuticucho station and Chururaqui station there is a linear distance of nine kilometers, with an average stream gradient of 96 meters per kilometer, or four times as steep as the Huarocondo location. In this distance two pairs plus three additional males were seen, but owing to the impossibility of an adequate inventory of this precipitous and thickly vegetated canyon, many additional birds may have gone unnoticed.

Torrent Ducks are particularly abundant in the lake district of southern Chile (Johnson, 1963). We observed at least four males in a two kilometer stretch of the Río Petrohué, between Lake Esmeralda and the first extensive rapids. The Río Petrohué drops from an initial height of 180 meters to sea level in approximately 40 kilometers, with an average gradient of 4.5 meters per kilometer. However, Torrent Ducks are probably restricted to the upper portion of the river, where the gradient is considerably higher than this. Mr. Johnson tells me (*pers. comm.*) that the largest number of Torrent Ducks he has ever seen was at Los Queñies, where in the month of August he observed seven males and four females in an approximate ten kilometer river distance.

In summary, it would appear that Torrent Duck populations rarely exceed one pair per kilometer, and usually would be much less than this.

### General behaviour

By far the most impressive and unforgettable aspect of Torrent Duck behaviour is their incredible ability to negotiate the most impossible rapids, making headway upstream against an overpowering current, or turning and careening downstream through the tumultuous rapids, barely avoiding the rocks and nearly disappearing from sight amid the spray and froth. I have observed adults dropping over falls several feet high, particularly when they are attempting to escape danger. When not disturbed, however, they usually stop short of such falls, climb out on a rock, then fly down to the next stretch of calmer water.

While swimming, the body is often totally submerged, with only the head and neck visible as the bird moves up or downstream. When swimming upstream in very rapid water, both adults and young sometimes 'run' over the water surface in the manner of frightened fledgling ducklings. When frightened, a typical manoeuvre is to swim 10 or 20 yards upstream from the observer, then dive and be swept downstream by the current some 50 yards or more, finally emerging and flying away or continuing downstream with only the head above water. Although this is a typical adult response, we also saw two groups of downy young, no more than two weeks old, perform the same tactic. In one case they manoeuvred about 30 yards downstream through two stretches of rapids before emerging again. Although I was not able to ascertain this point positively, adults appeared to hold their wings open slightly when swimming under water, probably for steering purposes rather than propulsion. In general, birds took flight when frightened only as a last resort, usually flying no more than a few hundred yards before landing in the water again and generally hiding among the shoreline rocks. In three cases where pairs with downy young were found, the male conspicuously flew away from the group, often calling loudly. The females always stayed near the young and led them to shore where they hid among the rocks.

One remarkable and previously unnoticed escape device was observed that warrants description. In the Río Chongo, above Pisac, Peru, a pair had been under observation for several days and it was believed that the female might be nesting. On one afternoon the male was observed foraging alone in the river several hundred yards above the presumed nest site. At our approach he began to swim downstream, then turned and, swimming underwater, went rapidly back upstream to the base of a small waterfall about 2 feet high, and disappeared from view in the spray of the fall. The river was sufficiently shallow to see that he had not gone back downstream, and we concluded that he must be hiding at the base of the fall. To find out we threw several large rocks into the water near the point where he disappeared, but to no effect. We were about to abandon the search when the male suddenly appeared on a rock at the base of the fall, saw us, and disappeared again. This time we approached the fall, threw several more rocks into the spray, and even reached back into the recesses of the rocks as far as possible. Still failing to dislodge the bird, we began to walk away, whereupon the

male emerged flying from the very spot we had searched, moving downstream some 150 yards to the next waterfall of similar size. It landed just above the brink, swam over it, and again disappeared in the white water below. Later, in Bolivia, we observed a female with young hide in exactly the same manner after the young bird had retreated from us to the rocks on the opposite shore. In this case she remained hidden for over half an hour before she finally emerged and flew downstream to her mate, who had remained in sight during most of this time.

One difference in general behaviour of the Torrent Duck that sets it apart from such stream-dwelling species as the Salvadori's Duck and the Harlequin Duck *Histrionicus histrionicus* is the fact that Torrent Ducks do not 'nod' the head when swimming or walking as these species typically do. Furthermore, unlike the Salvadori's Duck, the Torrent Duck rarely raises its tail from the water and never cocks it vertically during normal swimming. When standing on a rock and watching some object in the distance or about to dive into the water, Torrent Ducks do frequently move their heads up and down, or from front to back, possibly as a distance-estimating technique. These may also serve as diving intention movements.

Torrent Ducks take flight without any obvious pre-flight movements or calls, and can spring out of a rapid torrent with the agility of a teal. They fly low over the water, rarely higher than 20 feet, and methodically follow the course of the river. While most flights are of short duration and only long enough to put them out of the observer's view, on one occasion we flushed a pair that must have flown at least three kilometers. This occurred on the Río Lurin, near Lima, and as we followed the birds upstream, we met several groups of natives who informed us that they had seen the birds fly past. Finally, some three kilometers upstream, we abandoned the search.

The wingbeats of Torrent Ducks in flight are unusually shallow and rapid, although the speed of flight does not appear to be great. On the basis of some short motion picture scenes, the rate of wing beats during sustained flight is about twelve per second.

#### Foraging behaviour and food

The foraging of Torrent Ducks is no less remarkable than their escape behaviour. Typically the birds forage from a large, rounded rock near the middle of a stream, from which they repeatedly dive. When

diving the bird usually drops head-first directly into the current in front of or beside the rock, and completely disappears from view until it suddenly appears scrambling up the smooth rock surface near the point where it entered the water. In Chile on the Río Petrohué some measurements of diving and resting times were taken of a male foraging in the fastest rapids of this then-raging river. During a period of 3 minutes and 22 seconds the male made seven dives, ranging in length from 12 to 18 seconds (average 16.0), and rested on a rock for seven periods ranging from 9 to 18 seconds (average 12.6). I estimated the surface velocity of the river at that point to be approximately 10 feet per second; thus, a bird simply maintaining its submerged position in the water for 16 seconds would have to perform the equivalent effort of swimming 160 feet underwater! The repeated performance of this feat would appear to be almost impossible, and thus I believe that during these dives the bird must go directly to the bottom, foraging upstream along the river floor where the water velocity is greatly reduced, and then returning to the surface at nearly the exact point of entry.

Three other methods of foraging were observed. At times the birds would swim on the surface, with only the head submerged and directed upstream, apparently picking up food as it was swept past in the current. An extension of this method was to be almost totally submerged except for the tail, feeding in the pools and eddies behind large rocks. Finally, a bird would sometimes swim to the foot of small fall a foot or two high, crawl behind the main flow of water, and probe among the rocks with the bill as the water flowed over its back and head in an almost unbroken sheet.

It is clear that Torrent Ducks rely largely on food of animal origin, judging from published records. Niethammer (1952) noted that three Bolivian and one Peruvian Torrent Duck he examined contained almost entirely stone-fly and caddis-fly larvae. A nesting female Colombian Torrent Duck collected by Holman, near Cali, contained caddis-fly larval cases, and three Peruvian Torrent Ducks collected by Lord W. Percy near Lake Junin contained primarily larvae of caddis-flies and mayflies, with only a trace of vegetable materials (Phillips, 1926). Pemberton (in Phillips) reported that in southern Argentina the Torrent Ducks ate 'mollusks including gastropods', while Conover found that two collected in the same general area contained insects and their larvae.

Although it has not been reported in the

literature, it is possible that at least in some areas small fish may contribute to the diet of Torrent Ducks. Dr. F. C. Lehmann tells me that biologists in Bolivia report considerable damage to planted trout fingerlings by Torrent Ducks. In Peru we were told by a local hunter who knew the birds well that one male he had shot in March had a full crop of 'sardine-sized' fish. I examined the male we collected on the Río Zongo, and found that the gizzard contained only well-ground vegetable matter and a few very small stones.

It is worth noting that, except in Chile, we never failed to find the White-capped Dipper *Cinclus leucocephalus* on every stream where we found Torrent Ducks. Indeed, the best 'indicators' of Torrent Ducks proved to be the presence of Dippers and white droppings on the larger rocks in the rivers. Since the quantity of droppings produced by *Merganetta* is considerably greater than that of *Cinclus*, it was a simple matter to distinguish them. In Chile, however, we were south of the Dipper's range, and the winter rains quickly washed away droppings on the rocks, so that we were not able to use these clues. In any case, it is probable that Dippers and Torrent Ducks have nearly identical habitat requirements and probably are dependent on the same sources of food.

### Breeding Seasons

Although very few Torrent Duck nests have been found (two of the Chilean race and two of the Colombian race are known to me), it is possible to make a few observations about breeding periodicity. On the Río Chisbar near Popayán, 11th July, we found a pair with two young less than a week old. We were told by natives that two other pairs with young of similar age were seen a few days previously on the Río Blanca, near Paletara. Conover (1943) reports downy young of this race taken in October, eggs taken in November, and immatures taken in January, March, April and September. Thus, it is clear that the breeding season in Colombia is a very extended one, as might be expected near the equator.

In the Cuzco area of Peru, Chapman (1921) reported a pair with two downy young in Huarcocondo canyon in late July. On 26th July we located two pairs with downy young in this same canyon. One of the broods, with two young, was estimated to be no more than two weeks old, while the other brood of three appeared slightly older. We also had reason to believe that a female on the Río Chongo, near Pisac, was nesting at this time. These sightings would suggest that breeding in

the Cuzco area occurs during the dry season.

In Bolivia, Niethammer (1953) reported collecting a pair of Torrent Ducks with enlarged gonads near Pojo in early August, leading him to conclude that the ducks breed prior to the rainy season, when the water is clear and not flowing too swiftly. Our observation of a pair on the Río Zongo with a single downy young (two or three weeks old) on 3rd August, supports this view, although the male we collected only ten kilometers upstream had inactive testes.

It is clear that in Chile and southern Argentina seasonal temperature variations are of greater importance than farther north, and that breeding occurs during the southern spring. Johnson (1963) found a nest in an old burrow of the Southern Ringed Kingfisher *Megaceryle torquata stellata* with three nearly fresh eggs at Llifén, on 11th November. He has also observed (pers. comm.) broods somewhat later than this, usually numbering two or three young, but as many as five (twice). Therefore, the nesting season in Chile occurs at the end of the wet winter, and young emerge during the mild and relatively dry spring.

Judging from our observations of four broods in Colombia, Peru and Bolivia, no specific brooding habitat requirements exist. However, in two cases the brooding area was bounded below by fairly steep canyons and high falls, which perhaps represented the original nesting sites. Likewise, the presumed nesting area near Pisac, Peru, was a steep-walled canyon with falls and rapids both above and below. Both of the broods found in Huarcocondo canyon were seen on or near low, rocky islands on which shrubs and low trees were growing; presumably these islands served as relatively safe resting and sleeping areas.

### Vocalizations

Previous accounts of Torrent Ducks have offered little information regarding vocalizations, which is not surprising considering the problems of hearing calls above the noises of rushing water. Scott (1954) reported a call, described as a 'keech', uttered by Bolivian Torrent Ducks repeatedly when the birds were nervous, and Niethammer (1952) mentioned a shrill whistle uttered by the male and possibly also the female.

We heard vocalizations from males of the Colombia, Turner's, Bolivian and Chilean races. In all these races the calls appeared identical, and most commonly consisted of a sharp, clear whistle, dropping

slightly in pitch toward the end. This was uttered at several second intervals by males to other males, their mates, or their families, apparently as a warning note. It was usually uttered as the bird stood on a rock, but was also produced by swimming and flying birds. On one occasion, on the Río Chongo, the male swam up the canyon in which we believed his mate to be nesting, uttering a series of eight to ten soft and rapidly repeated whistling notes. At this time the female remained hidden, but on the next day when the same call was given, the female emerged from the rocks above the river and joined the male, then both flew downstream together.

We did not hear any definite calls from females, but Mr. H. Lüthi (pers. comm.) heard an unusual sound from a group of four Torrent Ducks (two pairs) in May. This was a rough, guttural sound, prolonged and on the same pitch, which may well have originated from the females. Mrs. A. W. Johnson (pers. comm.) remembers that when they captured a nesting female it uttered a high and strange squealing note, quite different from the usual calls of female ducks, and that only once did it produce anything resembling a 'quack'. Mr. Johnson also recalls hearing a 'weak quack' from this bird.

The 'lost' calls of the downy young, which we heard on several occasions, are single-noted peeping whistles, much like the distress note of downy Mallards *Anas platyrhynchos*.

#### Pair bonds and social behaviour

In contrast to most ducks, the Torrent Duck does not appear to be gregarious and has never been reported as occurring in flocks. This solitary nature may simply be a reflection of limited food supplies and the sedentary tendencies of the species, although some altitudinal movements may occur at various seasons. We observed birds almost exclusively in pairs or presumed pairs; the only exception occurred in Chile, where no females were observed. However, according to Johnson (1963), female Chilean Torrent Ducks become much less conspicuous in winter than males.

There can be little doubt that Torrent Ducks are monogamous and have relatively permanent pair bonds, which would explain the greatly extended breeding season in northern South America, and might possibly allow for more than one brood per year. This prolonged pair bond would also account for the lack of an 'eclipse' plumage in males. Other South American species which are similar in this latter regard are the Ringed Teal *Callonetta*

*leucophrys*, Brazilian Teal *Amazonetta brasiliensis* and Chiloë Wigeon *Anas sibilatrix*.

There is little opportunity for contact between Torrent Ducks and other waterfowl under most conditions. We observed at least three pairs of Sharp-winged Teal *Anas flavirostris oxypterus* in Huarcocondo canyon and the adjacent Urubamba River, occupying relatively calmer stretches of these rivers. In southern Chile there may be occasional contacts with the Bronze-winged Duck *Anas specularis*, although we did not encounter this species.

#### \* Sexual behaviour and displays

The published observations of Phillips (1953), Scott (1954) and Johnson (1963) comprise the sum total of previously available information of Torrent Duck displays, and these three accounts show remarkably little similarity. Undoubtedly, the fact that pair bonds are relatively permanent largely accounts for the rarity with which display has been observed in this species, and thus it might be expected that most displays serve in maintaining, rather than establishing, pair bonds. The absence of sympatric, closely related species also reduces the need for elaborate pair-forming displays.

Of the available accounts, Scott's (1954) appears to be the one which most probably represents pair-forming display in Torrent Ducks. His observations on the Bolivian Torrent Duck, made in late March, were of a group of two females and three males. The male displays he describes show no similarities to those of typical dabbling ducks or any other anatids, but such singularity in male pair-forming displays might be expected.

Phillips' (1953) accounts of display in the Peruvian Torrent Duck were obtained during January on the Río Cañete. He describes seeing a male on a rock 'bowing deeply and at the same time pushing the tip of its tail upward to a height exceeding that of its vertically extended head and neck. The entire action appeared to be pendulum-like, with the feet serving as inverted fulcrums. After each such four- or five-second performance, it would resume its normal stance which was marked only by an occasional turn of the head. It would then advance 6 to 12 inches and perform again.' A female was later found to be standing on part of the same large rock.

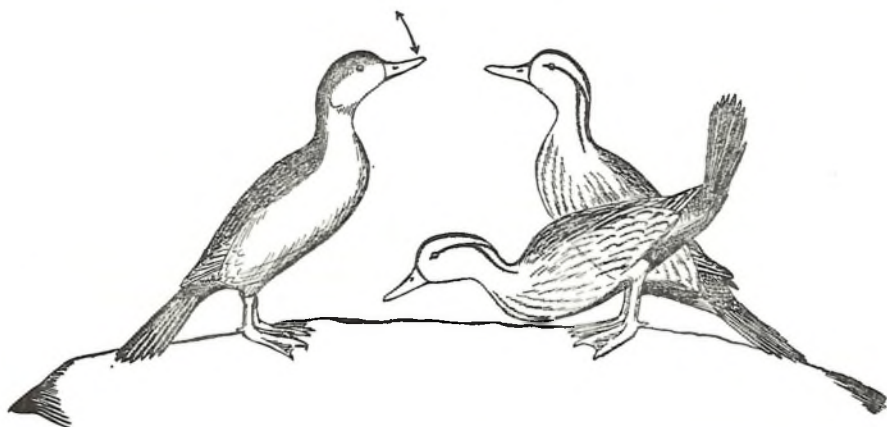
Wright (1965) has recently reported on some apparently aggressive behaviour he observed in Peruvian Torrent Ducks. He describes two drakes facing one another in a stiffly upright posture, with the body, neck and head all held nearly vertically.

While in this upright posture the males rhythmically bobbed their heads and remained about half a meter apart, in the presence of a single female. One male finally flew away, while the other remained with the female.

My own observations of display were made on the Colombian and Chilean races, and are remarkably similar to those of Phillips. On 8th July on the Río Grande, we watched a pair of Torrent Ducks foraging some 100 yards away. The male soon climbed a large rounded rock, and was shortly joined by the female who stood within 2 feet of him and facing him. She stood quite erect, with her tail propped on the rock, and began to perform rapid vertical bill movements toward him. The male, also standing erect and facing the female, suddenly began a series of increasingly strong downward and forward thrusts with his head, each one more pronounced than the one before, until his bill nearly touched the rock, and with each thrust raising his hindquarters and cocking his tail (see accompanying sketch). After

On 19th August, on the Río Petrohué in Chile, I observed what clearly was the same display. In this case a male performed the display apparently to another male which had just flown off the rock. In this instance the male preceded the display by standing very erect and nearly motionless for several seconds, and followed the display with the same rapid wing-shaking movement that was observed in the Colombian race. In both instances the distances were too great to photograph the activity or to determine whether any calls were associated with it. It is significant, however, that the same display should occur in the three populations which represent the most morphologically distinctive forms, indicating that the taxonomic interpretation of a single species of *Merganetta* is a reasonable one.

Although no female was definitely present in the last encounter mentioned, I believe that this is basically a pair-maintaining display, and thus is probably a basic and important display in the species. It is similar in form to the mutual



about six of these fairly rapid, teeter-totter movements the bird assumed a normal posture, appeared to shake his wings, and repeated the sequence. At least four such sequences were performed in a half minute or less. The female responded to the male with much less conspicuous vertical head movements. Both birds then jumped into the water, swam downstream through several series of rapids, and resumed foraging. A few days later a less elaborate version of the same display was observed in another pair. In this instance as a male approached a resting female on a large rock, he made several 'bowing' movements without cocking the tail, then sat down beside her and tucked his bill under the scapulars.

displays of such perching ducks genera as *Cairina* and *Pteronetta*, although in these forms there is no tail-cocking associated with the head-thrusting movements (Johnsgard, 1965). In these species the display occurs in 'triumph ceremony' situations as well as during aggressive encounters.

Of all aspects of behaviour, none is more uniform within taxonomic groups and more indicative of evolutionary relationships than that associated with copulation. Although I did not witness such behaviour, a detailed account has been provided by Johnson (1963) for the Chilean Torrent Duck. Precopulatory behaviour consisted of the two birds swimming round each other, making repeated bill-snapping and thrusting movements of the head, as if

catching flying insects, and mutually rising in the water in a grebe-like manner. Similar mutual thrusting movements occur during precopulatory display in some perching ducks (*Aix galericulata* in particular), but the grebe-like posturing appears to be unique among the Anatidae.

#### Evolutionary relationships and taxonomic conclusions

It appears that Torrent Ducks have little or nothing in common with typical dabbling ducks in their sexual behaviour patterns, and may more closely approach the perching ducks in this regard. Some aspects of their general behaviour, such as their hole-nesting, apparently reduced female vocalizations, and obvious climbing and perching abilities might also suggest affinities with the perching ducks, but the possibilities of evolutionary convergence must be carefully considered here.

Niethammer's (1952) conclusion that the sternum and trachea of *Merganetta* indicate dabbling duck affinities appears to be an over-simplification, since Woolfenden (1961) reports numerous unique skeletal features of the genus which are not suggestive of this relationship. The tracheal bulla has the same general configuration as that found in the dabbling ducks, perching ducks, and shelducks, but it is no more similar to that of *Anas* than, for example, is that of *Pteronetta hartlaubi*.

If the distinct morphological similarities between Torrent Ducks and Salvadori's Ducks are simply the result of convergence, then inclusion of *Merganetta* in the tribe Anatini is certainly not warranted. Unless a separate tribe Merganettini is

recognized I would favour including *Merganetta* in the perching duck tribe Cairinini.

The fact that at least the Chilean, Peruvian and Colombian forms of Torrent Ducks possess identical head-thrusting and tail-cocking displays may be regarded as evidence supporting the view that only a single species of *Merganetta* should be recognised. Further, because of the unusually great male plumage variation occurring in Peru, Bolivia and northern Argentina, I believe that the races *turneri*, *garleppi* and *berlepschi* should not be recognised, and that the entire population from northern Peru to the Tucumán area of Argentina should be regarded as *M. a. leucogenis* until a more thorough study of these regions can be made. This procedure would also avoid the present inexplicable situation of four alternately light-bodied and dark-bodied races geographically replacing one another in a north-south direction.

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# The process of family disintegration in Black Brant

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## Summary

A study of family behaviour in Black Brant in Izembek Bay, Alaska, in the fall of 1965 revealed that family groups arriving in migration from the nesting grounds disintegrate before resuming the migration southward. Birds arrived in flocks of non-breeders or of family groups and after family disintegration departed in flocks of random mixture.

Students of wildfowl have long observed the existence of family groups in geese and swans. The present authors studied family behaviour and groupings in Black Brant *Branta bernicla orientalis* while conducting age group counts as described by Jones (1964) on the Izembek National Wildlife Range in Alaska. The age group counts have become a regular function on the Wildlife Range, and have been expanded not only in numerical size, but in the complexity of population analyses. This time a minimum of 30,000 observations was deemed necessary to fulfil planned studies. We sought to apply the methods of Lynch and Singleton (1964) for developing annual productivity data as a check on our own, but achieved little success. Brant decoying to a feeding or resting flock in Izembek Bay approach at low elevations and pitch into the water without ceremony. There is rarely an opportunity to identify families in flight except when the family flock is by itself. Moreover, Brant movements in Izembek Bay tend to be on such a large scale that groupings of near birds are obscured by those behind.

In Izembek Bay there are no emergent aquatics so the observer has a clear view of flocks resting on the water. Most of our observations were of such flocks, although we often followed identifiable family groups after they flew from the water. We employed good quality, tripod-mounted telescopes from a firm base on the beach. Usually a 20 power eyepiece gave the best results, but occasionally we found a 30 power useful. Wind is the limiting factor in choice of high power lens. We rarely worked in calm, and as motion of the telescope is amplified by the power of the instrument, the choice turned on how much motion could be tolerated. Lighting conditions regulated our ability to identify plumage characteristics accurately, the worst conditions occurring when direct sunlight glared on the water.

Compiling the age group counts is the major enterprise on the Wildlife Range during the time the Brant are present, which this year (1965) was from 1st

September to 15th November. In the final tally we recorded some 34,000 observations, of which these authors compiled almost half. Because these observations entail a goose-by-geese analysis of plumage characteristics, a splendid opportunity was offered to study behaviour.

We set out to look for social groupings, of which the basic unit is the family. Members of family groups fly together, swim and feed together, and defend their bit of space together. Brant arriving from the north were in flocks of family groups and flocks of non-breeders. The age group counts revealed a tendency of non-breeders to reach Izembek Bay earlier than the reproducing adults and juveniles. In the counts prior to 20th September the percentage of juveniles was low, starting at about 10% and rising to the final 22.1%. Though it is not always possible to see the final big influx of birds, the quantitative data of the counts leaves little doubt. By 20th September the population of Brant was disposed in (1) flocks entirely of family groups and (2) flocks almost exclusively of non-productive birds. The family group flocks were relatively small and yielded high counts of juveniles while the non-producers gathered in much larger flocks almost devoid of juveniles (see Table I). The latter exhibited a placid disposition and little social interaction.

The flocks of family groups, however, were easily excitable and quarrelsome. They scrambled into flight at the approach of an airplane as well as an avian predator. The most common of these in Izembek Bay is the Bald Eagle, *Haliaeetus leucocephalus*, the approach of which puts all species of geese to flight. Aircraft have the same effect on Brant as long as the family groups are intact, but later, following family group disintegration, only low flying aircraft disturbed the large amorphous flocks that then form.

Family groups in Izembek Bay are readily distinguishable and offer the classic form of two adults plus one to five juveniles. Four and five young in Brant families are rare indeed, but we do observe such families

**Table I. Age group counts of Black Brant in Izembek Bay, Alaska, in 1965.**

Date	Adults	Juveniles	Total	% Juveniles
September				
3	190	30	220	13.6
13	1012	232	1244	18.6
14	35	36	71	50.7
15	1316	59	1375	4.2
20	307	177	484	36.5
23	345	232	577	40.2
24	921	310	1231	25.2
27	313	73	386	18.9
28	427	241	668	36.0
29	201	59	260	22.6
30	665	217	882	24.6
October				
4	3320	587	3907	15.0
6	1740	430	2170	19.8
7	1055	317	1372	23.1
8	1456	405	1861	21.7
9	1220	257	1477	17.3
10	2	4	6	Disregarded
13	1966	418	2384	17.5
14	669	276	945	29.2
15	865	313	1178	26.5
18	3052	887	3939	22.5
19	950	283	1233	22.9
20	2738	833	3571	22.2
21	2025	568	2593	21.8
	<u>26790</u>	<u>7244</u>	<u>34034</u>	<u>21.2</u>

occasionally. Single adult families and orphans are unusual because hunting mortality is small to this point. Sometimes a third adult attaches itself to a family group for a short while but this condition is transient. Hanson (1965) suggests that yearling Canada Geese sometimes rejoin the family following hatching of a new brood, but we have no single example of additional permanent adult-plumaged birds with the family group in Brant.

We observed little strife in flocks consisting of two or three family groups, but in the larger aggregations with the enhanced opportunity of invading another family's space, hostile encounters were common. Except in rare cases these encounters seemed purposeful, at first to maintain the integrity of the family group, but later to insure its dissolution. Competition for food does not occur in Izembek Bay. The most extensive eelgrass beds in the world (McRoy, 1965) constitute the food resource of the Izembek Range.

On the order of 16,300 hectares (or 40,260 acres) (McRoy, 1965) these eelgrass beds furnish food for the entire population of Black Brant (currently estimated at about a quarter million), a population of Pintail *Anas acuta* considered to be at least equal in size to that of the Brant, roughly 100,000 Lesser Canada Geese *Branta canadensis parvipes*, and

about 40,000 Emperor Geese *Anser canagicus*. McRoy (1965) has calculated eelgrass utilization by 300,000 geese for 60 days to represent 1.2% of the existing summer standing stock. Hence the birds are never in competition for food.

In the rare cases where hostile encounters seemed purposeless we ascribed the 'bully' role. These were cases of an adult bird (never a juvenile) swaggering through a family-group flock making unprovoked attacks to right and left. Some of these attacks drew hostile rejoinders, but more often the birds just moved out of the 'bully's' way. The senior author observed this type of hostile encounter while attempting to capture Brant in 1952 with a projection net.

Hostile encounters were executed on the water or on land but we have no record of any occurring while the flock was in flight. An attacking bird thrust its head and neck forward and with the bill opened rushed at its opponent. The opened bill suggests that a call accompanied the attack. This may also be an identification posture, since we have noted the apparent hostility-posture employed in situations where it was not directed to an adversary. Instead the posturing bird would receive an answering posture from another bird some distance away, whereupon they would join and go off together. Frequently this was

the means by which a family member regained its group. We also observed this in Lesser Canada Geese when mingled with the Brant.

While the family integrity is maintained there seems to be a role differentiation in the adults. One takes the lead while the other brings up the rear, evidently spurring lagging juveniles to keep with the group. These roles do not appear interchangeable, except when the group is not travelling in a given direction. The flocks as a whole may swim consistently in one direction or 'mill' in one area. In the latter case continuity of observations is difficult to maintain. The Brant feed as they swim, or walk when the eelgrass beds are exposed at low tide. As the fall advances, more and more leaves are sloughed from the plants and these float. The Bay is quite filled with floating eelgrass leaves and many dense mats form. This grass tends to form in windrows along which the Brant swim while feeding. The flock thus strung out offered optimum conditions for our purposes. While observing social behaviour we recorded many of the comfort movements described by Weller (Delacour, 1964). Somersaulting in the water while bathing was one of the more obvious of these, and we repeatedly noted sleeping birds swimming with a feeding flock. They seemed to experience no difficulty in keeping position in the moving flock even though their head was thrust under the closed wing.

We detected no cohesion in flocks without family groups. A flock of adult-plumaged birds arriving together from a flight did not remain together. The average time we could maintain such a group under observation was about 20 minutes. In this time non-family groups merged with the big flock and when they took flight the small flocks were composed of different individuals. We saw many examples of what we considered pairs, and these remained together.

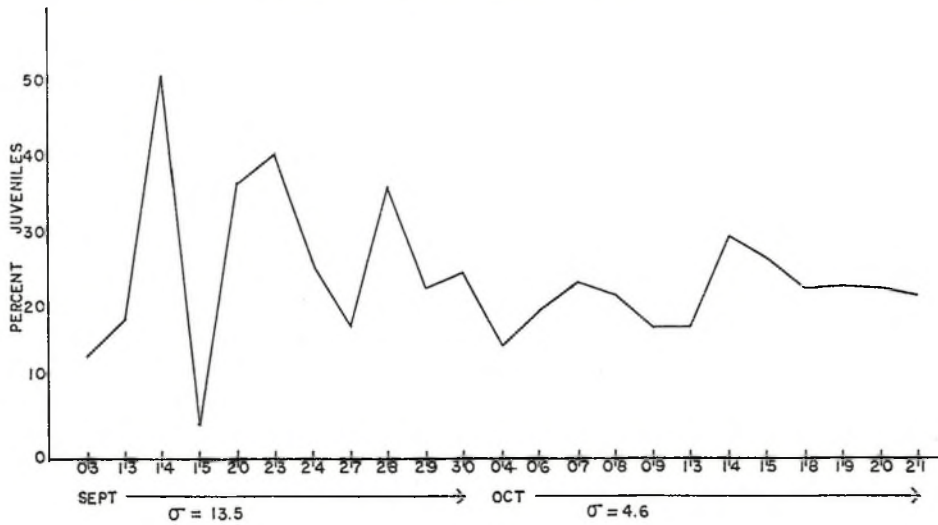
Non-family flocks decoying to a family-group flock did not alight with the latter. In many instances they alighted nearby and swam away but more often, after determining the nature of the flock, flew elsewhere. This trait is quite striking. We observed single birds and small flocks veer sharply off course to decoy to a family-group flock, then veer just as sharply back in the direction they had come. We observed small numbers of family groups associated with the large non-family flocks but these groups were always on the periphery.

In a letter dated 16th November, 1964, T. W. Barry of the Canadian Wildlife Service wrote, 'The banding data (of Brant) seem to show that the young tend to separate out on the wintering ground.' He suggested the process might begin on the Izembek Range. Our observations show that the process does indeed begin here and at least this year was completed before departure of the birds. The southward migration of Brant and Canada Geese from the Izembek Range depends upon atmospheric pressure patterns that develop westerly winds blowing all the way across the Gulf of Alaska. When the birds have accumulated sufficient fat and protein reserves to be ready for the flight, suitable pressure patterns will initiate the migration. The earliest migration recorded since 1948 is 21st October and the latest (this year) is 14th November.

In September, when we made our first observations of family behaviour, we recorded no examples of juveniles unattached to family groups. Between 23rd September and 18th October, the degree of interaction in these flocks clearly increased, and so did the disposition to fly at the approach of an airplane. The increased interaction manifested itself in more frequent hostile encounters, including one involving two entire families. The most common encounters at this time occurred between adults and juveniles. We first regarded this as an action to defend the family space, but an alternative possibility was suggested when it became apparent that the family groups were losing their identity. The possibility is that the parents were themselves forcing the dissolution.

The first unattached juvenile was observed 13th October. On this same date a group of two adults and three juveniles with differing plumage development was noted. One juvenile had a fully developed white neck band, the second had none, and the third showed a band in intermediate development. This we concluded was not a family group which, with the observation of unattached juveniles, suggested that the group structure was changing. The number of unattached juveniles rose from this date until 18th October, by which time the process was essentially complete. As the family groups disappeared there was a decrease in irritability. When the dissolution was complete, the population was disposed in a relatively few very large flocks in which all age groups were represented. In these flocks hostile encounters were rarely observed and the flock was not disturbed by the approach of an airplane.

**Figure 1. Percent juvenile Black Brant in age group counts showing changes in flock composition with family disintegration.**



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# Field studies on the Harlequin Duck in Iceland

SVEN-AXEL BENGTSON

## Summary

A five-year study of a breeding colony of about 50 pairs of Harlequin Ducks on the River Laxá near Mývatn, north-east Iceland, has added some numerical data on breeding behaviour, chronology and output to the meagre published information. The Harlequins return from the coasts to the breeding river at the end of April and begin to lay from the middle of May. The interval between eggs is normally 2-4 days. Most eggs are laid in early June. The average clutch on the Laxá is 5.5 eggs. Many eggs are collected (quite legally) by man. The Mink is probably the next most important predator. In recent years the ducks have increasingly nested on the banks of small remote streams instead of on islands in the river. Duckling survival is relatively high, with losses of about a third in the first week but few later. The males desert the females early, moving away from the nesting area, and play no parental role. The social and sexual behaviour in May, June and July is described. Territorial behaviour is most apparent in areas where pairs are scarce. Visual displays are probably less important than vocalizations. Feeding activity, described in detail, shows a diurnal rhythm, with greatest activity around 8-9 p.m. and 5 a.m. Harlequins are far more efficient divers in a fast-flowing river than other ducks. On the coast in winter they are much more gregarious and active than in summer.

## Introduction

Throughout its breeding range the Harlequin Duck *Histrionicus histrionicus* lives an inconspicuous life often in rough mountainous areas far from civilization. This is the main reason for our lack of detailed information on its breeding biology. A characteristic feature of the life of the Harlequin at its breeding grounds is its preference for turbulent streams and waterfalls. In this respect the Harlequin is unique among the ducks of Europe and North America but it shares this adaptation to fast running rivers with two genera of ducks in the southern hemisphere, *Merganetta* and *Hymenolaimus*.

The biology of the Harlequin in winter, when it is found at sea, is poorly known.

This paper is a preliminary report based on a series of field studies of Icelandic birds conducted during six expeditions during the five years 1960-64. Five of the expeditions, varying in length from two weeks to three months, fell between 10th May and 15th August while the sixth was carried out between 10th December 1964 and 10th January 1965. The members of the expeditions have changed and I have been accompanied by both English and Swedish ornithologists. The Harlequin has been observed in several parts of Iceland. The main study area has however been the River Laxá at the outlet of Mývatn, the well-known duck refuge in north-east Iceland. The area is one of the best for Harlequin in Iceland and has the advantage of being situated near colonization where the expedition could be based.

My inability to reach Mývatn before 10th May has resulted in a serious deficiency in my material concerning the first weeks of activity at the breeding ground. Nor, as my investigations have ended in mid-August or earlier, have I

observations of the later stages in the growing-up of the young.

Each year immediately after my arrival at the study area in May I have tried to estimate the population size, with special reference to sex ratios, and to compare the progress of breeding activities with those of other years. The Harlequin is a rather late nester in Iceland and as a rule egg-laying is not completed until mid-June. Fresh clutches may be found as late as the first week of July.

Though the major part of pair-formation seems to be finished by the second week of May when my observations begin, until mid-June there are usually fairly good opportunities to watch displaying Harlequins as well as to make notes on general behaviour. During the last weeks of June the activity of the Harlequins decreases rapidly as the females begin to incubate and the males congregate and prepare for their departure from the breeding ground. The moult period has also started and some individuals have already lost their spectacular reddish and bluish nuptial plumages.

From mid-June onwards broods are regularly seen and parental care, growth of the young, etc. can be studied. I have made efforts to establish the nature and importance of different mortality factors affecting the Harlequin broods. In addition the behaviour of the downies has been compared with other species of ducks frequenting the same habitat.

The male Harlequins leave the breeding ground at the end of June and go to the sea. Little is known about this migratory movement.

In addition to the observations at the breeding grounds I spent some days in the fishing village of Grindavík south-west of Reykjavík in the south in December 1964 to study the winter ecology and

ethology of the Harlequin. The weather was very unfavourable and prevented any successful work.

### Occurrence in Iceland

Icelandic Harlequins are highly sedentary and rarely leave the island. From September until early spring they are seawallers and flocks are seen diving for food in the surf all around the coast. The rest of the year they spend at their breeding grounds up in the rivers, sometimes far into the interior (Hantzsch 1905, Timmermann 1937-49, Gudmundsson 1961). They are widely distributed all over Iceland and are to be met with in most streams in more or less abundance. Even in the isolated rivers in the central parts of the country one can expect to find Harlequins and in this respect they show similarities with the Long-tailed Duck *Clangula hyemalis*. I have seen Harlequins in rivers flowing through sterile 'lava-gravel-deserts' with a minimum of vegetation on the banks of the rivers.

According to Gudmundsson (1961) the Harlequin has been observed on lakes only on a few occasions and I have myself only twice seen it in Mývatn (in June 1960 and July 1963).

Although Harlequins breed in most rivers their numbers cannot be compared to those of other ducks. There are not many places where the population exceeds 20 pairs in a limited area, as on the River Laxá. The Icelandic rivers are usually relatively poor in plants and animals and cannot support any greater number of waterfowl. It seems as if the rivers with concentrations of Harlequins of the order stated above offer the optimal requirements of food and possibly also of nest-sites. The Harlequin can hardly be regarded as a colonial nester anywhere in Iceland. Where sizeable populations occur they nest in clusters depending on the topography of the shores and islands in the river.

### Winter habitat

No attempts have so far been made to estimate the total number of Harlequins in Iceland. A winter census along the coasts would probably give some idea of the size of the population. However, regular counts have been carried out only along the south-western coasts. From Grindavik to Staður (approximately 5 km.), Gudmundsson (1961 and personal communications) has counted up to 600 birds at the end of December. Along the same part of the coast I saw about 200 Harlequins for a week in December 1964. This part seems to be particularly favoured by the Harlequin in winter and it is the best place for

field-observations. It is highly possible that there are more places in Iceland with as many or more wintering Harlequins still unknown because of their inaccessibility. Harlequins frequent all coastal waters of Iceland but in varying abundance. They are particularly fond of places where the surf breaks directly against the rocks. Consequently they seldom select deep bays or fjords but are seen around the outermost peninsulas. Their choice of winter habitat is determined by the bottom conditions and hence the availability of suitable food. The Harlequin is seldom seen feeding close to the shore but frequents a zone between approximately 100 and 300 m. from the shore. Apparently they prefer rather shallow waters with a depth not exceeding 3-4 m. At the winter quarters near Grindavik referred to above I usually saw them in flocks diving close to the low skerries which were exposed during tide. I never saw them use either the skerries or the shore as loafing spots.

No details as to the food consumed by the Harlequins when at sea were collected by me. They share the habitat with the Eider *Somateria mollissima* in particular. Probably the food of the Harlequin is very much the same as that of the Eider, i.e. molluscs and crustaceans. Stomach analyses of a small sample of Icelandic birds seem to confirm this (Gudmundsson 1961).

### Behaviour in winter

Outside the breeding season the Harlequin is very sociable and is rarely seen solitary. While they are quite tame at the breeding grounds they are quite shy in winter and usually they took off when I was 500 m. away. The Eiders and Red-breasted Mergansers *Mergus serrator* let me approach to within 100 m. Although the Harlequins are in full brilliant breeding plumage, the males are not easy to spot in rough sea and poor light. The 'general appearance' is the best field-characteristic and dense flocks of Harlequins are unmistakable even at long range to the trained observer (cf. Bergman 1935).

Feeding was the predominating activity in December when I studied them on the south coast. The Harlequins were seen foraging from 10 a.m. until 3 p.m. No observations could be made during the rest of the day due to the lack of light. I am quite sure that they feed also in the dark to a large extent.

They feed in parties of 5-25 birds and usually dive simultaneously at the moment just before they reach the top of a wave, that is to say 'into' the wave. I believe this behaviour has something to do with the difficulties of maintaining position in

relation to the suitable places on the bottom in rough seas. It is also possible that food items are whirled up from the bottom by underwater currents caused by the conditions on the surface.

The length of the dives at sea in winter are about the same as in the rivers during the summer. I usually timed dives of 15–25 sec. and Alford (1920) found the same. I twice recorded dives of 45 sec.

I was able to collect some information on different sexual behaviour related to pair-formation but the end of December was obviously not the best time for that sort of study. Only a relatively small number of Harlequins were paired by that time. I found twelve pairs with apparently strong pair bonds out of some 200 birds. The paired Harlequins were usually seen well apart from the large flocks of unpaired birds. Some pairs fed together but the pairs always kept some distance between each other. No display activity was recorded except two cases of Inciting\* behaviour by females when strange males came too close to the pair. The posture of an Inciting female will be described in another section of this paper.

In the flocks of 10 to 30 unpaired Harlequins 'courting-parties' were frequently seen, with a female followed by 3–8 males. The males displayed elaborately with their necks stretched and tails erected. They were seen to perform head movements (named Head-nodding by Myres (1959a)) with short intervals. Every now and then a male was seen to rush after the female and chase her for some 10 m. until she escaped by diving. The other males of the 'courting-party' then intensified their display; stretched their necks and performed Head-nodding but did not rush after the other male. No fighting was ever recorded. Occasionally a male chased another male for a few meters. Several ritualized movements of the type Body-up-with-wing-flap were seen to be performed by the males. The difficult conditions however made it impossible to get a clear picture of what happened. For the same reason no vocal activity could be heard. However, I am almost sure that they were quite noisy at times as the males were seen with open bills. No female displays were recorded.

Most displays were recorded about 2 p.m. The rest of the hours of daylight the ducks spent feeding and preening. Several different comfort movements could be seen such as 'preening-behind-wing',

\* Here and elsewhere in this paper I have followed the convention of capitalizing the names of ritualized movements, introduced by Moynihan (1955).

'preening-dorsally' and 'abdominal preening'. It is possible that some of these activities are involved in some of the sexual displays but none of them were clearly ritualized.

### Migratory movements

According to Gudmundsson (1961) the whole Icelandic population spends the winter in the sea around the coast of Iceland. Not a single record from freshwaters in winter is known. A few individuals have occasionally been recorded in other parts of Europe but not all of these are satisfactorily documented.

At the end of April or beginning of May the Harlequins start their 'spring migration' from the sea to the breeding grounds. Before that they have moved up the fjords to the river-mouths. The migration up into the river probably takes some time as they are said to swim most of the way. The sexes migrate together in the spring while there is a marked sex-difference in the 'autumn migration'.

At the end of June and beginning of July the males abandon their mates and leave the breeding ground in flocks heading for the sea. This time they move faster and fly most of the way if they are not too heavily moulted. The details are still somewhat obscure and contradictory hypotheses exist (Gudmundsson 1961, Sellick 1960).

The females usually remain at the breeding ground with the young until these are fledged, though sometimes when they are a few weeks old the female may start to move slowly downstream with the brood.

In the other breeding areas of the species (North America, Greenland and eastern Siberia) the migratory movements of the Harlequin appear identical in major patterns with those in Iceland (Gabrielson and Lincoln 1959, Salomonsen 1962, Bergman 1935), being confined to movements between the breeding grounds and the sea, with possibly some movements up and down the coasts in winter.

### Habitat selection

No other European or North American duck is so strictly bound to fast running streams during the breeding season as is the Harlequin, though other species may secondarily occupy the same ecological niche (e.g. Barrow's Goldeneye *Bucephala islandica*).

In some American literature the Harlequin has been included in the list of 'hole-breeding' ducks or at least mentioned as a species laying in crevices (Kortright 1953, Johnsgard 1962). The Harlequin has also been reported to breed in hollow trees in the forested regions of its North American

range. In Greenland and Iceland no trees of sufficient size are to be found and the Harlequin is restricted to holes and crevices in the lava or in the banks of the rivers.

In Greenland Salomonsen (1950-1) states that the Harlequin breeds in two distinctly different habitats; (a) turbulent streams, and (b) along the coast on the outermost skerries. The latter category is not known from Iceland.

In Iceland the Harlequin frequents all rivers that can provide enough food and suitable nest-sites. Looked upon as a whole the biota of the Icelandic rivers is rather poor qualitatively as well as quantitatively. However, in some places where sizeable populations of Harlequins can be found both vegetation and aquatic fauna is unusually rich, for instance in the River Laxá close to Mývatn. There the small islands in the river on which the ducks breed are densely covered by low scrub mostly birch (*Betula* spp.) and willow (*Salix* spp.) and the herbage is rich in June-August. Mývatn is well-known as a 'good' area for flies (often called mosquitoes) and as a matter of fact the lake has got its name because of this (Midge Lake). Several species occur of which *Simulium vittatum* predominates around the River Laxá. *Chironomida* spp. are also very abundant.

Of the factors controlling distribution and breeding frequency of the Harlequin in Iceland the availability of suitable food seems to play the most important role. Gudmundsson (1961) found in the stomachs of 12 Icelandic birds living on fresh-water mainly Simuliidae and to some extent Chironomidae and Trichoptera. As Simuliidae comprise the greater bulk of nutrition of the Harlequin and are strictly confined to fast running waters, it seems reasonable to assert that the occurrence of this group of flies to a considerable extent regulates the density and distribution of the Harlequin in Iceland.

The availability of nest-sites as a determining factor has already been hinted at. However, I think this factor is of secondary importance compared with food. The Harlequin prefers to nest on inaccessible islands surrounded by rushing water. Due to the absence of trees they lay their eggs in caves and holes in the lava, though sometimes the nests are found in rather open situations, although as a rule under dense bushes. Iceland was formerly covered by deciduous forests, which were completely destroyed by the first settlers. The Harlequin may thus have utilized trees and hollow trunks as nest-sites long ago in Iceland.

The preference for inaccessible islands is

of certain survival value as parts of Iceland are or have been much haunted by Arctic Fox *Alopex lagopus* which used to be considered as the most serious predator on wildfowl. Recently the Mink *Mustela vison* has spread in Iceland and caused marked decrease in the number of ducks at several places and at Mývatn and its surroundings in particular. The increased occurrence of Mink has even changed the habit of the ducks in a few cases. For instance, the Harlequins in the River Laxá now seem to desert the islands (except for the completely inaccessible ones) and the banks of the river during egg-laying. Instead the females move up along the small brooks which connect with the main river. Nests may be found several kilometres up. The local farmers, who are well acquainted with the ducks, confirm my own observations of this marked change.

#### The population of the River Laxá

In order to obtain comparable figures as well as for practical reasons a section of the river about 5 km. long, stretching from the outflow in the lake down to the farm named Hofstaðir, was chosen for the chief studies of the Harlequins. My investigations indicate a regular breeding population of at least 50 pairs in this area. Exact figures are very difficult to give, because the number of breeding and non-breeding birds is very difficult to establish and nest records are incomplete because not all the islands could be visited. The Harlequins breed all the way down the river but nowhere else in concentrations like those close to the lake. Few localities in Iceland support a larger population of Harlequins than this part of the River Laxá, or are better suited for field studies.

I have no first-hand data on the time of return of Harlequins to their breeding places but I have been told by the farmers that the first Harlequins are to be seen at the end of April or in the very first days of May. This date probably varies little from year to year, as the Harlequin is independent of the break up of the ice, since the turbulent rivers never freeze.

To determine the sex-ratios counts were carried out at different times in 1961-64 in the study area. Ideally the counts required more than one observer but I did not always have a co-operative ornithologist at hand. The results from all four seasons are compiled in Table I. The material collected is by no means sufficient but indicates the main patterns in the variations of the sex-ratio. A significant preponderance of males is noticeable. On the basis of all my observations at the River Laxá, the sex-ratio can be estimated as approximately 130



**Table I. Sex ratios in Harlequin Ducks on the River Laxá in May and June.**

Year	Data in the form, males: females (% males)		
	20-31st May	10th June	23rd June
1961	95:43 (69%)	26:11 (70%)	5:5 (50%)
1962	143:92 (61%)	39:20 (66%)	11:9 (55%)
1963	117:92 (56%)	41:30 (58%)	18:13 (58%)
Sum	355:227 (61%)	106:61 (63%)	34:27 (56%)

males per 100 females, or 57% males and 43% females. The counts in May average about 61% males but the figures from 1961 (69% males) may be too high, due to my inexperience and the fact that females are a lot easier to overlook than the males.

By the end of May some females may have started to incubate while some of them are not to be seen on the water as they are inspecting nest-sites, though usually accompanied by their mates. When the females start to incubate the majority of the males congregate and leave the breeding ground so that the numbers of both sexes that are visible fall. The results also give an idea of the time of laying: after 10th June the number of females decreases markedly but it increases again about mid-July when the eggs hatch.

#### Predation

The population of Harlequins on the Laxá is well-known. Barrow's Goldeneye breeds regularly in the river (although the majority breeds in the lake itself, especially in parts with plenty of lava-formations) and so do the Long-tailed Duck and Goosander *Mergus merganser*. Most species present on Mývatn occasionally occur in the river, some of them perhaps more often than others, for instance Wigeon *Anas penelope*, Mallard *A. platyrhynchos*, Scaup *Aythya marila* and Red-breasted Merganser.

All local farmers agree that the numbers of ducks (not only Harlequins) have decreased, on the river as well as on Mývatn itself. Gudmundsson (1963) has discussed the reasons for the decreases, which are much more marked in some species than others.

The ducks have few natural enemies in the area. Today only the Mink and some predatory birds are potential enemies. The Arctic Fox is lacking in the immediate vicinity of the lake. The damage caused by the Mink has not been investigated enough. Of course it does a lot of harm as a rapidly increasing newcomer but I think that there soon will be a stabilization. The Mink certainly is a threat to the fishing in the lake, which is very important. I think the Harlequin is more threatened by the

presence of Mink than any other duck due to its restricted habitat selection.

Several pairs of Icelandic Gyrfalcon *Falco rusticolus islandus* breed near the lake. Investigations at some eyries indicate that the falcon preys on ducks to a large extent in this part of Iceland but no remains of Harlequin have been found. I have occasionally watched the falcon hunting along the river valley but I never saw it attack any duck. Harlequins rarely take off from the water when a potential predator approaches as Barrow's Goldeneye and other ducks do.

Far more harmful to the ducks are the Arctic Skua *Stercorarius parasiticus*, Great Black-backed Gull *Larus marinus* and Raven *Corvus corax*. The first two species are not very numerous but several pairs of Raven breed. I have no exact figures as to the amount of eggs or young each of these predators take, though investigation is in progress.

In and around Mývatn extensive egg-collecting is practised but exact figures are not obtainable at present. It mainly concerns the ducks and all collecting is done by the local farmers. Formerly eggs were taken only for consumption. Now, however, agents purchase a lot of them to export for hatching purposes. These transactions are now being controlled by the Icelandic authorities and some species will be banned. Although difficult to keep alive and at present impossible to breed in captivity, the Harlequin is much in demand and the eggs fetch high prices. The majority of Harlequins' eggs exported are collected along the River Laxá, which in the long run is bound to affect the population adversely. By law the farmers must leave four eggs in each nest and this is the reason why so many 'short' clutches and broods can be seen in the area. Whether the Harlequins would lay repeat clutches if all the first eggs were taken is not known. The taking of eggs of ducks around Mývatn is especially hazardous to the Harlequin and Common Scoter *Melanitta nigra*. Other species do not seem to be so seriously affected. The taking of eggs of the two species mentioned will be prohibited very shortly (Gudmundsson, personal communication).

### Notes on general behaviour

As a consequence of its extraordinary adaptation to its habitat the Harlequin exhibits several conspicuous specific characteristics.

The drake Harlequin has a spectacular and very conspicuous nuptial plumage which yet matches the whirling and foaming water magnificently so that it is tempting to call it a cryptic colouration. Anyone who has experienced the duck in its natural environment can affirm that the male is not easy to detect either when sitting against a background of green vegetation or rumbling down a river surrounded with foaming water. The female has of course an undeniably cryptic plumage.

Harlequins often sit on stones submerged in the middle of the river or close to the banks. When disturbed they usually move out into the river and let the current carry them away. The pairs normally stick tight together with the female ahead. As they are transported down the rapids they demonstrate great manoeuvring skill; the ducks so to say 'sit high' on the water and no propulsive movements can be seen. They constantly jerk their heads in a way very similar to the Head-nodding referred to above but having no apparent display function. I prefer to call these unritualized head movements simply 'nodding'. They occur in many different phases and situations. The movements described as 'nodding' in a way remind one of other familiar species frequenting similar habitats, for instance the Dipper *Cinclus cinclus* and the Grey Wagtail *Motacilla cinerea*. They are also typical of Torrent Ducks and Salvadori's Ducks.

When moving against the current Harlequins adopt three main types of locomotory behaviour:

(a) They dive repeatedly in order to reach the place towards which they are headed. This is not very often done and then only for short distances, as when crossing to the opposite side of the river.

(b) They swim directly against the current, trying to make use of the whirls in the most advantageous manner. They stick close to the shores where the current is less powerful or they rush in stages from stone to stone or between small islands, taking advantage of the leeward sides of the obstacles in the river. Constantly they are seen to perform the typical 'nodding' and they make strong propulsive movements with their feet.

(c) Where the current is too strong for swimming and no obstacles are in the way they rush straight up the river with their bodies lifted out of the water, running like a fast speedboat. Myres (1959a) very

appropriately compared this behaviour to that of ducklings running to their mother. The posture they assume is very distinctive with body and head horizontal.

The Harlequin is an expert diver. Diving technique and foraging behaviour are discussed in a later section.

One of the striking features of the breeding ground is the presence of 'clubs' where paired and unpaired birds spend the first days after arrival and where males and unpaired females (or females off duty) loaf from about 10th June and onwards. Very little activity characterizes the 'clubs' and only when newcomers arrive may the birds act for a moment in some way or another. Preening and sleeping are the only activities an observer will usually see even if he watches a 'club' for several hours. The Harlequin is much less active at the breeding ground than the Barrow's Goldeneye for instance. The requirements of a good 'club' are in general terms a shallow place with a lot of obstacles sticking up in the middle of the river and plenty of rapids. Occasionally a 'club' is situated on an island or on the bank of the river. A big 'club' may be occupied by up to 40-50 birds at a time. The 'club' can be described as a public loafing spot.

Several authors have paid attention to the problems connected with the behaviour and the place of residence of the sexually immature Harlequins in the summer (Salomonsen 1950-1, Gudmundsson 1961). Harlequins probably do not reach sexual maturity until the age of two years and consequently they spend at least one summer as non-breeders. Both in Iceland and Greenland it has been shown that the yearlings spend their first summer at sea, though Gudmundsson states that sometimes the yearlings may accompany the adults into the fjords but no further. I have annually recorded one or two males at River Laxá which definitely were yearlings judging from their plumage, which lacked the bright colours of the adults. I estimate that about two per cent of the males at River Laxá are non-breeding yearlings which disappear together with the adults when they go to sea when the incubation period has started. The one-year-old males show less display activity than the adult males. One-year-old females cannot be identified in the field.

Nobody has so far credited a 'flight-intention' movement to the Harlequin. There is no obvious reason why such behaviour should be lacking in this species although the Harlequin perhaps has fewer enemies than most other ducks. During excitement, as when a potential predator approaches a flock of Harlequins, an

intensified 'nodding' is to be noted with rapid sequences of short elliptic head movements and the neck held at about 70° with the water. When the intruder gets nearer the Alarm-Posture is assumed. This is a stretching out of the neck with the neck feathers slightly expanded which makes the whole appearance look more impressive. No, or very minute, movements accompany the Alarm-Posture. As stated above the Harlequin seldom escapes by flight; their normal way of getting away from an enemy is to swim or dive.

The Harlequins fly low over the water and follow all bends of the river, never cutting off over land and never flying over bridges. The flight, which is somewhat reminiscent of that of the Common Scoter, appears very fast and erratic. It is possible that the speed is exaggerated owing to the short wings and rapid wing-beats of the Harlequin. They use flight as a means of transportation for longer distances only and tend to fly in dense flocks.

They are more liable to fly at the end of May than in the first half of June, probably in consequence of the restlessness that characterizes the period just before egg-laying when the females are very active in searching for nest-sites and the males still have not started to moult and cluster at the 'club'.

The Harlequin is extremely unwilling to use its wings as a means of escape when at the breeding ground, in contrast to its behaviour in winter.

### Territory

Myres (1959a), quoting Darcus, states that each pair has its own territory at least for a short period of the season. I have found that on the Laxá the territorial boundaries are very indistinct and sometimes seem to be lacking. This might be a result of the relatively sociable behaviour of the species at places with concentrated populations. In places where only a few pairs breed the maintenance of territories seems more pronounced and each pair occupies and defends a small section of the river. This can be seen when you walk along the river and encounter a pair of ducks. You then drive them in front of you until they reach the outer limit of their territory when they turn against you and swiftly pass you and return to their original spot.

The pairs on the Laxá that do maintain territories are mostly birds breeding on the periphery of the area. In the densely populated central parts of the breeding ground I am often inclined to relate the 'territorial behaviour' of the male to its mate rather than to a certain area.

At places where more than one pair

dwelt the pairs stand well apart and the mated birds close together. When a female leaves its mate and by chance approaches a strange male her mate immediately assumes an attitude which besides being a display of courtship origin probably has some bearing on 'territorial behaviour'. He lowers his neck and head and performs repeated Head-nodding and approaches the strange male swimming or walking (depending on the circumstances). Normally no other activities take place but the male and female return to their starting point to preen or sleep. Both when a male defends a certain area and when he limits his 'territorial behaviour' to the female he maintains a loafing spot (cf. 'defense-of-the-mate-behaviour' in Velvet Scoter *Melanitta fusca* (Koskimies and Routamo, 1953)).

### Courtship and agonistic behaviour

The different displays of the Harlequin are inadequately known and described in the literature. The most detailed description of the sexual behaviour of the Harlequin is that by Myres (1959a) whose terminology is adopted in this paper.

Bretherton (1896) has described a complex display in which the male throws his head back and then forward with a jerk and simultaneously the bill is opened and he utters a call. The wings are said to be slightly expanded. I refer to this paper because it has been much quoted. So far I have never recorded any such behaviour or any similar. However, his description is not very detailed. Yeates (1951) recorded 'many scurryings, divings and displays with heads thrown back into scapulars and whipped forward with a quiet whistle'. This also is a very vague description. Michael & Michael (1922) published an account in which they state that a pair they watched bobbed their heads and bowed to each other and swirled round uttering chatty sounds and dipped their bills in the water. My own observations have more in common with this description than with those referred to above.

The male displays (except copulatory behaviour) in the tribe Mergini show few similarities and relationships cannot be inferred from them. The most striking feature of the display of *Histrionicus* is the paucity of visual activities. This lack of elaborate displays is evidently compensated by a vocal display superior to most of the other diving ducks. In this respect the Long-tailed Duck can be compared to the Harlequin. Both species form monotypic genera. It is suggested by Myres (1959a) 'that paucity of visual displays is an

indication of isolation from related groups, due to ancestral divergency'.

The Head-nodding is undoubtedly the fundamental display movement of the Harlequin in most situations (cf. winter observations above). Myres (1959a) believes that this is the only male display. The Head-nodding is present in both sexes. The motivation of the Head-nodding is not yet satisfactorily studied and its degree of ritualization is in many cases doubted. I have not been able to record enough courtship and agonistic displays at the breeding ground to separate these two components from each other with certainty.

The 'ordinary', fully performed, Head-nodding movement describes an elliptic course with the long axis parallel to the surface of the water and the bill held horizontally. However, as pointed out before, there are many modifications in the Head-nodding. The behaviour shows similarities to the Rotary-movement in Barrow's Goldeneye (Myres 1957, 1959b and own observations). The absence or paucity of lateral head movements requires further attention as the Harlequin certainly does not lack conspicuous patterns on the head. The crescentic white patches on the sides of the head and the reddish back of the head could have significant signal functions (cf. Barrow's Goldeneye as to the white head-patches).

Many ornithologists claim the Harlequin to be rather pugnacious. Encounters occur frequently at the breeding ground throughout the season. When, at the 'club' for instance, two birds compete for a certain stone to loaf on or when a newcomer alights nearby the birds perform Head-nodding. The same form of Head-nodding behaviour occurs whenever two birds or more get in close contact. The Head-nodding in such cases consists of rapidly performed movements of the neck and head which do not seem to be complete: they are not so extensive as in many other displays and look stiffer. Myres (1959a) suggests that the Head-nodding also serves as a greeting. I think it is a form of hostile behaviour, because, if the opponents are not discouraged by each other's Head-nodding (which they usually are), Threat-Posture is assumed. This posture comprises two phases: first a lowering of the head and neck to the horizontal and second the actual attack when the bird slowly approaches the opponent (walking or swimming), sometimes with its bill open. The Threat-Posture may continue into a fierce attack when the duck leaps or rushes at its opponent with water spouting. The length of the 'rush' varies from 2 to 30 feet. When fighting, Harlequins dive a lot but I

have never seen them performing underwater attacks, as Barrow's Goldeneye regularly does.

In the encounters both males and females are generally involved but fights between males are more common than 'mixed' conflicts or encounters between females only. Encounters with only males involved are as a rule of the type described above in connection with 'threat-behaviour'. Apart from incidents at the 'club', etc., encounters frequently occur in 'courting-parties' or where a pair is attended by a single unpaired male. Normally a conflict ends in a 'rush' from one of the combatants and only rarely does it lead to a serious fight. A female may in connection with display activity perform a 'rush' at a foreign male, or occasionally a female. The 'threat-behaviour' of the female is seemingly identical to that of the male but is more seldom recorded.

Males frequently chase females but these actions are not only aggressive since courtship displays and copulatory behaviour presumably involve quite a lot of aggressive tendencies.

In about 80% of the cases where both sexes display mutually the male is the initiator. Both birds perform sequences of Head-nodding ranging from 2 to 17 movements and with a duration of 8 to 15 seconds. The Head-nodding of the female is generally less elaborate than that of the male but even a little Head-nodding by the female markedly influences the male's activity.

Whereas the sexual displays of the female seem to be limited to Head-nodding and Inciting, the male seems to possess at least a few other displays which probably are ritualized. The male has been recorded as performing Head-nodding and lateral shaking of bill in the water ('Water-twitch' of Myres 1959b?). I have seen this behaviour of the male when the birds displayed mutually. Frequently the male assumes a 'look-for-food-posture' as he dips his forehead into the water and, as it were, skims the surface. This posture is often assumed when he is excited and then he may also exhibit an attitude which seems identical to Threat-Posture. Occasionally he opens his bill and utters a squeaking sound at the same time.

It is not quite clear how much the aggressive 'rush' in connection with pair-maintaining displays is ritualized. Possibly this behaviour is mostly confined to pre-copulatory behaviour since copulation may follow immediately after. (Copulatory behaviour is treated below.)

Quite frequently during mutual Head-nodding the male has been seen to upward-

stretch, with flapping of the wings. This display is rather weak and often interrupted and it may just be a comfort movement, though the frequency with which it has been recorded in connection with sexual displays, except copulatory displays, favours the possibility that it is ritualized.

Preening sometimes occurs during courtship and agonistic displays. Both preening dorsally and behind the wing have been recorded but it is not yet clear whether these activities are highly ritualized. Some of them are probably only comfort movements. An action which probably is to be regarded as a 'two-wing-stretch' (also observed in Barrow's Goldeneye and several other species of ducks) has apparently no display function. Stretching of one wing and the corresponding leg also occurs in the Harlequin.

The only specific display of the female, other than copulatory behaviour, I have noted is Inciting. This has not previously been described for *Histrionicus* (Johnsgard 1960). The movements involved are similar in principle to the Inciting of Goldeneyes. The female lowers her head and neck, often touches the water with the throat, and performs distinct Head-turns (easily distinguishable from Head-nodding), alternating from one side to the other. This has been seen on four occasions (twice in summer and twice in winter) while in a fifth case the female just pointed the bill at an interfering male without any Head-turns. In a sixth case the Head-turns were followed by a 'rush' of two or three feet, after which the female repeated the Inciting. The usual response of the male to the Inciting was Head-nodding and twice he assumed Threat-Posture. During Inciting a female was once heard to utter a harsh call. The performance of the displays common to both sexes is as a rule weaker (not so elaborate) in the female than in the male.

An elaborate 'flight-display' compared to that of many other ducks evidently does not occur in the Harlequin. 'Courting-parties' chasing a female through the air have been recorded several times but no distinct behaviour patterns have been attributed to these flight chases. Possibly the Harlequin possesses a 'flight-display' which is more elaborate during winter and early spring when the birds are at sea.

### Copulatory behaviour

The copulatory behaviour of ducks is regarded as highly conservative and can thus be used as a possible criterion of relationship. Very few ornithologists appear to have seen copulation in the Harlequin.

This is not only due to the remoteness of the breeding grounds because even rather extensive observations seldom result in seeing a copulatory sequence. Possibly the copulatory frequency is highest at the beginning of the breeding season and then rapidly decreases. My own material includes seventeen interrupted copulatory sequences but I have so far recorded only five more or less completed copulations, two in May, two in June and one in July. The earliest attempt was seen on 20th May and the latest on 2nd July. Most copulatory activity apparently takes place around 10 a.m. and between 3 and 6 p.m. Attempted copulations have been recorded at places where parties of ducks have been present but all five completed acts occurred in secluded spots with no more than two pairs.

Pre-copulatory behaviour can be initiated by either sex, though most frequently by the male. The performance commences with mutual Head-nodding. The Head-nodding of the female is more irregular and is less pronounced than that of the male. It seems to serve mostly as a stimulus to the male. I have once seen a female use a head-movement as a defence action when the male became aggressive during copulatory display. This mutual Head-nodding may last for five to thirty minutes, but eventually the birds lower their necks and heads to 10-15° with the water. In this posture they have been seen to perform mutual 'bill-dipping' with lateral movements of the bill (in eleven interrupted and four completed copulations). This may last for 30 seconds or more. The actual dipping of the bill involves 3-5 dips in rapid sequence.

The most striking pre-copulatory behaviour of the Harlequin is the 'rush' of the male which seems identical with those occurring in courtship and agonistic encounters. The male skids towards his mate with his bill widely open and uttering a sound reminiscent of 'a group of fighting mice' (Myres 1959a). The male tries to grab the nape of the female who usually seems to struggle to avoid capture. The aggressive element in copulatory behaviour is very pronounced in the Harlequin. No definite rape has been recorded, but it is often difficult to draw a line. In one case that occurred on 18th June, 1964, the male chased the female (later observations proved that they were paired) by 'rushes' until she took off, followed by the male. After a short pursuit-flight she alighted near a small island and the male tried unsuccessfully to mount her. All the time the male called constantly. The female ran up the slope (45° angle) of the island

nearby pursued by the male. After a few rounds on land the female got out of the male's sight for some time. A 'foreign' female happened to be in the water near the island and the male caught sight of her and displayed energetically in front of her without any response. Suddenly the male spotted his apparent mate again and made a rush at her. Soon after that the sexual activity declined and they began to feed together. However, after a very short time the male again commenced to perform Head-nodding and rushes and at this time an under-water-pursuit even occurred. More chases on land took place (the Harlequin is very agile on land) and again the male tried to mount without any success. Hence it seems as if a male Harlequin in an aggressive state might even copulate on land occasionally. The pair was first seen at 3.00 p.m. and at 5.40 p.m. the male still showed aggressiveness, although less extreme.

Copulation may be preceded by 5-20 'rushes' extending over a long time (10-30 minutes and exceptionally even longer).

In a pre-copulatory sequence I once recorded a form of 'body-up' without wing-flap. The male had been displaying to a female for about 15 minutes when he performed this 'body-up' display five times in less than a minute. He then 'rushed' at the female and renewed his displays. The posture was very much reminiscent of pre-copulatory 'rearing' behaviour in Steller's Eider *Polysticta stelleri* (Johnsgard 1964). The neck seemed to thicken and the feathers on the back of the head were ruffled, giving the bird a very peculiar appearance. The 'body-up' posture could have been only a comfort movement unconnected with copulatory behaviour at all as it has only once been recorded.

No male displays definitely suggesting exhibition of the metallic plumage have been noted. I think the pivoting and turning in front of the female is over-estimated because of the spectacular colours of the male and the unwillingness of the female in early stages of the copulatory behaviour. This may even lead to small combats with the female trying to grab the tail of the male while he attempts to clutch her nape.

Female pre-copulatory behaviour includes brief sequences of Head-nodding and sometimes dipping of the bill while lowering the head and neck. She does not normally assume a Prone-Posture until immediately before treading, or in some cases not at all. Occasionally I have seen the female in Prone 10-20 seconds in advance.

The copulation takes 2-6 seconds (5 instances) and during treading no calls

have been noted. The male presses the female almost under the surface of the water and his wings are slightly expanded (in two cases not at all). No flapping of the wings has been observed in connection with the act.

Post-copulatory behaviour is poorly developed in *Histrionicus* and presumably absent in the female. Rotary-movements by the male like those of *Bucephala* (Myres 1957) have been recorded twice, but it is possible that these motions occurred on account of the female's struggling to release herself in interrupted copulations. After coition the female may bathe (dive) and preen for some time but this behaviour is very variable and may be lacking completely. No distinct post-copulatory displays have been attributed to the female.

Nor does the male Harlequin exhibit any specific displays after copulation. He may dive a couple of times and thereafter repeat the aggressive parts ('rushes') of the pre-copulatory display but with less intensity. If the female rejects the courting both birds eventually preen themselves. I have never seen two copulations in succession. The aggressive post-copulatory behaviour of the male Harlequin is very characteristic.

The paucity of visual displays in *Histrionicus* is apparently compensated by a rather great vocal activity. Elaborate and conspicuous aquatic displays would be difficult to perform in a fast running river where the Harlequins breed. The male sexual displays in the sea ducks are in all but a few species very elaborate. The Long-tailed Duck, which is not confined to rushing streams, has at least two fairly distinct and conspicuous, though not very elaborate, visual displays (Johnsgard, in letter). The Barrow's Goldeneyes which breed in the study area on the River Laxá are only seen to perform their displays at sheltered places where the water is smooth.

The unique habitat selection of the Harlequin and its lack of close relatives perhaps reduce the importance of displays as an isolating mechanism to prevent hybridisation. No hybrid Harlequin has been recorded.

The vocal ability of the Harlequin is indisputable, as is that of the Long-tailed Duck, which supports the idea that vocal displays compensate for reduced visual displays. It is of interest to note that the Common Scoter possesses both vocal and visual displays of high degree. To be of any importance the vocal display of the Harlequin must be very pronounced as the river noises interfere not only to human ears but very likely also to the Harlequins'.

Concerning the copulatory behaviour of our species more observations are needed. However, in view of the facts presented above it is suggested that the genus *Histrionicus* should be placed close to *Polysticta* and form a link between Steller's Eider and the *Clangula-Melanitta-Bucephala* assemblage on the basis of behaviour characteristics.

#### Nest-site selection

As early as in the middle of May some of the females may begin to lay eggs. During the latter part of May the majority start to prepare for egg-laying. Harlequins' nests are always found very close to the water. In Iceland they nest among lava blocks or, more often, directly on the ground under a layer of protecting bushes or other types of ground vegetation, for example *Angelica* sp.

Owing to the fact that most nests are situated on inaccessible islands in the river, it has not been possible to examine very many. However, my observations indicate that there is a strong tendency of the female Harlequin to return to the same nest-site for consecutive years. My statement is based on several observations at nest-sites which are so concealed and unusual that it must have been the same bird returning year after year. It should be noted that so far no banding of adult females on the nest has been done. The great homing tendency in hole-breeding ducks is well-known (cf. Erskine 1961).

The nest consists of a thin layer of grass and occasionally a few dry twigs and leaves. It is lined with white down with reddish tips. The amount of down never reaches the quantity found in nests of Eiders. The most prominent feature of the nest is that it is mostly protected from above by dense vegetation. This has been proved to be of survival value during cold spells with snow-falls (Bengtson 1963).

No interspecific competition for nesting places has been noticed, though eggs of Goosanders have been found in Harlequins' nests (Gudmundsson 1961).

The females alone choose the nest-site. In the latter part of May females attended by their males are seen exploring sites. The Harlequins' search for sites differs in one major respect from that of Goldeneyes in that the birds are never seen flying over land as the latter species frequently do. Concerning the Barrow's Goldeneye at Mývatn it has been established that immature females (and possibly even some mature ones) spend a lot of their first spring season looking for nest-sites. Due to the lack of trees they investigate crevices in the lava chimneys and ventilators in the

farmhouses. These flights have been proved to occur predominantly in slight drizzle (Gudmundsson 1961 and my own observations). Harlequins have shown no such weather preference.

When Harlequins look for nest-sites they walk on the islands or on the river banks for an hour or more at a time. They disappear into every cave and behind every rock and bush. Every now and then they stop and remain motionless for several minutes looking out over the area. The males follow their females continuously, though without paying so much attention to the holes and caves as do the females. They mostly stay on guard. When disturbed the birds dash down to the river. They walk or run on land without any difficulty even for quite long distances. When looking for sites along the small brooks recently resorted to for nesting the pair swims up into the brook. The noisy behaviour of the Harlequin during these explorations is striking.

#### Egg-laying

The Harlequin is a comparatively late breeder. As in various other high boreal and arctic breeding birds, the egg-laying extends over quite a long period. One can expect to find fresh clutches in Iceland from the second half of May until mid-July (approximately an eight-week period). The majority of females start to lay in the last week of May. Some authorities are of the opinion that egg-laying is not finished until the second part of June (Hantzsch 1905, Gudmundsson 1961). The regularity with which downies occur in the first weeks of July indicates that many females have already completed their clutches in the very last days of May and the first week of June. Hantzsch (1905) refers to a set of eight eggs collected at Mývatn (identical to River Laxá) on 30th May, 1898. The egg-laying seems to take place simultaneously in Alaska and Iceland although Bent (1925) mentions a clutch of seven eggs found on the west coast of North America (Washington) on 7th May, 1924. In the latter instance the egg-laying must have commenced about 20th April or even earlier. My own observations in Iceland indicate egg-laying from 10th May until 8th July with the majority in the first days of June.

I have been able to follow up the egg-laying in only three nests (in one case from the second egg only). I have found the intervals between the eggs to be two to four days. A lapse of three days seems normal but two-day intervals also occur quite frequently. Only one four-day gap was recorded. I believe that females may

lay two days in succession on rare occasions although this has never been directly observed. The local farmers have also found the interval between the eggs to be two to three days.

The clutch seldom exceeds nine eggs. The number of eggs in eleven nests I have examined ranges from three to seven, average 5.5 (Table II). It should be noted that clutches with four eggs or less may have been depleted by the egg-collecting farmers, as permitted by law. Table II also includes some broods observed when the young were so small that it may be presumed that the number of young reflected the (minimum) clutch-size. As can be seen I have recorded females with nine to ten downies and as no robbing of young from each other apparently occurs in the Harlequin these observations are, I think, good evidence for large clutches. Gudmundsson (1961) has found nests with eleven and twelve eggs but he adds that they may possibly have been laid by more than one female.

### Incubation

Incubation starts before completion of the set. At this time the female begins to pluck feathers and down from her breast with which to line the nest-cup and to cover the eggs when leaving the nest. The incubating bird generally sits very tight throughout the incubation period and can sometimes be touched by the observer without being flushed. When disturbed on the nest she may utter a hissing sound and try to bite the intruder. If flushed she generally leaves the eggs without splashing them with excrement as do most other ducks.

After most females have begun incubating very few Harlequins are to be seen on the water. The males have departed (or are just about to) and the females on eggs very rarely leave them. No continuous observations have been carried out in order to establish how often the incubating females leave their nests to feed. However, certain observations indicate an interval of 48 hours between the feeding pauses of an incubating bird.

Once I watched a female leaving her nest after having covered the eggs with down. She swam straight to a nearby waterfall where she foraged for 26 minutes and then climbed up on a ledge and preened and

rested for 38 minutes. Then she continued to feed with brief pauses for nearly one hour before she finally returned to the nest. In total she stayed away from the eggs for about two hours.

Unfortunately I have not been able to establish the length of the incubation period in the Harlequin with desirable exactness. The available literature states that it takes 31-32 days (Scott and Boyd, 1957) or even 33-34 days (Witherby *et. al.* 1958) for the eggs to hatch in an incubator. My own investigations indicate a period of 28-29 days which is a rather long time considering that some bigger ducks require less than 30 days. However, 'hole-breeders' tend to have longer incubation periods than ground-nesting species. It would be of great interest to get sufficient information on the length of the period in Harlequin.

### Behaviour of the males after incubation has started

From about 12th June a new phase starts on the River Laxá in that the females disappear to their incubation duties and the drakes and non-breeding birds begin to moult and congregate at the 'clubs' and other favourable feeding places. The females that are seen at the 'clubs' I believe are non-breeders as those that still have not begun or finished egg-laying do not frequent such places.

Sometimes a male may spend a day or two in the vicinity of his incubating female and accompanying her on her feeding time but very soon he deserts her.

At the end of June I once observed a solitary pair of Harlequin in a river near the mountain Herðubreið (north-east Iceland). Nothing indicated that the female had started egg-laying but she could have done so. The male was still in full nuptial plumage. It would be of interest to know whether the tendency of the males to remain with their mates is greater in isolated pairs, where the sociability of the moulting males is not so favourable as at the River Laxá.

The males do not remain for long at the breeding grounds after they have abandoned their females. After a few days at the 'club' they depart for the sea. The majority leave around 20th-24th June and at the beginning of July only a minor portion of

**Table II. Numbers of eggs in nests and young in broods seen along the River Laxá, 1961-63**

	Number of eggs or young								
	3	4	5	6	7	8	9	10	mean
Clutches	1	1	3	4	2	-	-	-	5.5
Broods	-	5	3	3	2	1	1	1	5.7



the males in the population is left (late breeders).

They are now more social and when disturbed (as by my arrival) they cluster together and if the intruder gets too close to their loafing place they all leave in a dense flock swimming or flying. The social behaviour they exhibit at this time of the season at the 'clubs' probably prevails through the autumn and winter until pair-formation starts. During the last days before departure a marked tendency to fly has been noticed among the not yet moulting males.

After a visit to the River Laxá in 1958 Sellick (1960) opposed the hypothesis that the males go to sea when the females begin to incubate. He found 60-70 males, in eclipse, at a secluded spot a little way down the river. He suggested that the belief about the males making for the sea arose because no, or very few, males are seen at the breeding ground at that time. In his opinion this could be owing to difficulties in distinguishing the sexes when the males moulted. I have never observed any flocks of Harlequins in the river after the third week of June, only scattered males, and I think it is quite possible to determine a moulting Harlequin as to sex and age in the field.

The males that remain at the breeding ground until early in July are late breeders still in full plumage and may perform various displays and attempted copulations.

### Feeding methods

In a previous section it was stated that the staple diet of the Harlequins in Iceland were pupae and larvae (and to some extent imago) collected from the surface of the water) of *Simuliidae* and *Chironomidae* in particular which are both very abundant in certain districts (around Mývatn almost a plague) with suitable hatching conditions.

Harlequins use three different methods of feeding: (a) skimming off the surface combined with dipping of the head under water; (b) actual diving and (c) 'up-ending' as in the surface feeders. In shallow places they use the first method and scrape the surface of stones with their bills in order to obtain edible items. This method of feeding gives an impression of being less effective than diving and can be characterized as 'inactive feeding'. Diving is the normal way of obtaining food and can be practised almost anywhere in the river. Not even the most turbulent and strongest current or falls form any apparent barrier and the Harlequins readily find their way along the bottom of the river. They dive with their wings open and from the steep slopes of

the river I have often had excellent opportunities to watch their activity in the clear water. They make use of their wings under water, as far as I can tell not for propulsion but to keep their balance as they move on the bottom like a Dipper. Even when feeding in strong currents Harlequins manage to emerge in almost exactly the same spot from where they dived. At least they seldom emerge downstream. The 'precision diving' is amazing and very typical of this species. The third method, 'up-ending', is identical with that used by dabbling ducks. It is rarely practised. When they do Up-end they dip their heads only on most occasions as a supplementary method. 'Up-ending' was never recorded by Pool (1962) but Michael and Michael (1922) mention it.

Michael and Michael (1922) give 15 sec. as the average duration of the dives and state that they rarely exceed 25 sec. Cahn (1947) frequently timed dives of 30 sec. or more. The duration of the dives may of course differ from place to place and season to season. In the River Laxá Harlequins normally dive for 15-18 sec. The longest dive I have recorded was 39 seconds. As the female seems to dive first when a pair is feeding simultaneously in 48.3% of 1,210 recorded dives and both birds submerge about the same time, the dives of the female tend to be slightly longer than the dives of the male.

No correlation between the duration of the dives and the depth of the water has been established. The Harlequins do not show any apparent preference as to the depth of water in which to feed. As in the case of swimming on the surface, the Harlequins try to take advantage of the lee-sides of stones and islands when diving for food. This may also be a consequence of the greater tendency for the larvae and pupae of insects to be attached on the lee-sides of underwater obstacles.

The Harlequin was claimed by Alford (1920) to be mainly a 'day-feeder'. Pool (1962), from observations on the Laxá, disagreed. In mid-July, 1961, Pool was impressed by the rarity with which the Harlequins were to be seen feeding at all and found them to be most active just before sunset (10.30-11.00 p.m.). My more extensive observations on feeding activity of the Harlequins are compiled in Figure 1 into a curve showing the daily rhythm in this respect. It is obvious from this diagram that they feed with a two-peak frequency, one maximum being around 6 a.m. and the other at 5-6 p.m., the latter being the more pronounced. Apart from these two peaks a less marked one seems to occur at midnight. No variations in the

daily rhythm in the course of the summer have been established. The problems connected with feeding activity in ducks deserve further attention.

It seems as if the females are more active than the males as they often continue to feed a long time after the males have stopped. This has, however, not been statistically proved.

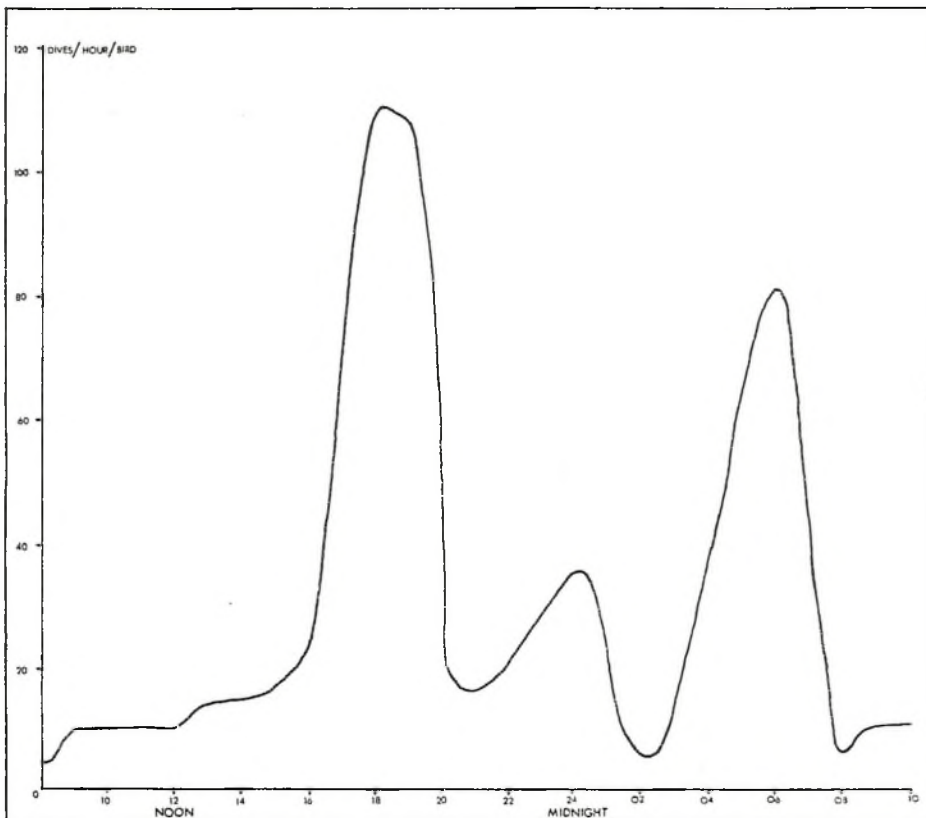
During the winter at sea the social feeding behaviour of the Harlequins is a predominating feature. At the breeding ground they normally do not feed in parties unless there are so few suitable feeding-areas that they have to frequent the same place. If possible the pairs feed well apart from each other, or occasionally two pairs together.

In Figure 1 a simple method of expressing feeding intensity was used, just the number of dives being recorded. A 'feeding-rate' has also been estimated by watching birds (one at a time) when feeding and timing the dives during a selected period during which uninterrupted feeding occurred. The time spent diving

has then been calculated as a percentage of the length of the entire observation period so that the figures obtained are the ratio between the dives and the intermediate pauses. As a rule the 'feeding-rate' is very high in the Harlequin; about 80% (or dives of about 15 sec. with 2-3 sec. long pauses). A bird may feed constantly for 5-50 min. but the 'feeding-rate' decreases slowly and the feeding is interrupted for periods during which the bird preens and rests on a ledge. These resting periods gradually increase in length until the feeding is stopped completely.

In order to further illuminate the adaptation of the Harlequins to their environment, the feeding behaviour of other species of ducks in the study area has been examined in the same way. The comparison of feeding efficiency in Table III, using the measures devised by Dewar (1924), shows quite indisputably that the Harlequin is superior to the other species in most respects. From field-observations it is quite clear that other ducks do not have the same skilful way of diving and

**Figure 1. Daily rhythm [in feeding activity of Harlequin Ducks on the River Laxá: Based on times of 2,450 dives in the summers of 1961-64.**



swimming in rushing streams as do the Harlequins and consequently no other species can occupy this ecological niche. Dow (1964) studied the 'diving efficiency' (measured by the dive/pause ratio) of some North American diving ducks in still water and found the Long-tailed Duck (ratio 4.1:1) to be superior to species like the common Goldeneye *Bucephala clangula* (2.2), the Red-breasted Merganser (2.2) and Surf Scoter *Melanitta perspicillata* (1.8). Yet in rushing streams the Long-tailed Duck is outclassed by the Harlequin.

### Parental care and behaviour of the young

The first broods as a rule can be seen from the first week of July and onward, though a single young was observed on 24th June, 1962, and on 25th June, 1964, a female with downies was reported from the River Laxá (Santesson, personal communication). I have about ten records from the first days of July but most eggs do not hatch until 20th July. By the end of the month females with broods are frequently seen. Hantzsch (1905) saw downies from mid-July. The yearly variations are small as would be expected.

I have no personal observations on the behaviour of the female and young in the first hours after hatching. Millais (1913) states that the newly hatched Harlequins are fed directly by the duck. He bases this statement on observations of small downies pecking with their bills at the bill of the female. Even very small ducklings (approximately one to two days old) which I have watched have never done this. They have been seen taking food directly from the surface. The female alone takes care of the young and I have never seen a male escort his mate with a brood (the males are only rarely present at the breeding ground then).

The average number of downies in a brood corresponds to the average clutch-size. Females with nine to ten downies have

been recorded but normally they have two to four. As is the case in several other genera of sea ducks (e.g. *Melanitta*, *Somateria* and *Mergus*), the Harlequin shows social tendencies when rearing young. Quite frequently two or three females will have a mixed group of downies in common in which all sizes of young may occur. No tendency to 'rob' downies from each other has been noticed. The aggressive behaviour of the females in a group of broods is not very pronounced and no real combats have been recorded. Females unsuccessful in breeding sometimes participate in the rearing of broods.

The female takes her brood as soon as possible to a secluded part of the river where they stay for some time, moving about very little. The duck is very anxious about her offspring and when the brood is in danger she assumes what looks like the Prone-Posture and utters a jarring sound (Barrow's Goldeneyes behave in the same way). She is then very bold and I once approached to within eight feet of a female in this posture.

The young grow very fast and according to Faber (1822) they are fledged after 40 days. Very early they show the same excellent adaptation to their habitat as the old birds. Their pre-fledging mortality is probably rather low and their worst enemies are the Mink and bad weather. The mortality in five broods (or more probably, seven, since two were each accompanied by two females) was recorded. Of the 37 ducklings in these broods, 24 survived one week and 19 two weeks from the date when first seen, indicating losses of at least 35% in the first week but a much reduced mortality rate thereafter.

To catch a young Harlequin with bare hands when it is in the water is almost impossible because even when quite small they dive with great skill in very turbulent rapids. They use the same technique as the adults when avoiding an intruder; that is they let the current carry them downstream.

**Table III. Feeding efficiency of diving ducks in the River Laxá.** An observation period is a time during which constant feeding takes place. The dive/pause ratio is the quotient of the average period of a series of dives divided by the average length of the corresponding series of periods spent at the surface of the water during a spell of diving.

	Observation periods (min.)			Number of dives	Duration of dives (sec.)		Dive/pause ratios
	number	lengths	total		mean	range	
Harlequin Duck	34	12-31	510	1028	16.2	3.7-34.2	4.0
Long-tailed Duck	17	7-19	148	302	10.1	4.1-22.2	2.2
R.-b. Merganser	11	4-13	91	221	11.2	3.1-19.1	1.9
Barrow's Goldeneye	27	3-17	310	652	8.7	2.7-18.4	1.9
Common Scoter	8	5-11	75	210	8.7	2.4-11.1	1.0
Tufted Duck	7	3-8	42	182	6.0	2.6-8.1	0.7
Scaup	18	5-12	133	440	6.4	2.1-9.2	0.9

Usually they first try to hide under the dense curtain of vegetation hanging down from the banks of the river and islands.

Young Harlequins are hardly ever seen on land but they may loaf on the shore within a foot of the water or on ledges in the river. All the time the female and young remain on the breeding ground they live a very inconspicuous life. Not until the young are fledged does the female take them down to the sea according to Gudmundsson (1961) who also states that females with fully fledged young may occasionally be met with far inland as late as 20th September.

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# Geese in cold winter weather

JULES PHILIPPONA

## Introduction

When studying geese, it has sometimes been possible to watch how these birds react to severe winter weather, with phenomena such as snow cover, low temperatures, sometimes combined with strong winds. Most of the observations were made in the Netherlands and some in Mecklenburg (German Democratic Republic). They conform closely with those of Markgren (1963) in the southern part of Sweden.

## Haunts of geese

In the hard winter of 1962-3 only comparatively small numbers of geese remained in the Netherlands throughout the winter. Many of these geese (their total number perhaps amounting to between 4,000 and 5,000 birds, all species combined) did not occur in the well-known geese haunts. Some groups stayed in the neighbourhood of those places, but mostly in a somewhat different habitat. Scattered groups appeared in parts where geese are never seen in normal times. Some examples illustrate the use of abnormal winter habitats:

(a) In the western part of Noord-Brabant geese wintered near the villages Etten and Hoeven (51°34'N, 4°36'E). Close to the north of this region the open grasslands near the river Mark provide thousands of geese with very important feeding grounds in other winters. Probably no geese visited this region in 1962-3 during the long periods with frost and snow cover. Instead, the geese (600-1,100 White-fronted Geese *Anser albifrons*, some tens of Bean Geese *Anser fabalis*, ten Pink-footed Geese *Anser brachyrhynchus* and some Barnacle Geese *Branta leucopsis*) occurred in the surroundings of the villages mentioned, in a habitat that consisted of pastures, winter grain fields, small fields of Brussels sprouts, hedges, farm houses and narrow roads.

(b) A group of 16 Bean Geese stayed in the dunes near Zandvoort (52°22'N, 4°32'E) for some weeks in January. These birds were seen on the open water of some canals and feeding on the long grasses on the steep banks of the canals (photograph at p. 14 of Section II).

Some of the reasons causing geese to shun the large well-known geese haunts in the Netherlands were: (1) the snow cover made the short grasses of the grasslands difficult of access or not accessible at all; (2) in the landscape of the normal haunts which is mostly very open, the geese were

more exposed to the chilling effect of the frequent strong winds and to drifting snow; (3) instead, other regions provided foods like sprouts, which were much eaten, while the geese probably also profited by the cover which the landscape offered there.

## Feeding

In the Netherlands grass forms the most important staple food for most species of geese. When the snow cover is rather thin, and as long as the snow is loose and soft, the geese can reach the grass by removing the snow by means of their bills. Markgren (1963) shows (Figure 8) that Bean Geese can reach the vegetation under a snow cover of 15 cm.

Some examples from field observations:

27th December, 1963: Near Oudega in Friesland (52°57'N, 5°32'E) some thousands of Pinkfeet and Barnacles feed on grassland which is covered with a layer of 5-8 cm. of loose snow. Some grass-blades appear above the snow. Obviously only few difficulties are met with in feeding.

23rd February, 1963: Near Someren (51°23'N, 5°45'E) a flock of 140 Bean Geese feeds on a pasture which is covered with 10 cm. of rather loose snow. When inspecting this feeding ground it appears that in many small cavities the underlying grass has become visible. The geese made these openings with their bills.

28th December, 1964: Between Wiebkenhagen and Löbnitz in Mecklenburg (54°57'N, 12°42'E) 350 Bean Geese stay in fields covered with a layer of 8-10 cm. of loose snow. As far as can be seen at a distance, feeding can take place fairly normally.

We may conclude that feeding in grounds covered with a layer of 10 cm. of loose snow can continue in most cases. It is probable, however, that in these circumstances time and energy are wasted by the grubbing movements of the bill. These losses could be compensated by restricting other activities like taking wing at alarm and making long flights between feeding grounds and roosts.

In the Netherlands the snow was covered with glazed frost in the first days of January, 1963. The geese soon reacted to this fact. Thousands of them abandoned their haunts in this country and soon reached more favourable regions in France (Den Daas, 1963).

Those geese that stayed profited from

the closed hunting season from the beginning of January. They showed greater tameness than normal and could be seen feeding and even roosting nearer to roads and houses than can be called normal for these birds. The geese were able to save energy in this manner.

In certain circumstances geese do not walk when they are feeding but lie down on the ground instead, only occasionally taking a few steps and then lying down again. The bird takes the food that is within reach of its bill. We can agree with Markgren (1963) that the birds protect their legs in this way from the cooling effect of the wind. Geese may behave like this whether or not the ground is covered with snow. Generally geese lie down when low temperatures ( $-3^{\circ}\text{C}$  or lower) are combined with strong winds.

When the weather becomes very unfriendly (stormy wind, drifting snow, low temperature) geese show clear signs of inactivity, which again are described by Markgren (1963). The birds lie down on the ground with their fronts towards the wind and they often do not feed at all but sleep.

Some relevant field observations:

12th January, 1963: Near Lage Zwaluwe ( $51^{\circ}42'\text{N}$ ,  $4^{\circ}45'\text{E}$ ) 500 White-fronted Geese feed on grassland which is covered with rime in the early morning. Many geese are grazing in a lying position (photo Section II p.14). Weather: moderate wind, temperature  $-8^{\circ}\text{C}$ .

8th March, 1964: Big numbers of Whitefronts and Barnacles have alighted on pastures near Tjerkgaast ( $52^{\circ}54'\text{N}$ ,  $5^{\circ}41'\text{E}$ ) after their morning flight from the roost. The ground is covered with some rime. Most of the geese start feeding in a lying position (photo Section II p.15). Later when the rime has disappeared and the temperature has risen, the geese start walking. Weather: fairly strong wind, temperature  $-5^{\circ}\text{C}$ .

30th December, 1964: A flock of 100 Bean Geese lies in drifting snow near Trent on Rügen, Mecklenburg ( $54^{\circ}30'\text{N}$ ,  $13^{\circ}15'\text{E}$ ). Some birds are feeding, most of them however are sleeping with their heads under their wings. Weather: strong wind, temperature  $-2^{\circ}\text{C}$ .

As was stated before most of the flocks which were observed during the severe winter showed considerably less shyness than at other times.

17th February, 1963: Hoeven ( $51^{\circ}34'\text{N}$ ,  $4^{\circ}38'\text{E}$ ). A group of 20 Whitefronts, 7 Beans and 10 Pinkfeet stay on a small pasture at a distance of 75 m. from a house. The landscape is snow-covered. Some children are throwing snowballs at each other, 60 m. from the geese. These

are not disturbed. Only when we come nearer, do they take wing, at a distance of 40 m.

The food of the geese in the cold winter of 1962-3 still consisted partly of grass, but many geese turned to another staple diet. One of the most important foods was formed by Brussels sprouts. Especially in the province of Noord-Brabant there occur many small fields of sprouts, mostly in the surroundings of villages and farm-houses. Of the plants, the geese ate the sprouts, the leaves and even the stalks.

23rd February, 1963: Etten ( $51^{\circ}33'\text{N}$ ,  $4^{\circ}40'\text{E}$ ). A flock of 600 Whitefronts, 30 Beans and 5 Barnacles stays near a field of sprouts. Regularly small groups fly to the sprouts and begin to eat (photograph, Section II p. 15).

Abnormal feeding habits were also recorded by Harrison and Hudson (1964). In England White-fronted Geese were seen feeding on kale, sprouts and maize in 1962-3. In the Netherlands geese were also coming to some places where food had been provided by man. There they ate maize, wheat and other cereals.

## Roosts

Geese mostly have their roosts on shallow waters. They also often sleep on ice (Brotherston, 1964, Markgren, 1963, Mathiasson, 1963, Rutschke, 1962).

In 1962-3, as well as in other years, geese often used their roosts when these were frozen over. Sometimes even new roosts were formed when the water is ice-covered, as occurred on the IJsselmeer near the new Noordoostpolder. The IJsselmeer near this polder is not suited for roosts, for the water is deep and ships often pass. When the water is ice-covered, however, thousands of geese sometimes sleep there. Then they feed in the pastures and fields of the neighbouring Noordoostpolder.

In the severe winter of 1962-3 geese were seen to roost in their feeding grounds:

22nd February, 1963: Etten. A flock of 480 Whitefronts and 20 Beans feed on sprouts. Afterwards when the evening twilight has come, they fly 50 m. away and settle on the snow. An hour later they are still there. It is quite certain that they will pass the night here, although some farm-houses are within 150 m.

## Conclusions

In those regions where many geese winter, the weather is rather mild most of the time. Sometimes the series of mild winters is interrupted by a severe one. Moreover cold spells of short duration occur in many mild

winters. The geese can react to the cold weather in two different ways:

1. They can emigrate to regions with more favourable conditions. Tens of thousands of geese left (or passed) the Netherlands in the cold winter of 1962-3 and arrived in France.

2. The geese can try to adapt themselves to the changed conditions. Some thousands of geese stayed in the Netherlands in 1962-3. Most of them succeeded in surviving. The adaptations took the following forms: the geese stayed mostly outside their normal wintering places, often showed

other feeding habits, often changed their roosting behaviour and showed less shyness.

During the shorter cold spells of mild winters only few wintering geese leave the Netherlands. They prove to be hardened, even when temperatures fall very low (less than 10°C). Only when some weather factors give an unfavourable combination (thick snow, stormy wind, very low temperatures or glazed frost on a snow cover) will many geese disappear soon, as was the case in 1962-3. But this happens only when no or little food remains accessible.

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## Catching wildfowl by artificial light

ROY H. DENNIS

At Fair Isle Bird Observatory we use an assortment of methods for catching birds to ring. The majority of our catch each year are either passerines trapped in permanent Heligoland traps, small wire traps and mist-nets, or Fulmars, Shags, auks and gulls, ringed on the cliffs. Since 1959 we have been catching a variety of species by the use of artificial light at night. We have been particularly interested in those species which do not usually enter our normal traps, including wildfowl, waders and wintering gulls. We have so far caught and ringed by the use of artificial light about 630 birds of 51 species. In 1965, we caught 166 birds of 28 species by this method alone.

Fair Isle is generally speaking a poor place for wildfowl. Thirty species of wildfowl have been recorded on the island, but all, except the Eider which breeds, are usually recorded in small numbers on migration. The latest addition to the list was a pair of Harlequin Ducks, which stayed in one of the geos from 11th January to 2nd February, 1965. Most of the wildfowl recorded are on diurnal passage past Fair Isle and after flying over the island or circling a few times they continue their migrations. In bad weather, some of them stop on the island to await better conditions and it is at these times that they roost overnight on the island and we have a chance to dazzle-net them. The migrant sea-ducks stay in the rocky bays and are generally out of our range, but the rest of the ducks, geese and swans usually roost on the island. Invariably, they roost in a different area from that where they spend the day and most of them are found at night on small lochs or burns. Mallard and Teal, which have become 'semi-resident' on the island, forage at night in the burns and marshy areas.

One difficulty with the dazzle-netting technique is that the weather conditions must be suitable otherwise one will have little success. The ideal night is one with no moon, a howling gale and lashing rain; if one is brave, or daft, enough to venture out with an artificial light and a net, there is a very good chance of catching wildfowl and waders.

### Equipment

The most important item of equipment is a powerful lamp. We now use, after trying a variety of electric torches, a converted Tilley lamp. Originally, this lamp was a

Tilley radiator heater, which has a heating mantle mounted on a vaporizer and a dish reflector. The base of the heater is a pressurised tank for holding paraffin; a pump is fitted in the side of the tank for pumping the paraffin up the vaporizer and into the heating mantle. We had the reflector silvered and replaced the heating mantle with a 500 candle power lighting mantle shielded by a glass dome for outside work. Another lamp we converted has a 300 c.p. mantle and we find this nearly as efficient and easier to keep alight.

This equipment gives a very strong wide beam. A powerful torch with a narrow beam is not as efficient, because one has to spend so much time sweeping with the torch beam to find a bird, whereas the Tilley lamp gives off a beam of, say, 150° arc and illuminates all the birds in front of the operator. Also, on Fair Isle, we find it cheaper and handier to run a lamp on paraffin, rather than buying batteries for a large torch, especially as the batteries are only of use for dazzling when they are new; once they are slightly run down they lose most of their effectiveness for dazzling.

The other piece of essential equipment is a good hand-net: really one needs several hand-nets suitable for different weather conditions and species. We make our nets from a length of stout fencing wire, which we shape into a circle, from one-and-a-half to three feet diameter. A net is fixed on to the wire; for smaller birds we use a small mesh and do not have much 'bag' on the net and for larger birds we use a larger mesh and have more 'bag'. If the mesh is too big, the birds tend to get tangled and time is wasted in extracting them. The ends of the wire are twisted together and bound tightly to the end of a bamboo cane or long stick. For all purposes we prefer the longest and lightest pole and the largest diameter of net. Our best hand-net has a 12 ft. bamboo handle, but often the wind is too strong and the larger hand-nets become unwieldy. It is important that the handle is firm and does not whip in a wind and that the wire frame is tightly bound to the handle so that the net will not swing in the wind or rattle against the handle when in use. We use binding wire and string to join the net to the handle and finish it off with adhesive tape.

When dazzle-netting we always carry a small rucksack containing bird-bags and sacks for holding the catch, an electric torch, note book for recording retraps and matches for re-lighting the Tilley if it



blows out. We wear long rubber boots so that we can wade into wet areas. We find the oilskins make too much noise as we walk and scare the birds, so we wear anoraks.

### Methods

On Fair Isle the summer months are too light and the first nights suitable for dazzle-netting are in August. The best team for dazzle-netting on Fair Isle consists of two people; the lamp-man who carries the lamp and the net-man who walks directly behind, holding the net. It takes practice to become a good team, because the net-man must keep directly behind the leader and not switch on a torch to find his way over rough ground. Our routine on a suitable night is to make a circuit of the island, visiting various small lochs and marshes and walking along streams. Nearly all wildfowl and waders prefer to roost overnight on or beside water and the choice of roosting area is affected by wind direction and strength. On suitable nights we walk up the Gilsetter burn to Sukka Mire and the Mire of Vatnagard, which are favoured roosting places because they are marshy areas dotted with small pools, in an isolated part of the island.

The leader carries the lamp, in front of him, shining it on to pools and streams; most birds show up as a pale dot in the beam. The light is shone at the bird and both persons approach as silently as possible. Usually the bird either flies away as soon as the light is shone on to it or else it is dazzled and stays on the pool. No talking should be necessary and it takes practice for the net-man to decide which bird is being dazzled without actually being told by the leader. Ducks, once they are dazzled, tend to swim slowly away or round in circles but great care should be taken not to scare them by rushing after them. Making a splash as you step into water is the quickest way to lose a duck. Care must be taken to walk quietly through water, keeping the light shining on the bird. On really dark nights, some wildfowl will actually swim towards the light. If the bird is swimming quietly in front of the lamp-man, the net should be lowered to head height, so that the distance can be judged, and then brought down quickly over the bird. The net-man should not move out of the shadow before the net is over the bird. There are now two courses of action. If it is a solitary bird, the net-man runs to the net as quickly as possible and extracts the bird in the light; but if it is one bird from a flock, the light-man should continue to shine the light on the rest of the flock and walk past the net, the net-

man can then extract the bird in the shadow. The bird is put in a bag and carried by the lamp-man. It is generally easier to catch a single bird than one from a flock. Approach can be made from any direction, but we find into the wind or across it more successful.

Geese and waders tend to walk steadily away from the light and then stop and run towards it; both persons should walk quickly and quietly after the birds until within catching distance. Diving-ducks in shallow pools tend to become dazzled easily and dive as soon as they are netted or become worried. The net should be lowered quickly over them and pulled towards the net-man so that the bird is caught in a bag of netting, sealed by the wire rim of the net; scooping up by a 'shrimping' motion does not seem to work.

We have on two occasions dazzle-netted birds on the sea from a boat. Both birds (a Long-tailed Duck and a Little Grebe) were easily dazzled, once we had found them. We caught them by dropping the net over them and pulling them into the boat, rather than trying to scoop them up, when the net would be visible to them as it entered the water between them and the lamp. Dazzle-netting from a boat has a great potential, but it requires a great deal of local knowledge of boats, tides and rocks. Wildfowl are probably easier to dazzle-net on open water than they are on land, where they are always wary of ground predators.

When dazzle-netting Whooper Swans it is better to use a swan-hook rather than a net to catch them. They are quite easy to dazzle but rather a job trying to control in the dark. If one flies off, it is well worth calling like a swan; they usually answer and land nearby.

We usually take all our captures back to the Bird Observatory for examination and ringing. If it is a wet or windy night we generally roost them overnight at the Bird Observatory in a dry tea chest and release them at dawn, rather than releasing them into a gale at night. If a bird is ringed immediately after capture, rather than being taken back to a base for ringing, it must be held away from the light for several minutes and allowed to become accustomed to the darkness before being released.

During 1965 we dazzle-netted and ringed the following wildfowl at Fair Isle; one Mallard, two Tufted Ducks, one Long-tailed Duck, one Greylag Goose, one Pink-footed Goose, one Barnacle Goose and three Whooper Swans. In previous years we dazzle-netted and ringed two Mallard, two Teal, three Wigeon, one Tufted Duck,

three Eiders, two Greylag Geese and four Whooper Swans.

Dazzle-netting is an extremely exciting method of catching birds for ringing, even though it is carried out in very uncomfortable, and sometimes hazardous, weather conditions. Part of the thrill is that you never know what species your lamp beam will pick up next. Unusual species we have caught and ringed at Fair Isle at night

include Heron (2), Ringed Plover (62), Little Stint (3), American Pectoral Sandpiper (1), Great Black-backed Gull (111), Glaucous Gull (5), and Snow Bunting (5).

Finally, it should be pointed out that all qualified ringers require a licence to use artificial light at night, under paragraph (e) of sub-Section (1) of Section 10 of the Protection of Birds Act, 1954.



## British literature on European wildfowl 1961-65

M. A. OGILVIE

This is the third list of books, papers and notes published in Britain and dealing specifically with the European Anatidae. It covers the years 1961-65, with a few from 1960 not noted earlier. The two previous lists will be found in the Tenth Annual Report, pp. 162-75, covering 1945-57, and the Twelfth Annual Report, pp. 157-62, covering 1957-60. The titles are listed alphabetically by authors' names. Published details of wildfowl ringing are listed separately at the end.

We would also like to draw attention to the published proceedings of two conferences devoted to wildfowl and their wetland habitat.

*First European Meeting on Wildfowl Conservation 1963.* 289 pp. Nature Conservancy, London.

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#### Wildfowl Ringing

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## British literature on European waders 1960-65

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At the instigation of the International Wildfowl Research Bureau, lists of literature published on European waders are to be compiled on similar lines and to perform a similar valuable function to those on wildfowl (*antea* pp. 100-108). This is the first British contribution and covers the years 1960-65. The annual reports on ringing and on rare birds that appear in the journal *British Birds* will be found in the wildfowl publications list and are not repeated here.

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## The W.A.G.B.I. Report and Year Book. Reports for 1964-65 and for 1965-66

The Wildfowlers' Association of Great Britain and Ireland, 43 The Albany, Old Hall Street, Liverpool, 3. Free to members, price to non-members not stated.

Until recently the W.A.G.B.I. annual report was essentially a document for its members. The inclusion of article of scientific and conservation interest began a few years ago. This new trend has been accelerated in the two latest editions, which should appeal to wider audiences.

The most important achievement of W.A.G.B.I. in the years under review was to secure from the Crown Estate Commissioners authority for Association members to carry guns on Crown foreshores. Such authority became necessary when the Firearms Act, 1965, came into force. That powerful measure has already done much to reduce irresponsible shooting and it is good to know that this has been achieved without seriously curtailing the freedom of law-abiding wildfowlers. In three areas, local associations have gone further and obtained leases of the foreshore. It seems likely that such arrangements will be made elsewhere in the near future, so that clubs will exercise an increasing powerful influence on the sport of wildfowling.

Various other aspects of policy, administration and records of activities take up nearly half of the 1964-65 Report. The remainder is devoted to articles, a few primarily academic, but the majority very relevant to management problems. Contributors include members of the staff of the Nature Conservancy and of the Wildfowl Trust. A paper by Harrison, Harrison and Meikle on 'The establishment of a winter wildfowl population on a local reserve', a detailed analysis of wildfowl usage of the Sevenoaks gravel pit reserve, should be read by anyone contemplating setting up a reserve of that type. The 1965-66 Report includes a register of local reserves, privately-owned or administered by a variety of organisations. Who would have imagined, a dozen

years ago, that W.A.G.B.I. would be urging fowlers to add to this already extensive list?

The progress of the Association duck- and goose-rearing schemes continues to be reported in detail. 11,364 ducks were reared, ringed and released in 1964, and 13,265 in 1965, bringing the total reared since the scheme began in 1954 to nearly 64,000. The establishment of colonies of Greylag Geese, particularly in north-west England seems to be flourishing too. The art of duck-rearing is illuminated by Ernest Blezard's account of Sir Richard Graham's work at Netherby, Cumberland, between 1890 and 1926. Perhaps the most discouraging feature of that programme is that, despite its exceptional success, local stocks of most of the species reared did not persist for very long after artificial rearing has ceased.

In 1965 W.A.G.B.I. established a Conservation Centre at the old Boarstall Decoy, in Oxfordshire, as a base for its rearing programme where intensive and long-continued technical experiments will be possible. A paper by Wardell and Harrison analysing the recoveries of W.A.G.B.I.-reared Mallard in 1965-66, and in earlier years, suggests that the mortality rates of these birds resemble those of wild ducks, an encouraging sign. A paper on the sex-ratio of dabbling ducks shot in Kent carries 'blinding with science' to depths unprecedented in these Reports.

One critical note: much of the wealth of information in the 1965-66 report may well remain undetected, because it lacks either a list of contents or an index. The new covers, taken from photographs by Pamela Harrison, are a welcome change from the rather plain and matter-of-fact presentation of previous years.

**Die Wildgänse Nordeurasiens.** Dr. S. M. Uspenski. Die Neue Brehmbücherei Nr. 352. A. Ziemsen Verlag. Wittenberg Lutherstad. 1965. 6,80 MDN. (Dutch Guilders 7,05).

In the first part of his book Dr. Uspenski, of Moscow State University, describes the different species of geese of the Eurasian Continent. He deals with their distribution, sometimes with their numbers, with data on the breeding season, the food and with the wintering of some species.

The Snow, Red-breasted, Brent and Barnacle Geese are dealt with more fully than the others (White-fronted, Lesser White-fronted and Bean Geese). For each species the breeding grounds are given on a vegetation map. A number of photographs illustrate the birds on the breeding grounds and the habitat in the north of the Soviet Union and on the shores of the Caspian Sea.

Many interesting details are given, especially of the Snow Goose and the little known Red-breasted Goose. Of this last bird the total population is estimated at 50,000 and most of them stay for practically the whole of their lives within one country, the Soviet Union. We learn that the males of the Brent Goose moult in separate groups. One may wonder if a permanent bond between male and female can exist under such circumstances. The number of Barnacle Geese breeding in the Soviet Union is given as only 1,000 on Vaygach Island and the south island of Novaya Zemlya. But what to think of the 20-25,000 Barnacles which winter in Germany and the Netherlands, and which should breed there or elsewhere in the U.S.S.R., to judge from recoveries of ringed geese?

The author does not use the generally adopted division of the White-fronted Goose into four sub-species and of the Bean Goose into six sub-species. He recognises only two races of Whitefronts (*albifrons* in northern Eurasia and western North America and *gambelli* in eastern Canada and Greenland) and four races of Bean Geese (*brachyrhynchus*, *fabalis*, *serrirostris* and *sibiricus*). The inadequacy of his information on distribution outside the Soviet Union is, however, a minor matter in comparison with the details given about them within that vast country.

The second part of the book gives much information on ecological and other facts

concerning the breeding season. The typical black-and-white colouring of many arctic birds and mammals is caused by the intensity of certain oxidation processes. The rule of Bergmann, that within a given species the arctic populations have the largest measurements, does not hold for some geese (e.g. Bean Goose and Canada Goose). These departures from the rule, however, can be connected with the scarcity of food and the great use of energy for the regulation of the body temperature.

The snow-cover plays an important role in the life of the geese. The limit of the region that has three snow-free months coincides with the northernmost breeding sites of the White-fronted and Bean Geese. The Brent Goose and the Snow Goose can still breed in regions where the snow-free period is little more than two months. The incubation period of these species is shorter than in other geese. Exposed valley slopes offer favourable micro-climatic circumstances for breeding sites of White-fronted and Bean Goose because snow-melting starts earlier there than on level ground.

Important statements are made about the role of geese in the biocoenose of the arctic and sub-arctic regions. These include figures for the production of vegetable matter in the tundra and the consumption by the geese. The vegetation of constantly-visited sites is strongly influenced by the grazing and manuring of the geese.

The arrival of the first geese on the breeding grounds coincides with the moving up of the isotherm of  $-5^{\circ}\text{C}$ . In the extreme north mass-arrivals follow within some days, in more southerly parts within some weeks. The departure from the breeding grounds occurs well before a complete snow-cover has been formed.

The writer ends his books with a chapter on the economic value of the geese. Finally he mentions the importance of co-operation on an international level and gives as an example the well-known goose-counts of the International Wildfowl Research Bureau.

Without doubt this book can have a favourable influence on the co-operation on wildfowl affairs between countries of different parts of Europe.

J. PHILIPPONA





**THE WILDFOWL TRUST, SLIMBRIDGE, GLOUCESTERSHIRE**

**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1964**

£	EXPENDITURE	£ s. d.	£ s. d.	£	INCOME	£ s. d.	£ s. d.
<b>To General Expenses:-</b>				<b>By General Income:-</b>			
5828	Salaries and Superannuation, Administrative Staff . . . . .	5745 18 6		8907	Subscriptions, Ordinary . . . . .	9257 1 9	
258	Travelling, Administrative Staff . . . . .	280 7 10		420	Subscriptions, Life Members . . . . .	525 0 0	
1211	Rent, Rates, Water Rates and Insurance . . . . .	1237 11 10		7131	Donations (including Copper Coin Campaign) . . . . .	878 9 8	
2629	Postages, Telephone and Miscellaneous Expenses . . . . .	2687 12 4		1693	Income Tax repaid on Covenants . . . . .	1888 17 10	
400	Maintenance of Buildings . . . . .	651 10 5		455	Receipts from Sale of Annual Reports . . . . .	582 11 3	
1603	Printing and Stationery . . . . .	1478 11 11		453	Receipts from Annual Dinner . . . . .	325 8 0	
681	Hostel Upkeep . . . . .	223 19 0		590	Restaurant . . . . .	991 15 3	
564	Loan Interest . . . . .	530 0 0		—	Interest on Investment and Deposits . . . . .	297 2 4	
308	Bank Charges, less Interest earned . . . . .	175 7 1					
2482	Printing Annual Report . . . . .	3116 9 9		<u>19649</u>			14746 6 1
428	Expenses of Annual Dinner . . . . .	317 5 8					
2790	Advertising . . . . .	2633 18 5					
<u>19182</u>			19078 12 9				
<b>New Grounds and Peakirk:-</b>				<b>New Grounds and Peakirk:-</b>			
11736	Salaries, Wages and Superannuation . . . . .	11879 19 2		33160	Gate Takings . . . . .	40613 4 0	
493	Travelling . . . . .	335 7 1		3134	Sales of Surplus Wildfowl . . . . .	4889 3 0	
1536	Purchases and Transport of Wildfowl and Eggs . . . . .	1365 11 11		<u>36294</u>			45502 7 0
5934	Food for Wildfowl . . . . .	6248 14 4					
1766	Maintenance of Grounds . . . . .	1456 15 9					
745	Transport and Mechanical Equipment and Maintenance . . . . .	1208 6 6					
1360	Fuel and Power . . . . .	1306 16 5					
500	Miscellaneous . . . . .	463 3 3					
<u>24070</u>			24264 14 5				
<b>Gate Houses:-</b>				<b>Gate Houses:-</b>			
15824	Purchases for Resale . . . . .	14267 19 5		22596	Sales, General . . . . .	24505 0 4	
384	Royalties Coloured Key Publications . . . . .	497 11 7		1759	Sales, Coloured Key Publications . . . . .	2457 17 0	
3001	Salaries, Wages and Superannuation . . . . .	3336 18 8					
902	Miscellaneous . . . . .	1770 19 5		<u>24355</u>			26962 17 4
<u>20111</u>			19873 9 1				

**NOTE.**—The figures in the margin are those for the year ended 31st December 1963 and are given for the purpose of comparison.

<b>Scientific and Educational:-</b>			
11598	Salaries and Superannuation		11340 1 4
3924	Travel and Miscellaneous Research Expenditure		3329 14 6
1152	Abberton Ringing Station		1181 9 7
1074	Borough Fen Decoy		958 7 2
<u>17748</u>			<u>16809 12 7</u>
<b>Capital Expenditure:-</b>			
131	Restaurant		208 5 0
252	Development		3399 1 3
326	Equipment		120 14 0
—	Contribution to cost of British Transport Film <i>Wild Wings</i>		3000 0 0
39	Lavatories		— — —
68	New Water Supply		— — —
<u>816</u>			<u>6728 0 3</u>
	Less Profit on Sale of Freehold Property	224 10 0	
	Sale of Gate House	200 0 0	
<u>—</u>			<u>424 10 0</u>
			<u>6303 10 3</u>
<u>81927</u>	<b>To TOTAL EXPENDITURE FOR THE YEAR</b>		<u>86329 19 1</u>
24565	Valuation, 31st December, 1963		23299 0 0
598	Written off Buildings		597 16 3
9445	Balance, carried down.		11008 7 5
<u>116535</u>			<u>£121235 2 9</u>
2175	To Balance, 31st December, 1962		— — —
7000	Transfer to Accumulated Fund		10000 0 0
270	Balance, 31st December, 1964		1278 3 4
<u>9445</u>			<u>£11278 3 4</u>

<b>Scientific and Educational:-</b>			
12000	The Nature Conservancy Grant		12000 0 0
310	Donation from Abberton Ringing Station		415 0 0
528	Duck Adoption		354 9 4
100	Donations for Research		103 3 0
<u>12938</u>			<u>12872 12 4</u>
<u>93236</u>	<b>By TOTAL INCOME FOR THE YEAR</b>		<u>100084 2 9</u>
23299	Valuation, 31st December, 1964		21151 0 0
<u>116535</u>			<u>£121235 2 9</u>
—	By Balance, 31st December, 1963		269 15 11
9445	Balance for year to 31st December, 1964, brought down		11008 7 5
<u>9445</u>			<u>£11278 3 4</u>

**THE WILDFOWL TRUST, SLIMBRIDGE, GLOUCESTERSHIRE**  
**BALANCE SHEET, 31st DECEMBER, 1964**

<i>£</i>	LIABILITIES	<i>£ s. d.</i>	<i>£ s. d.</i>		<i>£</i>	ASSETS	<i>£ s. d.</i>	<i>£ s. d.</i>
7924	<b>Sundry Creditors</b>		11593 10 0		7738	<b>Cash at Bankers and in Hand</b>	1855 14 8	
	<b>Peterborough Provincial Benefit Building Society:-</b>				10211	<b>Cash on Deposit (including Special Funds)</b>	35110 13 3	
	Balance, 31st December, 1963	1499 16 9			17949			36966 7 11
	Less Repaid during year	38 6 1			1000	<b>Investment at Cost (Market Value £1145 approx.)</b>		999 15 0
1500			1461 10 8		2614	<b>Sundry Debtors and Payments in Advance</b>		4446 6 5
	<b>Loans:</b>					<b>Valuation (as valued by the Honorary Director):-</b>		
	Balance, 31st December, 1963	14512 13 10			400	<b>Office Equipment</b>	450 0 0	
	Less Repaid during year	3012 13 10				<b>New Grounds and Peakirk:-</b>		
14513			11500 0 0		8950	Wildfowl	8998 0 0	
	<b>Special Funds (see separate Accounts):-</b>				800	Transport	610 0 0	
10521	Research Centre Fund	2370 3 3			3465	Miscellaneous Equipment	2835 0 0	
—	Drayton Appeal Fund	9940 4 3			650	Hostel and Restaurant Equipment	800 0 0	
—	Tropical Aviary Fund	5101 15 3					13243 0 0	
10521			17412 2 9			<b>Gate Houses</b>		
	<b>Accumulated Fund:-</b>				5590	Stock for Resale	4787 0 0	
	Balance, 31st December, 1963	22700 0 0			1444	Coloured Keys	671 0 0	
	Add Transfer from Income and Expenditure Account	10000 0 0					5458 0 0	
22700			32700 0 0		2000	<b>Scientific and Educational:-</b>		
	<b>Income and Expenditure Account:-</b>				23299	Equipment	2000 0 0	
270	Balance per Account	1278 3 4				<b>Freehold Properties:-</b>		
						Amount, 31st December, 1963, at Cost or Valuation	7185 10 5	
						Less Sale of Glington Cottage, at Cost	1525 10 0	
							5660 0 5	
						Add Chestnut Close, Peterborough, at Cost	1939 7 0	
					7186	<b>Note.—The Freehold Properties are vested in The Wildfowl Trust (Holdings) Ltd.</b>		7599 7 5

<u>57428</u>	<u>£75945 6 9</u>	<u>57428</u>	<u>£75945 6 9</u>

5380	4782 10 0

<b>New Buildings, New Grounds, Slimbridge, Gloucestershire:-</b>	
Amount, 31st December, 1963 . . . . .	11362 13 10
Less Written off to 31st December, 1963 . . . . .	5982 7 7
Written off in year ended 31st December 1964 . . . . .	<u>597 16 3</u>
	<u>6580 3 10</u>

NOTE.—The New Buildings, etc., to be written off over a period not exceeding that of the Lease.

We have examined the above Balance Sheet of The Wildfowl Trust, dated 31st December, 1964, 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.

S. J. DUDBRIDGE & SONS,  
Auditors.

### THE WILDFOWL TRUST SPECIAL FUNDS AS AT 31st DECEMBER, 1964

RESEARCH CENTRE FUND	£ s. d.	£ s. d.
Balance as at 31st December, 1963 . . . . .		10521 7 2
Add Tax recoverable for prior years on Interest received . . . . .	158 16 8	
Donations received during year ended 31st December, 1964 . . . . .	5412 17 0	
Interest receivable year ended 31st December, 1964 . . . . .	<u>473 11 7</u>	
(The total includes £15,000 donated by The Wolfson Foundation)		6045 5 3
		<u>16566 12 5</u>
Less Expended on New Research Centre, year ended 31st December 1964 . . . . .	14196 9 2	
Balance, 31st December, 1964 (as per Balance Sheet)		<u>£2370 3 3</u>

DRAYTON APPEAL FUND	£ s. d.
Donations received during year ended 31st December, 1964 . . . . .	9600 11 8
Add Interest receivable (gross) year ended 31st December, 1964 . . . . .	339 12 7
Balance, 31st December, 1964 (as per Balance Sheet) . . . . .	<u>£9940 4 3</u>

TROPICAL AVIARY FUND	£ s. d.
Donation received during year ended 31st December, 1964 . . . . .	5000 0 0
Add Interest receivable (gross) year ended 31st December, 1964 . . . . .	101 15 3
Balance, 31st December, 1964 (as per Balance Sheet) . . . . .	<u>£5101 15 3</u>

**THE WILDFOWL TRUST, SLIMBRIDGE, GLOUCESTERSHIRE.**

**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1965.**

1964	EXPENDITURE	£	s.	d.	£	s.	d.	1964	INCOME	£	s.	d.	£	s.	d.
	<b>To General Expenses:-</b>								<b>By General Income:-</b>						
5746	Salaries and Superannuation, Administrative Staff . . . . .	6590	5	5				9257	Subscriptions, Ordinary . . . . .	9571	19	10			
280	Travelling, Administrative Staff . . . . .	252	9	7				525	Subscriptions, Life Members . . . . .	105	0	0			
1238	Rent, Rates, Water Rates and Insurance . . . . .	1430	16	3				878	Donations (including Copper Coin Campaign) . . . . .	1838	17	8			
2688	Postages, Telephone and Miscellaneous Expenses . . . . .	2589	7	9				1889	Income Tax repaid on Covenants . . . . .	1931	8	4			
652	Maintenance of Buildings . . . . .	925	4	1				583	Receipts from Sale of Annual Reports . . . . .	563	11	4			
1479	Printing and Stationery . . . . .	1813	15	7				8	Annual Dinner (net) . . . . .	8	11	0			
224	Hostel Upkeep (net) . . . . .	50	5	10				992	Restaurant (net) . . . . .	1088	10	10			
530	Loan Interest . . . . .	436	11	6				297	Interest on Investment and Deposits . . . . .	1271	16	1			
175	Bank Charges, less Interest earned . . . . .	203	17	0											
3116	Printing Annual Report . . . . .	2111	3	3											
2634	Advertising . . . . .	2944	10	3											
<u>18762</u>					19348	6	6	<u>14429</u>					16379	15	1
	<b>New Grounds and Peakirk:-</b>								<b>New Grounds and Peakirk:-</b>						
11880	Salaries, Wages and Superannuation . . . . .	13500	7	10				40613	Gate Takings . . . . .	38236	16	0			
335	Travelling . . . . .	424	7	6				4889	Sale of Surplus Wildfowl . . . . .	3370	12	6			
1366	Purchases and Transport of Wildfowl . . . . .	3134	15	3											
6249	Food for Wildfowl . . . . .	6946	1	10											
1457	Maintenance of Grounds . . . . .	2915	2	11											
1208	Transport and Mechanical Equipment and Maintenance . . . . .	1118	0	9											
1307	Fuel and Power . . . . .	1404	8	7											
463	Miscellaneous . . . . .	830	12	11											
<u>24265</u>					30273	17	7	<u>45502</u>					41607	8	6
	<b>Gate Houses:-</b>								<b>Gate Houses:-</b>						
14268	Purchases for re-Sale . . . . .	21539	11	1				24505	Sales, General . . . . .	26503	3	6			
498	Royalties Coloured Key Publications . . . . .	315	16	9				2458	Sales, Coloured Key Publications (2nd edition) . . . . .	1412	4	3			
3337	Salaries, Wages and Superannuation . . . . .	3864	17	3											
1771	Miscellaneous . . . . .	1884	13	0											
<u>19874</u>					27604	18	1	<u>26963</u>					27915	7	9

<b>Scientific and Educational:-</b>			
11340	Salaries and Superannuation . . . . .	13535	8 6
3330	Travel and Miscellaneous Research Expenditure . . . . .	4929	2 5
1181	Abberton Ringing Station . . . . .	1306	11 2
958	Borough Fen Decoy . . . . .	1029	8 2
<u>16809</u>			<u>20800 10 3</u>

<b>Capital Expenditure:-</b>			
208	Restaurant . . . . .	—	—
3399	Development . . . . .	2129	5 8
121	Equipment . . . . .	869	0 7
3000	Contribution to cost of British Transport Film 'Wild Wings' . . . . .	—	—
<u>6728</u>		<u>2998</u>	<u>6 3</u>
225	Less Profit on Sale of Freehold Property . . . . .	—	—
200	Sale of Gate House . . . . .	—	—
<u>6303</u>			<u>2998 6 3</u>

86013	To <b>TOTAL EXPENDITURE FOR THE YEAR</b> . . . . .	101025	18 8
23299	Valuation, 31st December 1964 . . . . .	21151	0 0
598	Written off Buildings . . . . .	82	10 0
11008	Balance, carried down . . . . .	2628	2 4
<u>120918</u>		<u>£124887</u>	<u>11 0</u>

10000	To Transfer to Accumulated Fund . . . . .	2600	0 0
1278	Balance, 31st December 1965 . . . . .	1306	5 8
<u>11278</u>		<u>£3906</u>	<u>5 8</u>

<b>Scientific and Educational:-</b>			
12000	The Nature Conservancy Grant . . . . .	14250	0 0
415	Donation from Abberton Ringing Station . . . . .	415	0 0
355	Duck Adoption . . . . .	425	9 6
103	Donations for Research . . . . .	161	10 2
<u>12873</u>			<u>15251 19 8</u>

99767	By <b>TOTAL INCOME FOR THE YEAR</b> . . . . .	101154	11 0
21151	Valuation, 31st December 1965 . . . . .	23733	0 0
<u>120918</u>		<u>£124887</u>	<u>11 0</u>

270	By Balance, 31st December 1964 . . . . .	1278	3 4
11008	Balance, for the year to 31st December 1965, brought down . . . . .	2628	2 4
<u>11278</u>		<u>£3906</u>	<u>5 8</u>

**THE WILDFOWL TRUST, SLIMBRIDGE, GLOUCESTERSHIRE**  
**BALANCE SHEET, 31st DECEMBER, 1965**

	LIABILITIES	£ s. d.	£ s. d.			ASSETS	£ s. d.	£ s. d.
<u>1964</u>					<u>1964</u>			
11594	<b>Sundry Creditors</b>		10536 11 2		1856	Cash at Bankers and in Hand	2447 17 8	
	<b>Peterborough Provincial Benefit Building Society:-</b>				35111	Cash on Deposit (including Special Funds)	20356 13 8	
	Balance, 31st December 1964	1461 10 8			<u>36967</u>			22804 11 4
	Less Repaid during year	32 14 2						
1462			1428 16 6		1000	<b>Investment at Cost</b>		999 15 0
	<b>Loans:-</b>				4446	<b>Sundry Debtors and Payments in Advance</b>		5208 7 7
	Balance, 31st December 1964	11500 0 0				<b>Valuation (as valued by the Honorary Director):-</b>		
	Less Repaid during year	4300 0 0			450	<b>Office Equipment</b>	475 0 0	
11500			7200 0 0		8998	<b>New Grounds and Peakirk:-</b>		
	<b>Special Funds (see separate accounts):-</b>				610	Wildfowl	10140 0 0	
12310	Research Centre Fund	2712 5 1			2835	Transport	860 0 0	
5102	Tropical Aviary Fund	5461 2 11			800	Miscellaneous Equipment	3225 0 0	
	Contingencies Reserve Fund	6100 0 0				Hostel and Restaurant Equipment	678 0 0	14903 0 0
17412			14273 8 0		4787	<b>Gate Houses:-</b>		
	<b>Accumulated Fund:-</b>				671	Stock for re-Sale	6355 0 0	
	Balance, 31st December 1964	32700 0 0				<b>Scientific and Educational:-</b>		
	Add Transfer from Income and Expenditure Account	2600 0 0			2000	Equipment	2000 0 0	
		35300 0 0			<u>21151</u>			23733 0 0
	Less Transfer to Contingencies Reserve Fund	5000 0 0				<b>Freehold Properties:-</b>		
32700			30300 0 0		7599	Amount, 31st December 1964, at Cost or Valuation		7599 7 5
	<b>Income and Expenditure Account:-</b>					<b>New Buildings, New Grounds, Slimbridge, Gloucestershire:-</b>		
1278	Balance per Account		1306 5 8			Amount, 31st December 1964	11362 13 10	
						Less Written off to 31st December 1964	6580 3 10	
						Written off in year ended 31st December 1965	82 10 0	
							6662 13 10	
					4783			4700 0 0
						<b>NOTE.—The New Buildings, etc., to be written off over a period not exceeding that of the Lease.</b>		
<u>75946</u>			<u>£65045 1 4</u>		<u>75946</u>			<u>£65045 1 4</u>

We have examined the above Balance Sheet of The Wildfowl Trust, dated 31st December, 1965, 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.  
24th February, 1966.

S. J. DUDBRIDGE & SONS,  
Auditors.

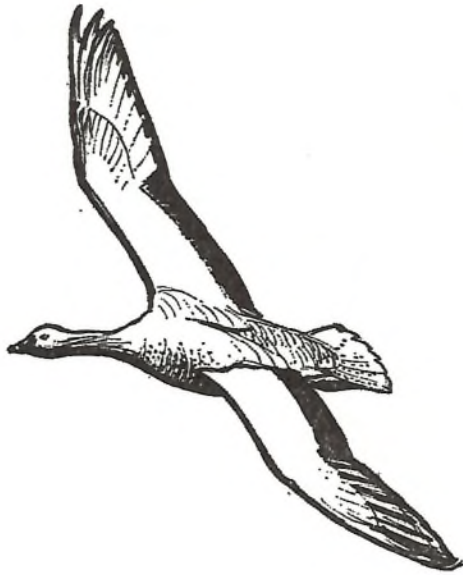


**THE WILDFOWL TRUST**  
**SPECIAL FUNDS AS AT 31st DECEMBER, 1965**

<b>Research Centre Fund (including Drayton Appeal)</b>			
Amount Contributed (including Interest) to 31st	£	s.	d.
December 1964 . . . . .	26506	16	8
Add Grant from Nature Conservancy . . . . .	8000	0	0
Donation . . . . .	20	15	0
Interest to 31st December 1965 . . . . .	238	6	6
	34765 18 2		
<i>Less</i> Expended on New Research Centre to 31st			
December 1964 . . . . .	14196	9	2
Expended on New Research Centre year to 31st			
December 1965 . . . . .	11643	16	8
Expended on New Gate House year to 31st			
December 1965 . . . . .	6213	7	3
	32053 13 1		
Balance, 31st December 1965, as per Balance Sheet . . . . .			£2712 5 1

<b>Tropical Aviary Fund:-</b>			
Balance, 31st December 1964	£	s.	d.
Balance, 31st December 1964 . . . . .	5101	15	3
Add Interest received year ended 31st December 1965 . . . . .	359	7	8
Balance 31st December 1965 (as per Balance Sheet) . . . . .	£5461 2 11		

<b>Contingencies Reserve Fund:-</b>			
Transfer from Accumulated Fund	£	s.	d.
Transfer from Accumulated Fund . . . . .	5000	0	0
Add Special Donations received . . . . .	1100	0	0
Balance, 31st December 1965 as per Balance Sheet . . . . .	£6100 0 0		



## Photographs—Section II

The Trust is much indebted to the following persons for permission to reproduce their photographs:

Dr. J. V. Beer  
Pamela Harrison  
Jules Philippona  
Philippa Scott

The contributors retain the copyright of all the photographs. Section I, containing photographs illustrating the papers by Gillham, Harrison and Harrison on *Aythya* hybrids and by Johnsgard on the behaviour of Torrent Ducks, will be found opposite page 48.



Kon, a wild Bewick's Swan *Cygnus columbianus bewickii*, which visited Swan Lake in the Rushy Pen at Slimbridge in 1964-65 and 1965-66. On 19th November 1965 it was caught and ringed.

PHILIPPA SCOTT



Wild Bewick's Swans on Swan Lake in the Rushy Pen, Slimbridge, photographed from the Director's studio windows. Up to 125 were present during the winter of 1965-66—see page 20.

PHILIPPA SCOTT





(Above) Amber, a visitor to Slimbridge in 1963-64, 1964-65 and 1965-66.  
(Below) A pair with their family of three cygnets, driving off other wild Bewick's Swans. Mute Swans *Cygnus olor* in the background.

PHILIPPA SCOTT





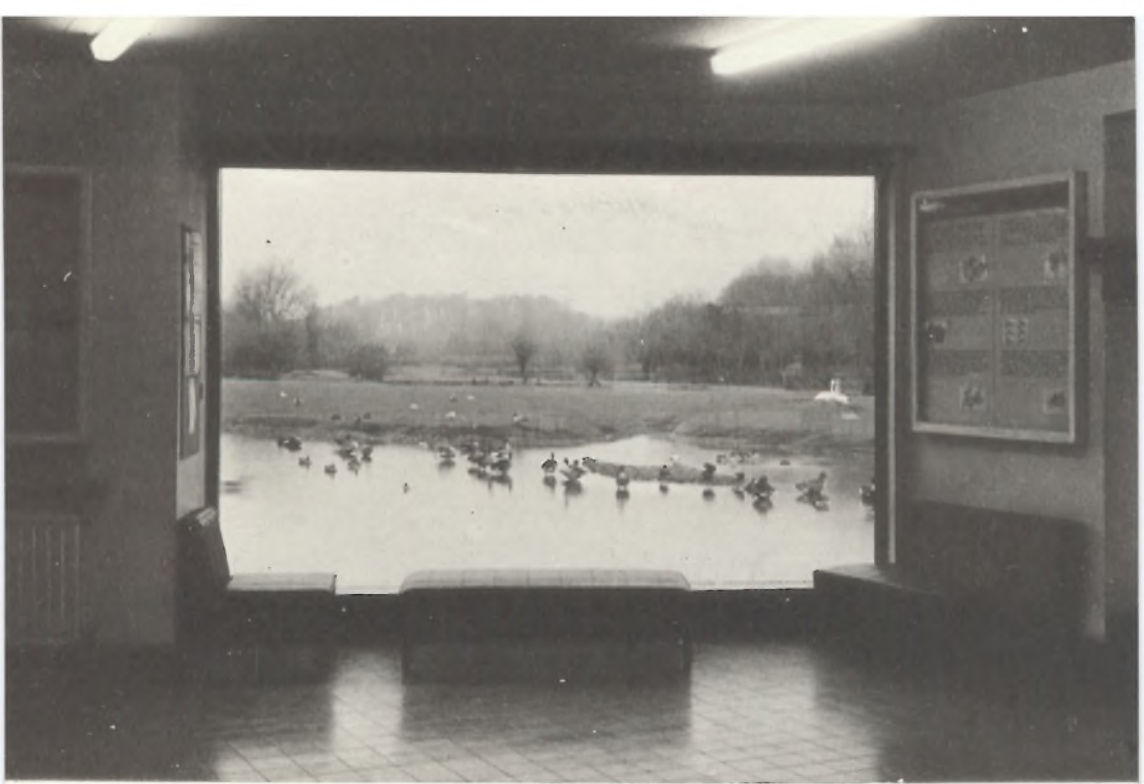
Her Majesty the Queen formally inaugurated the new buildings at Slimbridge on 23rd April 1966.

(Above) The entrance and part of the research building (on the left) and gate-house.

(Below) The new block from the Big Pen.

J. V. BEER





(Above) A visitor's first view of the Big Pen, from the entrance hall.

(Below) The research building, from the south. The ground floor consists of a lecture hall, surrounded by a permanent exhibition illustrating the work of the Trust and relating it to the major problems confronting mankind. The upper floor houses work rooms for the research staff, and the library.

J. V. BEER





(Above) Canada Geese *Branta c. canadensis* leaving the pens at Slimbridge.

PHILIPPA SCOTT

(Below) Twin embryos in the egg of a Muscovy Duck *Cairina moschata*—see p.35.

J. V. BEER





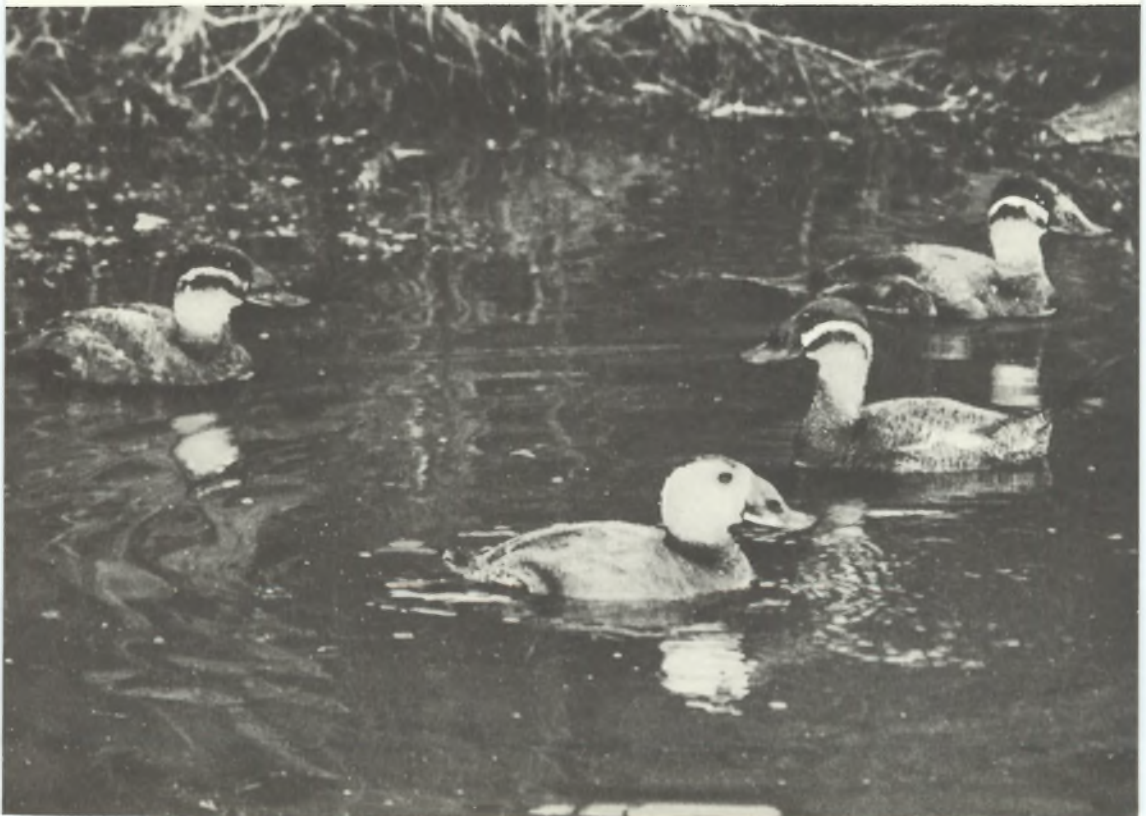


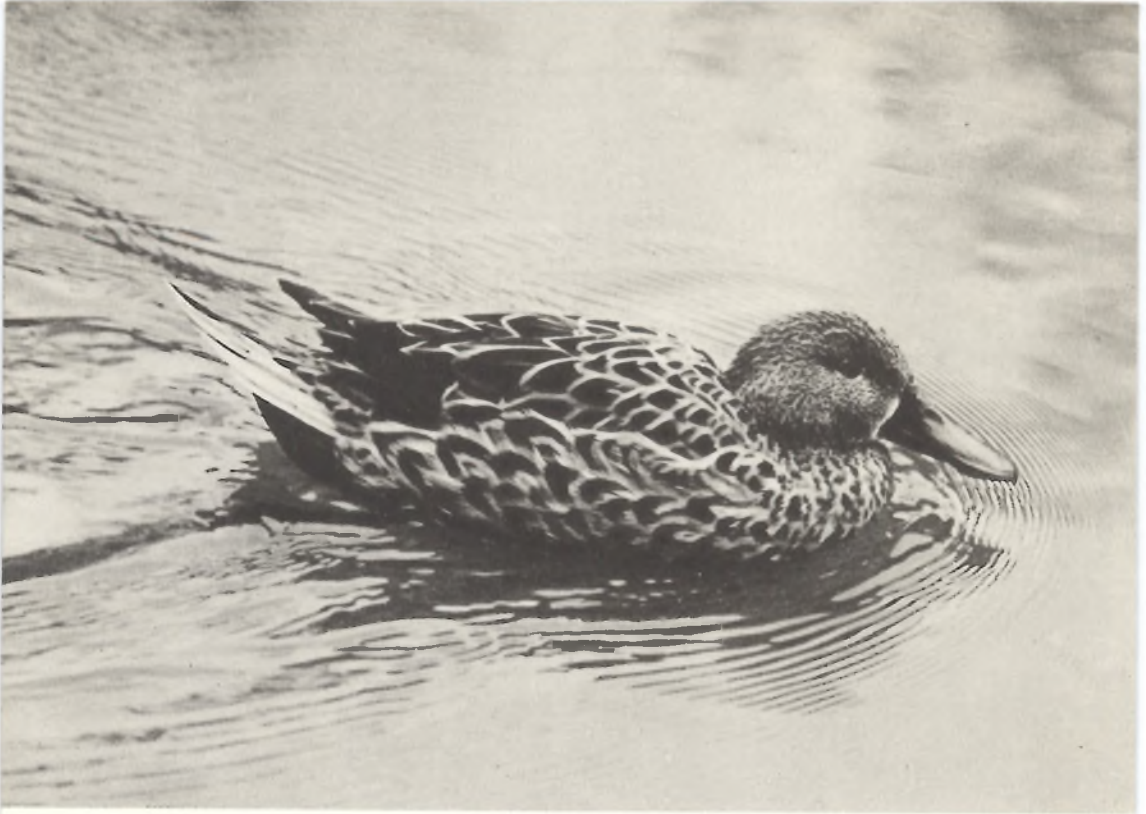
Recent additions to the collection at Slimbridge.

(Above) A Galapagos Pintail *Anas bahamensis galapagensis*.

(Below) White-headed Stiff-tails *Oxyura leucocephala*, a male and three females.

PHILIPPA SCOTT





Argentine Red Shoveler *Anas platalea*. Female above, male below. PHILIPPA SCOTT





(Above) A drake American Wigeon *Anas americana*.  
(Below) Marbled Teal *Marmaronetta angustirostris*.

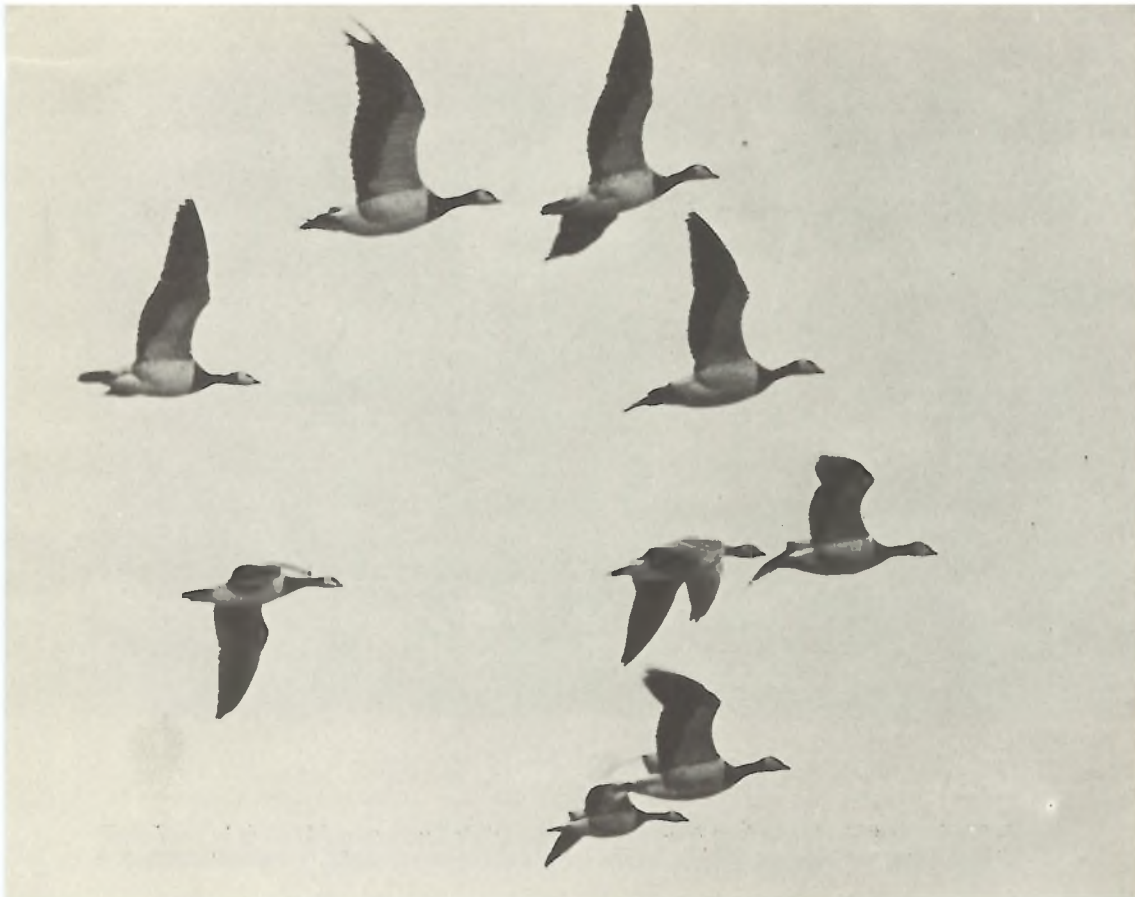
PHILIPPA SCOTT





Barnacle Geese *Branta leucopsis* at Caerlaŵerock National Nature Reserve—see pages 36-45,  
PAMELA HARRISON





Barnacle Geese at Caerlaverock. The photographs below and opposite show geese on pastures close to, but outside the Reserve. They show how densely Barnacle Geese pack while feeding.

PAMELA HARRISON





Harlequin Ducks *Histrionicus histrionicus* on the River Laxá, near Mývatn, in north-east Iceland—see pages 79–94. Males on the left, females on the right. PAMELA HARRISON





Harlequin Ducks on the River Laxá. (Below) Two pairs and a female at a typical resting place on the river bank.

PAMELA HARRISON





Feeding behaviour of wild geese in very cold weather in the Netherlands—see pages 95–97. (Above) White-fronted Geese *Anser a. albifrons* on a grass field. Note that most of the geese are feeding while sitting down. (Below) Bean Geese *A.f. fabalis* on snow covered sand dunes.

JULES PHILIPPONA







Egyptian Goose *Alopochen aegyptiacus*.

PHILIPPA SCOTT



(Above) White-fronted Geese settling into a field of Brussels sprouts.  
(Below) A dense group of Whitefronts on a snow-free pasture, with Barnacle Geese in the background.

JULES PHILIPPONA

