BRISTOL ORNITHOLOGY

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PREFACE

Publication of the tenth issue of *Bristol Ornithology* seems an opportune moment to look back briefly over the journal's progress so far. Seabirds, waders and passerine migration in the Bristol Channel; the Atlas for Somerset; bunting and Great Crested Grebe studies; wildfowl and Sedge Warblers at Chew Valley Lake; White Wagtail moult and distribution; albinism and melanism; various studies of local and foreign areas by Club members; plus many short notes and papers, add up to a very impressive array of work. The annual reviews provide a continuous thread giving a highly readable historical record of the bird-life of our area and together with the many illustrations and photographs make it a journal almost unique among those produced by local societies.

In this issue we see the continuation of Ken Simmons' 'Further Studies on Great Crested Grebes'; the first part of this detailed and fascinating study of a species that ought to be familiar to us all in the Bristol area appeared in *Bristol Ornithology* 8. Bernard King also contributes a short paper on the feeding behaviour and mortality of Mute Swans in the Bath area during the severe winter of 1962/63. Both papers show what results can be gained from close study of relatively common birds.

Once again we owe thanks to Brian Rabbitts for undertaking the arduous task of compiling the review of 1976. Progress towards publishing *Bristol Ornithology* as soon as possible after the year under review continues to be slow, but the Editorial Committee has high hopes for the future.

Ken Hall

Line drawings by Brian Slade and Robin Prytherch
Layout by Ken Hall, Robin Prytherch and Brian Rabbitts
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A REVIEW OF 1976

by Brian Rabbitts

Once again I am indebted to the 165 countributors to our monthly reports *Bird News*, from whose records the bulk of this review is compiled. At the risk of being repetitious the format is similar to previous reviews. The area concerned has been confined to the county of Avon, parts of Gloucestershire (to Frampton-on-Severn and bounded by the River Severn and Cotswold Hills) and Somerset to within some 30 miles from Bristol. There is still no access to one important ornithological site, Steart, and this has resulted in the lack of any regular species counts, especially for ducks and waders, from here.

Reservoirs, often referred to collectively, signifies those at Barrow Gurney, Blagdon, Cheddar, Chew Valley Lake (CVL) and Durleigh; WT is the Wildfowl Trust at Slimbridge and the New Grounds refer to the adjacent river bank and estuary whilst the levels refer both to the peat-moors and heaths in Somerset and to the moors which lie to the south of the Polden Hills. The ecology of the levels is unfortunately changing rapidly by the extraction of peat on a larger scale and the lowering of the water-table to provide more arable land. Some 225 species occurred during the year (excluding obvious escapes) and records of rare birds rejected by or not submitted to the British Birds Rarities Committee have been excluded. When computing totals, especially of the scarcer passage waders, minimum numbers have been used.

The first winter period

For the first three weeks of January temperatures were above average but it was often windy, as on the 2nd when a deep depression caused severe gales in many areas. A very cold spell followed and this continued well into February. March was generally windy with temperatures below normal but milder weather with west winds towards the end allowed many summer migrants to arrive (see Spring migration). Rainfall was below average throughout this period.

A Red-throated Diver was present at Steart on 19 February. At Cheddar a Slavonian Grebe appeared on the 3rd of this month and was last seen on 25 April, by which time it had assumed full summer plumage. Counts of Great Crested Grebe at CVL reached 122 on 17 January, but there were lower numbers in the following two months. The unsettled weather at the beginning of the year brought three Fulmars and a similar number of Gannets (one dead bird) into the channel. Numbers of Cormorants at CVL reached a new peak with 75 on 17 January, while the low water level with exposed mud-margins attracted Herons (a count of 33 was made on the same day). White-fronted Geese at the NG were present in lower numbers than usual and 2500 was the highest count while other geese here included two Lesser White-fronts (from 1975, remained to 4 March), two Bean and a Pink-foot. Brent Geese are, at the present time, enjoying high population levels (see *Brit. Birds* 69 (1976): 422–439) so it was not surprising that two occurred at various sites on the coast (perhaps only this number of individuals involved) to 20 April and two inland at Cheddar on 5 January. Counts of Bewick's Swans included 161 at the WT and groups totalling around 120 on the levels during January and again in March. Smaller numbers (up to 34) were present on the reservoirs.

Nationally most of the commoner wildfowl, according to the priority count reports published by the Wildfowl Trust, had excellent winter populations. Counts in our area included 1800 Teal at Durleigh in January, 3000 Wigeon at the NG in February and 563–654 Tufted Duck at CVL in this period. Other duck included up to 97 Gadwall here, a small influx of Shoveler in mid-March when 239 were present and 200 Pintail at the NG. Diving duck present included a Red-crested Pochard at Orchardleigh on 9 January, a Ferruginous Duck at CVL 6–18th, two storm-driven Common Scoter at Cheddar on 22nd and up to five Scaup here (four to the beginning of April and three to the 27th when last noted). Four Eider were off Portishead on 14 January with five on 14 February and three to 13 March. The following day these appeared off Sand Point and then continued to be recorded throughout the remainder of the year. Three Long-tailed Duck (from 1975) remained at CVL in January with two

until 24 April, there were some excellent numbers of Goldeneye here culminating with 85 on 20 March (last record is of five on 5 May), at least two Smew occurred on the reservoirs with another at Frampton while counts of Goosander included 56 on 21 February (last on 28 April). The winter flock of Ruddy Duck at Blagdon reached 127 in February. High numbers like these are only of comparatively recent occurrence and the area from which the birds originate has still to be confirmed (see *Brit. Birds* 69 (1976): 132–143).

Turning now to birds-of-prey, it was a good winter for Hen Harriers with the usual bird at Steart and additional records from the Axe Estuary, Clevedon, the levels and on Mendip (two individuals here). Peregrines

Peregrine

were observed at eight coastal sites and Merlins at five with this species also at CVL and Tealham Moor. Coot at Cheddar numbered 2500 to February (500 at the end of this month) and included the partial albino (first seen in 1972). This bird spent the majority of the rest of the year at Blagdon. Of the waders, Ringed Plover numbered 120 at Sand Bay in February (one at CVL on 21st was an unusual inland winter record), Golden Plover included up to 1000 on the levels while most Lapwing (up to 4000) occurred here and during the last two days of January there was a hard weather movement involving many thousands of birds. Dunlin numbers on the coast indicated 22000 during this month (11000 at Steart) and 15000 in February. There were smaller numbers (up to 100) than has been the recent trend on the levels, due perhaps to the dry conditions there, but 660 were at CVL in January and 296 in March. Groups of up to 70 Knot were present (since 1972 this species appears to have suffered a decline in our area) and Snipe numbers were rather low. Over-wintering and other scarcer waders included up to four Purple Sandpipers at Severn Beach; 24 Sanderling; Ruff in unprecedented numbers with 530 in February and 340 in March (counts included two groups totalling 300 on the levels and four others of between 100 and 190). It has been suggested that birds present in this country during January and February are part of a small European wintering population which moves north very early. Two of the groups in March, however, were just outside the date used in determining wintering birds (see *Bird Study* 20 (1973): 245–250). The occasional Spotted Redshank was seen; one or two Greenshanks; eight Green Sandpipers; Common Sandpipers at three localities; up to 11 Black-tailed Godwits on the coast while inland there was one at CVL (to 10 April) and 32 at Durleigh on 16 February with 65 on 4 March (some could perhaps be included under Spring migration); small numbers (maximum 15) of Bar-tailed Godwits with one at CVL from mid-February; Woodcock (always under-recorded) at six localities; over 50 Jack Snipe and a single Avocet at Steart. A Killdeer at CVL on 17 January was a first for our area and only the 21st appearance of this Nearctic and Neotropical wader in Great Britain.

A dyed and colour-ringed Black-headed Gull that was seen on the Axe Estuary on 10 January was caught and marked by the MAFF Pest Infestation Control Lab. at Callow Hill refuse tip, Egham, Surrey during Oct/Nov 1975. A Mediterranean Gull was identified at CVL on 14 February and seen again on 28th (by which time it had assumed almost full summer plumage). Also in this month was a dead Kittiwake at Frampton on 1st and a dead Razorbill at Steart on 8th. Flocks of Stock Doves in January included 500 at Chittening and Steart while the largest Collared Dove concentration recorded was in excess of 300 at the WT. One of the outstanding events of the winter

was an invasion of Long-eared Owls into the country. Two were at Severnside until February with one to mid-April, one found exhausted at Bristol in January later recovered and was released but less fortunate were birds picked up on the M5 Motorway on 8 March and 16 April. Up to five Short-eared Owls occurred at Steart, four on the levels, three at Chittening and singles elsewhere. Passerines included up to six Water Pipits *A.s. spinoletta* at CVL and, more unusual away from the reservoirs, one at Tealham Moor. Nine Blackcaps were seen, eleven Chiffchaffs, two Firecrests and four Black Redstarts. Several groups of around 500 Fieldfares were noted and it was a late departure for many with 50 at Godney Moor on 2 May (last at Weston-super-Mare on the 27th which is exceptionally late). Larger counts (three of 1000–1500) were made of Redwings and as usual they left earlier as evidenced by a heavy nocturnal passage over Whitchurch on 17 March. Willow Tits occurred in several areas away from some usual breeding sites while up to four Corn Buntings were present at Berrow (first appearance at this locality) with up to seven later in the year. There was only one Cirl Bunting and fourteen Snow Buntings. A Little Bunting trapped at CVL on 4 January was one of the surprises of this period as this vagrant normally winters in northern tropical Asia. Excellent numbers of Brambling were reported with record counts at Severnside of 2500 at Chittening and 2000 at Aust on the same day. Several groups of 50–60 Siskins were noted but Redpolls appeared less numerous, of 12 Twite identified at Clevedon in January, 10 were still present at the end of March, a sizeable gathering of Tree Sparrows at CVL in the first week of January reached 150 and four or five Hawfinches were at two regular haunts.

Spring migration

Milder weather at the end of March was not continuous and some cold spells followed (from the third week of April winds were mainly north-easterly). May was generally warm. Cool weather at the beginning of June did not persist as it became progressively warmer and was a prelude to an exceptionally hot summer.

No unusual grebes turned up on passage but there were more coastal records of Great Crested than is usual including three off Brean Down on 7 May. Fulmars appeared in the channel from 20 April; counts of Manx Shearwaters included 65 off Sand Point on 12 May and 37 off Brean Down on 25th; six Gannets were seen in this month with two in June while a Shag was at Sand Point on 23 May. The first Garganey was at CVL on 11 March and single birds continued to be reported to mid-May. The peak spring count of Tufted Duck here was made on 29 April when 610 were present. Other diving duck included ten Eider at Steart on the 18th with six off Sand Point on 9 May and several groups of between seven and nine Common Scoter (only one inland – at Cheddar 10–16 April). Birds-of-prey in May included an Osprey at Frampton 18–29th, Marsh Harrier at the Axe Estuary 9th, a Peregrine on the 26th while Hobbies occurred from the first week.

The maximum count of Ringed Plover was 146 at Berrow on 16 May, some 250 Golden Plover on the levels on 11 April included many of the northern form *P.a. altifrons*, Grey Plover numbered 100 at Steart on 2 May (one inland at CVL on the 28th was unusual) and Turnstone at Severn Beach peaked at 350 on 10 April. There was the usual inland passage of Dunlin (flocks of up to 21 at the reservoirs) and some 24 Sanderling (10 at CVL on 5 May) with coastal counts of 47 at Berrow and Steart. Movement of Common Sandpipers commenced from mid-April and then up to 39 were present at Cheddar in the first week of May. There appeared to be only a small passage of Black-tailed Godwits (26 on the levels 11 April and up to three at the reservoirs) while most Bar-tailed Godwits (maximum of 91) turned up at Chittening in the last four days of April. Whimbrel at their roost on Steart Island reached 930 on the 30th with 823 the following day and there were several groups of over 50 on the levels including 107 on 9 May. Scarcer waders were six Little Ringed Plover (five at Cheddar including a late bird on 28 May); three Little Stints at Chittening on 25th; up to six Purple Sandpipers at Severn Beach in April with singles lingering on until 22 May; at least 17 Ruff passed through (15 in April); seven Spotted Redshanks; eight Greenshanks and a similar number of Green Sandpipers. Rarer waders were a Temminck's Stint at Cheddar on 28 May (the same date as one here in 1975!) and a Broad-billed Sandpiper at the NG 6–9th was seen again on 2 June.

Nine Arctic Skuas were in the channel and of these seven at Berrow on 2 May were associated with a large movement of terns. There was a good passage of Little Gulls which, although not reaching the record numbers of 1974, was impressive when compared to their spring status in our area before 1971. Some 52 were recorded of which 30 appeared at Cheddar on 28 April. A Glaucous Gull was identified at the Axe Estuary on 1 May but detailed descriptions of another at CVL on 25 April did not rule out an aberrant gull of another species (see *Brit.*

Birds 68 (1975): 24–37). Kittiwakes (180) were seen in the channel from the beginning of April to 4 June with 76 in the first month (65 off Berrow on the 20th) and 87 during May. It has been suggested that there is some regular movement of adults in the early spring, not necessarily connected with rough weather, to explain some of the inland records in the Midlands area (see *Brit. Birds* 69 (1976): 62–63). Since 1968 large numbers have appeared in the channel during the spring although peak numbers (apart from weather motivated movements) have tended to be in May (see *Bristol Ornith.* 5 (1972): 201–204). Common/Arctic Terns (1160) were well recorded with most on the coast including 600 off Berrow on 2 May. Other terns concerned six Black, three Sandwich and two Little. A Guillemot was near Steep Holm at the end of May.

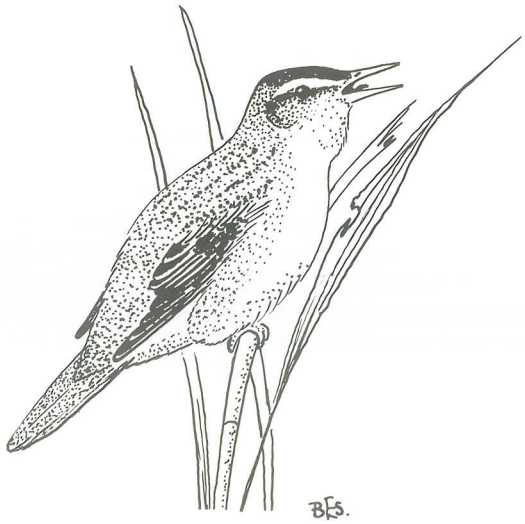
A Long-eared Owl that was present near Bristol for most of May was probably one remaining from the exceptional influx mentioned earlier. Single Short-eared Owls appeared at two sites on the coast at the end of April while two at CVL on 8/9 May initially caused some confusion with the first named species until one was trapped (see *Brit. Birds* 69 (1976): 281–287) on field identification). Summer visitors to arrive in March were Wheatear on 9th (25 in the Chittening area on 22nd); Chiffchaff 11th; Willow Warbler 12th; Ring Ouzel 18th; Swallow 20th and Sand Martin and House Martin on 21st. However, it was a slow build-up to any appreciable numbers for some migrants which served to underline the variable weather during this period. There was some evidence of a small movement of Collared Doves (up to six at Brean Down on several days). The main passage of Sand Martins was in the first week of May (300 at Cheddar on 3rd), Yellow Wagtails included two groups of over 50 at the end of April and some good counts of Redpoll included 60 at Abbots Leigh on the 22nd with up to 24 at coastal sites in May. Scarcer species (or formes) included a Cuckoo of the rufous phase on the levels 9 May; Hoopoe at Durleigh 9 April; Wryneck at Brent Knoll on 20th (another probable was reported at CVL on 20 May); Woodlark at Severn Beach 3 April; Blue-headed Wagtail *M.f. flava* at CVL 7–24th with another individual here on the last date not matching any of the known races of *flava*; some 45 White Wagtails *M.a. alba*; two Red-backed Shrikes at Kenn 25th; two Pied Flycatchers; a singing Black Redstart at Portishead 16th – this being a bird that as far as I am aware has never been proved to have bred in our area (see *Brit. Birds* 69 (1976): 9–15) – and eleven Ring Ouzels.

Breeding species (selected)

Due to the low water level at CVL Great Crested Grebes were mainly unsuccessful there but they bred on several smaller waters. The occasional Fulmar was present in the channel but there is no evidence that this species will colonize here. Cormorants numbered 56 on Steep Holm in June while of the Heron, counts at two of our main heronries revealed 36–37 probably occupied nests. A brood of 10 Shelduck was seen at CVL and a total of 104 young at three coastal sites. It appears to have been a good season for Mallard (66 young at CVL in May and one exceptionally large brood of 17 at Blagdon) while other breeding duck were Gadwall at CVL (75 young on 22 July), Frampton and possibly Litton and Tufted Duck at CVL (only four broods due to the low water level) and Litton (one brood). Teal and Shoveler were also present. Buzzards occurred at several sites on Mendip, a Peregrine was seen in June (apart from the factors which may slow up a recovery of this species discussed by Ratcliffe in *Bird Study* 19 (1972): 117–156 an added threat would appear to be from those wanting young falcons) while Hobbies were in six potential breeding areas. Red-legged Partridge were only noted at three places, three coveys (36 young) of Partridge were on Somerton Moor, Quail were also on the levels (two sites) at Marshfield (up to five) and Stanton Prior, a Water Rail appeared on 1 August and a Corncrake was heard on 22 June. Of the waders two pairs of Ringed Plover bred at Steart, Lapwing had a high population (17 pairs) at CVL but on some of the levels only usual numbers, Redshank bred at Blagdon (the first record here since 1939) while Black-tailed Godwits are maintaining no more than a tenuous hold. No assessment is possible for Redshank, Curlew and Snipe. Upwards of five pairs of Lesser Black-backed Gulls bred at CVL with small numbers at four roof-top sites in Bristol and one in Bath. Herring Gulls (increasing by some 13% per annum) and said to be reaching pest proportions in some parts of the country were found in at least eight such places. A pair of Great Black-backed Gulls held territory at CVL.

Dutch Elm Disease continued unabated and there are now few elm trees surviving in our area. Birds such as Little and Tawny Owls and Rook which use these trees as nesting sites could be affected, although the last named species continue to use them (even when completely dead) until they are ultimately felled. Collared Doves are still increasing but few records were submitted while Turtle Doves were located in 22 potential breeding areas and it appears to have been a good season for them. Barn Owls were at eight sites during May and June, Nightjars were still

found on Shapwick Heath, (despite the devastation of habitat) and Lesser Spotted Woodpeckers at 13 places May—July. Although it had been a colder winter than 1974/75, small birds such as Wren, Goldcrest, Long-tailed Tit, Coal Tit and Treecreeper, after five mild winters in succession, were still at relatively high population levels according to the Common Birds Census (see *Bird Study* 24 (1977): 55—61). Similar to the findings of this census, Swallow numbers remained rather low. Yellow Wagtails on the levels showed an increase while Blue-headed Wagtails nested (unsuccessfully) at CVL and there was a male (perhaps a breeding pair) in another area. Sedge Warblers were said to



Sedge Warbler

be at a generally similar level to last year on the levels (where wet enough!), Whitethroats showed a continued improvement but they still remain at a lower population than before its crash in 1969, Lesser Whitethroats were located at 24 sites in May and Wood Warblers at some usual scattered breeding places. It appeared to be a good year for Whinchat, Redstart numbers increased from the previous year while Nightingales were present at 17 possible breeding sites in May and June (up to nine at Shapwick). Other summer visitors to show decreases (according to the Common Birds Census 1974/75 mentioned above) were Garden Warbler, Chiffchaff and Spotted Flycatcher. One tragic result of the fine summer was that several nest-box broods of Blue Tit died as a result of over-heating. One also wonders how species such as Blackbird and Song Thrush managed to find sufficient food, certainly early in 1977 there appeared to be a decline of the last named. Few Corn Buntings were reported while Cirl Buntings continued to be almost non-existent. Redpolls in Leigh Woods during May were possibly breeding (undoubtedly there were others elsewhere), several pairs of Hawfinch nested and it was a good year for Tree Sparrows on the levels with families (twelve) at eight sites in July.

Other summer observations

A Red-throated Diver at Cheddar 17—21 June was most unusual and well outside previous dates for our area. Few sea-birds appeared in the channel, due perhaps to the fine weather and lack of observers, but 166 Manx Shearwaters moved south at Berrow on 13 June with 31 off Brean Down on 2 July. There was a count of 880 Shelduck at Steart on 6 June while high numbers of Mallard occurred at CVL with 1223 on 10 July rising to 1879 by the 22nd. Other duck here included 294 Pochard on 10th and 365 Tufted Duck the same day. Seven Common Scoter were reported off Brean Down on 8 June with nine off Sand Point on 24th. Waders during this month included an inland Oystercatcher at CVL on 6th, a Ruff here on 20th with a Greenshank on several days, the occasional Green and Common Sandpiper, five Bar-tailed Godwits at Sand Bay 15th, one or two Whimbrel and an Avocet at the Yeo Estuary on 6th. A Great Skua at Sand Point on 4 July was eclipsed earlier by the appearance of a Long-tailed Skua at CVL on 19 June. At the first locality a Glaucous Gull was identified on 10 July, some 21 Kittiwakes were observed in the channel (most near Steep Holm), one Sandwich Tern and the odd Common Tern was still around. A party of 15 Crossbills flew over Goblin Combe on 19 June but there was to be no large scale irruption later.

Autumn migration

The long hot summer continued and although nights were often cool during August the days were warm. It was mainly dry until the last few days when many areas had rain or thunderstorms. The weather really broke in September with unusually heavy falls of rain in short periods with much of the country having double the average rainfall. There were some gales in the first half but from the 17th temperatures rose above normal with winds from the south quarter. Unsettled weather dominated October with frequent outbreaks of rain and gales at times.

Great Crested Grebe numbered 490 at CVL on 11 September. Despite the weather few sea-birds were seen and these included two Fulmar in the first week of August, five Manx Shearwaters at the same time and a Gannet off Portishead on 7 October. A Spoonbill made a brief visit to CVL on 28 July. Following the good counts of Mallard in this month 1000–1210 occurred at CVL and Steart in August while Teal started to arrive from 10 July (an early date). Gadwall reached 210 at CVL, up to 40 Pintail were at Cheddar in September and movement of Garganey commenced on 22 July with a maximum of five here and four at CVL. Diving duck included some four Red-crested Pochard from 4 August, Ferruginous Duck at Orchardleigh 26 September, three Scaup during August and 40 Common Scoter from 18 July (28 in October, probably more, including up to three inland at Cheddar). Raptors included four or five Ospreys – at Cheddar 10 August and CVL 14 October and at least two at these localities 23–27 September. Favourable weather conditions in September suggested a large influx from the continent. A Goshawk over Bristol on 23 August and another on the coast a week later reflected the increased status of this species nationally. Peregrines were present from the same time, Hobbies continued to be reported (last on 2 October) and Merlins included one at Tadham Moor. The Coot population at CVL was high with most (1820) at the end of August.

Of the commoner passage waders Ringed Plover peaked during the last week of August with a total of 1500 at five coastal sites and up to 40 inland. Sanderling numbered 66 at Berrow on 1 August, some excellent counts of Redshank in this month included 1100 at Steart and 600 at Chittening, Black-tailed Godwits were in excess of 1000 in the Parrett Estuary on 15th (25 at CVL 25 July was a high inland count) but only small flocks of Bar-tailed Godwits appeared. However, a group of 25 at CVL on 31 August was notable and compares with two groups (total of 54) here 4–6 September 1975. There was also the usual small number of other species, normally associated with coastal habitat, inland. Other passage waders included a good movement of Little Ringed Plover (54 from 22 July to 18 October) with some 40 at Cheddar and most in August; 70 Little Stints from 10th of this month to 27 October; Curlew Sandpipers were scarce with only 23; 133 Ruff with 56 in September and 52 in October; Spotted Redshanks (67) from 25 July; it was an excellent autumn for Greenshanks (215) from the beginning of July with 123 in August; Green Sandpipers (143) showed a similar pattern; 12 Wood Sandpipers and groups of up to 30 Whimbrel on the coast. A Woodcock at Lawrence Weston on 28 August must have been a nearby summering individual while an Avocet was identified at Cheddar on 4 September. Rarer waders were a Kentish Plover at the Axe Estuary on 9 October, a White-rumped Sandpiper at Cheddar 9–15 August was closely followed by a Buff-breasted Sandpiper 20–31st with another at CVL 29 September–4 October and two Pectoral Sandpipers at Steart on 11th. A Wilson's Phalarope was identified at Frampton Pools on 2 September.

Grey Phalaropes appeared at Steart 7/8 October, Cheddar 13/14th and another on 16th while the much rarer Red-necked Phalarope was identified at Durleigh on 18 September. Three skuas were seen, all Arctic, at Brean Down on 7 August, CVL on 31st and Cheddar 15 October. A Mediterranean Gull was at Steart on 4 September, about 17 Little Gulls passed through while Kittiwakes included up to four off Brean Down in the last week of October. There was an early Black Tern at Cheddar on 9 July, but only small numbers (33) in August and to 20 September when a small movement took place (135 at CVL), followed by some 57 to 17 October. Passage of Common/Arctic Terns started on 20 July (16 off Sand Point) with only some 83 to mid-October. Other terns concened fourteen Sandwich from 17 July (six in this month) with the last on 2 October, three Little, a White-winged Black on the levels 9–11 October continued an unbroken run of appearances in our area since 1966, while one of the highlights of the autumn was a Whiskered in summer plumage at Cheddar 23 September–4 October. A Caspian Tern was at Frampton Pools on 9 July.

A Roller was seen on Kenn Moor in August and Hoopoes at Frampton on 25 July and Cheddar 11/12 October. Wrynecks, well reported from several other parts of the country in August, turned up at five places from

22nd to 3 September and a later bird 21/22nd. A Woodlark flew over Middle Hope on 29 July with another at Berrow 10 October while seven days later a Richard's Pipit was identified here. Several White Wagtails appeared at Cheddar in the period 6–10 September while an unexpected visitor to be trapped at CVL on 10 October was a juvenile Red-backed Shrike. Following last year's exceptional number (11) of Aquatic Warblers at Steart this was even exceeded with 11 trapped 10–25 August and another two seen on 30th while others were at CVL on 16th and Berrow 5 September. The question of the origin of British Aquatic Warblers still remains to be answered (see *Brit. Birds* 69 (1976): 228–229). A rarer migrant on the west coast was a Barred Warbler at Berrow 22 August. An unusual call note from a Chiffchaff at Cheddar during the latter half of this month suggested it was of the race *P.c. abietinus*. Other scarce passage birds were Wood Warbler at CVL 25 July (trapped) with another at Wraxall during August, several Pied Flycatchers, Nightingale at Weston-super-Mare 23rd, Bluethroat at Steart (trapped), two or three Ring Ouzels at Brean Down 23 October–3 November, a Twite here 22 October and four Crossbills at Stock Hill 10 July with seven at CVL on 22nd and three 7 September. After the main departure of Swifts there was a small movement in September with the last on 3 October, several other summer visitors lingered on until well into this month with Wheatear to 3 November and a Sand Martin at Keynsham on 18th. Visible migration in October included movements of Yellowhammers at Berrow with 44 on 17th and 54 on 24th and Chaffinches with 1560 at Clevedon on the first date; generally however numbers of the latter were small, as they were for Brambling, apart from 52 at Clevedon on 17th. Bullfinches were reported moving north and north-east at New Passage on 10th and to the south-west on 16th while there was a southwards departure of Tree Sparrows at Berrow with 70 on 10th, 37 on 17th and 109 on 24th. At the same time further up the estuary parties were frequently noted migrating to the south-west and north-east.

The second winter period

With low pressure over the Atlantic during the first half of November the weather remained unsettled as several fronts crossed the country. In the last week west to south-west winds were strong at times and heavy rain caused flooding in some places. December was cold (especially from 25th) with severe frosts at times and snow on high ground.

A Black-throated Diver was at Cheddar 7–12 December and a Great Northern Diver at CVL 3–9 November. There had generally been low numbers of Little Grebe there throughout the year and they did not exceed eight during this period while Great Crested Grebe reached 328 in mid-October. The maximum count of Cormorants on the reservoirs was 70 while up to 10 continued the now regular behaviour of resting on certain stretches of electricity transmission line (see *Brit. Birds* 69 (1976): 498–499). White-fronted Geese first appeared at the end of October, small groups were then seen along the estuary and inland while numbers at the NG reached 3000 in December. Other geese here in the same month included two Lesser White-fronts, two Bean and three Brent while singles of the last two also turned up at Steart. One can only speculate on the origin of a Barnacle Goose here but with the continued growth of wildfowl collections and the correlated increase in reports of odd birds in the wild, any unusual goose or duck must be open to suspicion as to it being a genuine wanderer. Bewick's Swans arrived on 30 October and later up to 97 were on the levels while the flock at the WT reached 350. Wildfowl numbers reached over 6500 at CVL in the second half of November but this record count was quickly surpassed by one of 9190 on 29 December, the birds being brought into a small area by severe weather conditions (lake three-quarters frozen-over). Individual totals (an asterisk denotes record for this locality): Mute Swan, 72; Bewick's Swan, 127*; Mallard, 1775; Teal, 1415; Gadwall, 330*; Wigeon, 1540; Pochard, 2810*; Tufted Duck, 790; Goosander, 46; Ruddy Duck, 101*. Some other counts in November included 2800 Teal and 188 Pintail (124 at Blagdon) with 201 Shoveler on 16 October. An American Wigeon which had appeared at Cheddar three days earlier stayed until 21 February 1977 before being seen again at CVL on 2 April. Diving duck included one or two Red-crested Pochard in November with one to 12 December; Ring-necked Duck at CVL on 26th joined by two others on 29th and all, together with a hybrid perhaps Ring-necked x Tufted Duck from 19th (the origins of this bird are still being investigated) into 1977; Ferruginous Duck at Durleigh on 28th; two Scaup in the estuary from 9 October with at least three on the reservoirs in the last week of December; seven Common Scoter off Sand Point and one inland at CVL; two Velvet Scoter at Chittening 31 October–16 November; Long-tailed Duck here on the first date and another at Cheddar 1 December remained until 13 April 1977; counts of around 30 Goldeneye here and at CVL; two or three Smew from 7 November and only one Red-breasted Merganser, at Frampton on 20th.

A Red Kite flew over Brean Down on 4 November. Hen Harriers appeared at Steart (two individuals) and on the levels while a more unusual early winter visitor was a Marsh Harrier to CVL on 9 November with another at Clevedon 25 December. Peregrines occurred at six localities (two inland) with three different birds at Steart in November and Merlins at ten (three inland). The population of Coot at Cheddar was 2500 by the last week of October and 2000 in December while numbers at CVL remained high (1183–1340) throughout this period. Turning now to waders there was a count of 900 Golden Plover on the levels 9 December while on the same day, but at a different site there, a very large concentration of 15000 Lapwing. Turnstone at Severn Beach reached 150 during

Turnstone

October, Dunlin indicated up to 10600 and 13300 (lower than usual) in the following two months with only small flocks (maximum of 170) on the levels while Knot numbers (up to 166 in October) continued to be low. During November some 54 Black-tailed Godwits were seen (40 at Sand Bay) and up to 68 Bar-tailed at Steart. An exceptional gathering of 6500 Snipe on the levels 26 December was well over twice the previous highest recorded (see *Brit. Birds* 63 (1970): 173). Scarcer wintering waders were three Little Stints; one or two Purple Sandpipers at usual habitats from 27 September; 11 Sanderling on 10 November; 20 Ruff; three Spotted Redshanks; nine Green Sandpipers in November and six in December; seven Common Sandpipers; four Woodcock; 45 Jack Snipe (first on 21 September) with one Avocet at Steart and more unusually at CVL 19 December. A White-rumped Sandpiper was identified at Frampton on 14 November and closely followed the autumn record.

Gull roost counts included 6000 Black-headed Avon Estuary November and December and 800 Lesser Black-backed at CVL 30 October. A Little Gull was at Portishead on 26 December and a Kittiwake at Frampton 28 November. Mainly single Short-eared Owls turned up at five coastal areas from 29 September with one at CVL on the 9th being early. The odd Rock Pipit was inland at Cheddar and up to seven Water Pipits occured at CVL. December was a good month for over-wintering warblers with some 19 Blackcaps and 16 Chiffchaffs (up to six at Cheddar). A Chiffchaff at CVL on 5 November showed characteristics of the race *P.c. tristis*. Stonechats were particularly numerous during this period in a variety of habitats. Three Black Redstarts at Brean Down on 17 October were followed by singles at six places including one wintering at Axbridge. Fieldfares were later to arrive than usual (nowhere did they appear to be very widespread) while it was not until the last two days of October that any appreciable numbers of Redwing came in (a large influx on the west coast with 10000 on Lundy Island). Counts in December included 2000 Tealham/Tadham Moors. There was a small irruption of Bearded Tits with perhaps as many as seven at CVL 31 October and one or two at Avonmouth 13 November–19 December. The bird of the year must have been a Wallcreeper that turned up in a quarry at Cheddar at the end of October or beginning of November and remained until the first week of April 1977. Only the eighth ever recorded in the British Isles of a bird that was thought to be normally sedentary these dates closely coincide with one that wintered on the Dorset coast in 1969/70. Unfortunately few people were privileged to see it and this must surely be a reflection on an increasing number of bird-watchers who travel vast distances to 'tick' a rare bird, some of whom have little respect for private property. Yellowhammers appeared to be more widespread than usual at some coastal areas and four Snow Buntings were seen. Unlike the previous winter there were only small numbers (maximum 35) of Brambling and perhaps the same could be applied to several other of the finch family. A count of 40 Siskins was made near Clevedon and a few groups of 20–25 Redpolls. Finally a Hooded Crow *C.c. cornix* was seen at Chew Stoke on 28 December.

FEEDING BEHAVIOUR AND MORTALITY OF MUTE SWANS ON THE RIVER AVON, BATH, IN THE SEVERE WINTER 1962/63

by Bernard King

The severe winter of 1962/63 proved the coldest in England and Wales so far this century, when many thousands of birds perished in consequence. Inevitably many important papers on this subject have resulted, of which the following are relevant: Dobinson and Richards (1964) described in depth the effects of the weather on birds in general; Boyd (1964) listed the species and numbers of wildfowl found dead in Britain; then Harkness (1964) and Sweet (1964) provided the ornithological assessments for Somerset and Bristol. Boyd and King (1964) found that the cold spell had no marked effect on the breeding success of ducks on the Bristol reservoirs, in fact it was unusually high for 1963, but Boyd and Ogilvie (1964) showed that there was a marked decline of Mute Swans *Cygnus olor* in England. During this intensely cold period, late December 1962 to early March 1963, I studied the population of Mute Swans on the River Avon, Bath. As far as I can ascertain no similar study was made during this period on a large population of Mute Swans residing in a city in England. The routine area of the Avon surveyed was from Poultney weir to the Midland Railway bridge, a little over two km (Fig. 1), and observations were limited to the periods outside my normal working hours.

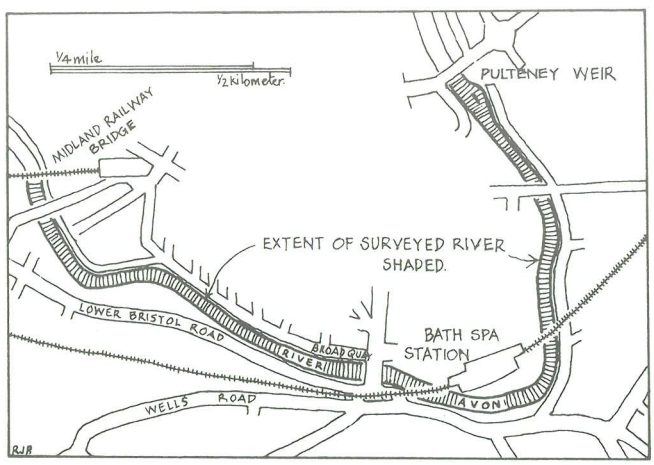


Fig. 1. River Avon, Bath, showing the stretch which was surveyed regularly for Mute Swans.

Harkness (1964) gave the mean minimum temperatures for Bath: December 1962, 30.7°F; January 1963, 20.8°F and February 1963, 26.2°F, though he states that there were lower mean minimum temperatures in December 1933 and February 1947. However, a few days before Christmas 1962, the weather, which had been very cold, worsened. By the night of 29/30 December heavy snow fell and with sporadic blizzards the following day, a Sunday, almost all traffic in and out of the city was brought to a standstill in the afternoon. Nevertheless, many of the Bath residents trudged to the river banks with large supplies of bread and other scraps for the water-birds, which comprised a varied population. Though scattered, the birds were mainly concentrated along the river from Broad Quay to the Bath Spa Station: 23 Mallard *Anas platyrhyncos*, many in 'mixed' plumage and thus revealing the influence of domestic strain, 15 Tufted Ducks *Aythya fuligula*, three Pochards *A. ferina*, some 20 or more Moorhens *Gallinula chloropus*, seven Coot *Fulica atra* and 99 Mute Swans. The mean number of Mute Swans in this area for the months September to November 1962 was 88. Of the 99 I counted that afternoon 81 were adults or sub-adults, i.e., having a wholly white plumage with the bill colours varying from orange-pink (full adults) to pale pinkish-grey or pale dull grey (usually indicating sub-adults) and 18 'true' immatures, all showing varying amounts of brown feathers on scapulars, wings and upper-tail coverts. So, in the early evening on this memorable occasion I eventually left them feeding on scraps by the light of the snow shrouded city lamps and made my way along the A4 towards my home at Saltford without seeing a moving vehicle of any kind.

Remorselessly, however, snow and ice with bitter winds continued to grip the area and by 21 January a record number of 111 Mute Swans were present within my study area. Of these 86 were adults/sub-adults and 25 were immatures. A few days later on 26 January a further count showed a small but significant reduction to 104, with 83 and 21 in their respective age categories. The impressive number of 111 was due to an influx of swans from outlying districts joining the resident winter population. I searched the snow covered river banks outside the city many times from Bathford to Keynsham where so much of the surface water was frozen and I came across only the mauled remains of swans. The swans could not truly be termed a 'flock' since for much of the period they were separated into small groups confined to their respective water holes or other open areas of water along the river. A small number which were eking out a living on some of the small but frozen canal back-waters in Bath are included in my totals.

Feeding behaviour

The hardships and hazards suffered by the Mute Swans when seeking food were considerable. In the initial weeks of the freeze it seemed that they were fairly well maintained by food supplied by man. However, I was doubtful whether the products thrown to them from the river banks were sufficient to keep them in good condition for long. This was borne out when I found swans vigorously contesting for the slimy green-coloured algae growing on the sides of the retaining walls which formed part of the river bank. In normal weather it was a food they pulled at leisurely – but now there was much bickering for the material. By about the second week of January 1963 even this was deinied them because it had become glazed over with impenetrable ice. Previously I had managed to scrape off some of the algae and Peter Olney, then the biologist at the Wildfowl Trust, kindly identified the specimen for me. It was an algae of the genus *Cladophora*, being a species common enough in winter and one to be expected in the Bath district. It is a known food of Mute Swans (Owen and Kear, 1972).

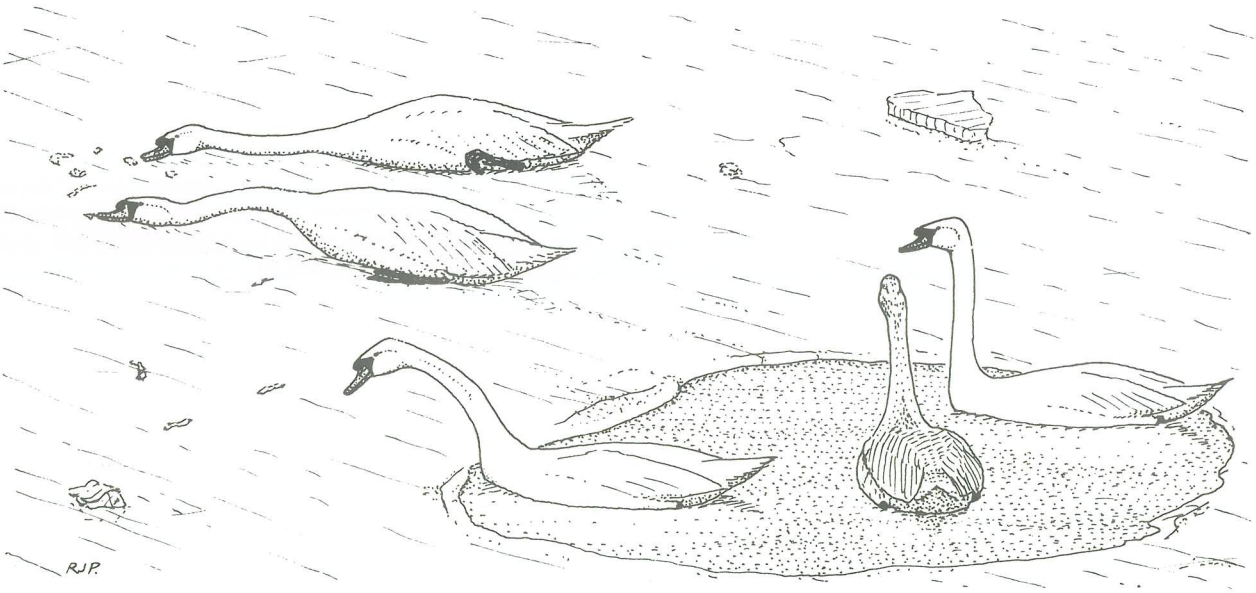
Furthermore, I noticed the swans occasionally breaking off small shoots from the crevices of the river walls before they became iced over. These were either quickly discarded by head-flicking movements, or, after being 'tasted' with some noticeable tongue and bill snapping movements, eventually swallowed. The swans were also occasionally seen pulling at fairly large chunks of raw fatty meat which had been thrown onto the banks and river. When two or three communally tugged, with considerable force, at the tough material small pieces could be wrenched off and these were avidly swallowed, until the whole piece had disintegrated and disappeared. I had previously observed similar behaviour by the Bath swans in June 1961 (King, 1962). It was a food which was always greatly relished. On another occasion pieces of rancid bacon were pulled out of the snow covered bank and summarily dealt with as described. On some of the very cold days boys had somehow found earthworms and these and mealworms were thrown to the swans and of course, they were quickly taken and swallowed.

With the unrelenting severe weather, as I have said, much of the River Avon froze on the surface. Also, hundreds of tons of snow and ice which had been swept or pickaxed from the metalled roads and verges were dumped into the Avon thus causing the river to freeze much sooner than it otherwise would have done. Many people continued to throw in large quantities of food but unless the bread, for instance, was eaten quickly much of it soon became rock hard or lay embedded in the ice. Conditions therefore became almost intolerable for the swans but somehow they did manage to keep a few water holes open, especially near the Poultney weir, by moving around in them during the day and presumably at night. It seemed that the swans fed whenever food was available, but usually it had to be thrown to them, though there were marked exceptions as the following will show.

A few Mute Swans occasionally found the energy to visit the small vegetable allotments on the sloping river bank near the Bath Spa railway station. It was indeed strange to see these very large birds actually in feeding competition with dozens of starving Feral Pigeons *Columba livia* and Wood Pigeons *C. palumbus* on the few brassicas which were exposed amongst the snow. While many of the pigeons lay dead nearby, others were feeding or resting or dying on the brassica-heads, and so by pushing these away the swans were able to pick off portions of the green leaves which were swallowed with some difficulty because they were frozen. Sometimes near the river the bitter winds exposed a few patches of grass along the verges and I watched two or three swans, including immatures, trying to pluck and swallow some of it. Nearby, Blackbirds *Turdus merula*, Redwings *T. iliacus*, Fieldfares *T. viscivorus* and

other birds, which were amazingly tame, allowed the swans to approach very closely before reluctantly moving elsewhere.

But to cap all these episodes was one I witnessed from near the Poultney weir. Two swans climbed rather laboriously out of a water hole onto the thick ice where bread had recently been thrown from the road overlooking the weir. They walked precariously towards the bread, having much difficulty in keeping their balance, often slipping onto one side. They tried to gain food in this way for at least ten minutes with the same negative results. Then, surprisingly, they resorted to squatting on the ice and to extending their necks along it, and in this curious position



tried to pick up the food in their bills. Everytime, however, the tips of their bills merely pushed the bread just a little further away. Still squatting, they then pushed themselves along the ice with leg-paddling movements and in this way some of the bread was captured in their bills and, of course, was readily gulped down. Unfortunately the performance seemed too much for them so they returned to a water hole to join a few companions, leaving much of the bread untouched.

Survival

Table 1 lists the counts that I made of Mute Swans in Bath before, during and after the severe weather. It shows that the population dropped by 39 birds from 111 on 21 January to 72 on 24 February (35.1% mortality). Since no flights to areas outside the city were observed this drop in numbers is indicative of the mortality which occurred amongst the swans. It is also interesting to note that, whereas the adults/sub-adults dropped from 86 to 53 (38.4% mortality) the immatures only dropped from 25 to 19 (24% mortality). That the immatures showed a higher survival rate is contrary to all known trends of Mute Swans in winter.

From the condition of the few remains of swans found in the city they appeared to have been attacked, or their carcasses mauled by Foxes *Vulpes vulpes*. Nevertheless, this predation does not necessarily account for the immature swans showing a higher survival rate than the adults. Beer and Ogilvie (1972) give mortality rates in various age groups of Mute Swans during normal weather conditions in the West Midlands and near Oxford. They found that swans of one to two years old showed 35.4% mortality, while much older birds of four years and over had only 18–20% mortality per annum. It was, of course, impossible to know the ages of the adult swans at Bath, but it seems possible that many were old birds resident as non-breeders on the Avon within the city and so would be those most likely to suffer from predation or from the effects of the severe weather.

Table 1. Counts of Mute Swans on the River Avon, Bath, before, during, and after the severe winter of 1962/63. The cold weather counts are shown in bold type.

	Adults/ Sub-adults	Immatures	Total
1962			
30 September	79	4	83
30 October	71	19	90
25 November	70	22	92
30 December	**81**	**18**	**99**
1963			
21 January	**86**	**25**	**111**
26 January	**83**	**21**	**104**
24 February	**53**	**19**	**72**
23 March	57	19	76
30 April	48	20	68

Subsequently, monthly counts from mid-March, 1963, revealed that the swans did not recover from the ravages of the arctic weather conditions. Unfortunately the return to fine weather also saw the start of major alterations and reconstructions of bridges and river banks in the city eventually causing considerable disturbance to the swans and no further study with any degree of accuracy could be contemplated.

Acknowledgements

I wish to thank my wife, Marjorie, for her aid and helpful suggestions when compiling this paper. I would also like to thank Dr Janet Kear who gave me much encouragement, Peter Olney for identifying algae specimens, John Rosetti who made useful and constructive suggestions to an earlier draft of the paper, and Robin Prytherch who drew the map and illustration.

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Bernard King
Gull Cry, 9 Park Road, Newlyn, Penzance, Cornwall.

FURTHER STUDIES ON GREAT CRESTED GREBES

2. MAINTENANCE ACTIVITIES AND ROUTINE

by K.E.L. Simmons

INTRODUCTION

This second paper in the new series on the Great Crested Grebe *Podiceps cristatus* deals with some of those items of individual behaviour often termed *maintenance activities,* thus providing a deliberate contrast to the topic of courtship treated earlier (see Simmons 1975a). Maintenance activities have been defined as behaviour which helps to regulate a bird's physiological state, or achieve homeostasis (Sauer and Sauer 1967). These authors discussed, in particular, yawning, stretching, and panting, and there seems to be general agreement that such patterns as feeding, drinking, comfort behaviour, thermoregulation, excretion, and resting belong to the same category. Some authors (e.g. Marler 1956, Ficken 1962, and Coutlee 1963) also included locomotion, but I prefer to keep this as a separate category (treated only incidentally here) as it impinges on nearly all aspects of behaviour. Some of the topics treated here were outlined briefly in part 2 of my preliminary monograph on the Great Crested Grebe (Simmons 1955) , and also in my thesis (Simmons 1970b) with particular reference to the ontogeny of such behaviour in the downy young.

The main subjects to be treated here are feeding behaviour and comfort behaviour, considered against the background of general routine. In his now classic paper, McKinney (1965) dealt with 'the behaviour patterns of shaking, stretching, preening, bathing, and related activities' in wildfowl (Anatidae) all under the single term 'comfort movements'. However, I prefer to separate the true *comfort-movements* (stretching, etc.) from *feathercare* (preening, etc.) proper; if a general name is needed for the whole complex, then I suggest *comfort behaviour* (Simmons 1970b; see also Ainley 1974). I shall also cover resting behaviour but must mostly neglect thermoregulation for lack of any substantial information. Unlike some other birds that I have studied in detail, notably the Brown Booby *Sula leucogaster* (which has, for example, elaborate cooling responses), the Great Crested Grebe shows no very obvious thermoregulatory behaviour apart from 'foot-stowing' (see later), totally lacking (along with other Podicipedidae) such behaviour as panting and gular-fluttering. It also lacks any sunning (sun-bathing) posture or associated structural adaptations (black-based feathers or special pigmented areas of the skin) such as are found in the smaller grebes below the size of the Slavonian *P. auritus* and Pied-billed *Podilymbus podiceps* — for example, the Little *Tachybaptus ruficollis,* Least *Limnodytes dominicus,* and Black-necked *Podiceps nigricollis* — and two larger species of the high Andean lakes of South America (see Storer et al. 1975). I shall also more or less ignore the question of excretion. Defaecation is a relatively inconspicuous process in grebes for which it is difficult to assemble substantial information during general watching; see Simmons (1975b) for some observations in relation to helminth-eating. Pellet-casting behaviour has yet to be described in the Great Crested Grebe, though feather pellets are now known (Simmons 1973); for reports on pellet-casting in other Podicipedidae, see Storer (1961, 1969, 1971) and Mather (1967).

ROUTINE

Great Crested Grebes have a reputation for feeding mainly in the morning and afternoon (Harrisson and Hollom 1932, Hanzák 1952), i.e. with two major feeding spells, or two main sets of intermittent spells, separated by a long break during the middle of the day — during which they loaf, preen, and carry out any other necessary activities according to season. A similar activity cycle has been demonstrated for the Western Grebe *Aechmophorus occidentalis* (Lawrence 1950). It is doubtful, however, if such a routine can be maintained except on waters with a plentiful supply of fish, preferably of an optimum size for efficient feeding (see later). Such a situation obtained at the Reading gravel-pits in Berkshire where I conducted my grebe studies during 1948–62 and where long loafing breaks were certainly a feature of the life-style of the local Great Crested Grebes in summer, at least when not feeding young (Simmons 1955). In winter, however, the birds tended to fish periodically throughout the day. At

Chew Valley Lake, North Somerset (Avon), during 1966–70, the individuals and pairs I studied intensively on Herriott's Pool and in the 'Arm' of Heron's Green Bay characteristically alternated throughout the day at all seasons between clear-cut periods of hunting (*feeding spells*) and loafing (*breaks*), though the pattern was complicated at certain times of the year by the need (e.g.) to court, defend territory, build, mate, incubate, and care for the young – all of which competed for the time available for the adults to self-feed and loaf.

The data on feeding spells and loafing breaks at Chew are extensive and have yet to be fully analysed in relation ot sex, time of day, season, phase of annual cycle, etc. Some examples during the autumn, winter, and spring before breeding are given in Table 1, from material at hand; these involve the study pair in Heron's Green Bay

Table 1. Numerical data on feeding spells and loafing breaks in the Great Crested Grebe at Chew Valley Lake

			Feeding spells				Loafing breaks			
Total time (hrs mins)	Sex of grebe	% time spent feeding:loafing	Sample	Mean duration (mins)	Median (mins)	Range (mins)	Sample	Mean duration (mins)	Median (mins)	Range (mins)
		(1) Pair, Heron's Green Bay, 15–28 February 1968 (7 watches)								
15.20	M	49:51	17	19·2	11·0	3–67	15	19·6	5·0	2–49
	F	53:47	31	13·9	9·0	2–56	29	7·8	5·0	2–25
		(2) Pair, Herriott's Pool, 1–12 May 1967 (4 watches)								
11.00	M	54:46	16	18·5	20·0	3–29	18	22·0	11·0	3–40
	F	54:46	16	21·7	23·0	4–31	14	11·6	9·0	2–32
		(3) Pair, Heron's Green Bay, 11–12 May 1967 (2 watches)								
5.30	M	47:53	6	25·7	26·0	5–52	6	28·9	20·0	5–90
	F	54:46	6	37·8	28·0	5–40	6	20·0	10·0	3–82
		(4) Lone male, Herriott's Pool, October 1967 – January 1968 (16 watches)								
31.20	M	72:28	28	35·3	21·0	2–106	29	13·3	9·0	2–49
		(5) Pair, Herriott's Pool, 29 January – 14 February 1969 (4 watches)								
9.00	M	63:37	10	34·2	17·0	3–30	11	18·0	5·0	2–21
	F	69:31	15	24·8	26·0	2–41	16	10·5	4·0	2–38
		(6) Lone Male, Herriott's Pool, 24 February – 19 March 1969 (9 watches)								
25.00	M	56:44	24	34·8	17·0	1–103	30	22·1	5·0	2–115
		(7) Pair, Herriott's Pool, 21 March – 22 April 1969 (8 watches)								
31.00	M	30:70	33	17·0	8·0	1–79	32	40·6	13·00	2–129
	F	28:72	42	12·5	8·0	1–31	47	28·4	11·00	2–83

and that on Herriott's Pool, or the male of the latter pair when alone there. Time spent feeding usually varied between 47 and 56% (males) and 53 and 54% (females) of observation time, but could rise as high as 72% (Pool male) and 69% (Pool female) in mid-winter or go as low as 30% (Pool male) and 28% (Pool female) when the birds were courting frequently. Observed feeding spells varied in mean duration from 17·0 to 35·3 minutes (Pool male) and from 12·5 to 37·8 minutes (females), with maxima up to 106 minutes (males) and 56 minutes (females). Short spells (less than 15 minutes) tended to be more frequent when the birds were courting – compare the median durations in examples (1) and (7) with the others in Table 1. Time spent in loafing usually varied between 44 and 53% (males) and 46 and 47% (females) of observation time, but could rise as high as 70% (Pool male) and 72% (Pool female) when courtship was frequent or descend to 28% (Pool male) and 31% (Pool female) in mid-winter. Loafing breaks varied in mean duration from 13·3 to 40·6 minutes (Pool male) and from 7·8 to 28·4 minutes (females), with maxima up to 129 minutes (males) and 83 minutes (females), females consistently having shorter mean breaks than males. The frequency distribution of the durations of feeding spells is given in Table 2 and that of loafing breaks in Table 3, based on the same limited samples as in Table 1.

Table 2. Duration of feeding spells in the Great Crested Grebe at Chew Valley Lake (from same basic data as in Table 1)

	% distribution of records in 5-minute intervals												
Sex	5 or less	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	Over 60
Males	18·7	14·9	17·2	9·7	10·4	10·4	2·2	1·5	2·2	0·7	3·7	0·0	8·2
Females	26·4	21·8	11·8	8·2	11·8	7·3	6·4	2·7	1·8	0·9	0·0	0·9	0·0
Both	22·1	18·0	14·7	9·0	11·1	9·0	4·1	2·0	2·0	0·8	2·0	0·4	4·5

Note. Values over 60 mins were 62, 67, 69, 72, 75, 79, 97, 98, 103, 106, and 160 mins (all for males).

Table 3. Duration of loafing breaks in the Great Crested Grebe at Chew Valley Lake (from same basic data as in Table 1)

	% distribution of records in 5-minute intervals												
Sex	5 or less	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	Over 60
Males	37·8	21·3	10·6	6·4	6·4	6·4	0·0	0·7	1·4	2·8	0·0	2·1	4·3
Females	46·4	17·0	12·5	10·7	3·6	3·6	0·9	0·9	1·8	0·9	0·0	0·0	1·8
Both	41·5	19·4	11·5	8·3	5·1	5·1	0·4	0·8	1·6	2·0	0·0	1·2	2·8

Note. Values over 60 mins were 61, 63, 74, 90, and 129 mins (males); 82 and 83 mins (females).

FOOD

With its long neck and bill, the Great Crested Grebe is primarily a specialised fish-eater, seeking its prey mainly under water. It feeds chiefly on deep-bodied, freshwater coarse-fish such as Roach *Rutilus rutilus* (Cyprinidae) and Perch *Perca fluviatilis* (Percidae), both adults and fry, rather than game-fish such as trout *Salmo* (Salminidae) – even when the latter are plentiful, as at Chew.

During 1948–62, any prey taken by adult Great Crested Grebes at the Berkshire gravel-pits was noted, more or less casually, and its relative size estimated. This can be done with fair accuracy for the birds hold prey items in the bill prior to swallowing or presenting them to the young (or, less frequently, the mate). Comparison with the length of the bill is a useful guide. At Old Theale Gravel-pit in 1957, this method of assessment was devel-

oped more systematically; and it was used consistently during 1966–70 at Chew. Prey items (the majority fish) were each assigned to one of eleven size categories: (1) minute; (2) minute/tiny; (3) tiny; (4) tiny/small; (5) small; (6) small-medium; (7) medium; (8) medium-large; (9) large; (10) very large; and (11) huge. Additionally, fish in categories 1–6 were termed 'little' and those in categories 7–11 'big'. I estimate that the actual mean length of each category was as follows: (1) ¼ inch (about 0·7 cm); (2) ½ inch (1·2 cm); (3) 1 inch (2·5 cm); (4) 1½ inches (3·8 cm); (5) 2 inches (5 cm); (6) 2½ inches (6·2 cm); (7) 3 inches (7·5 cm); (8) 4 inches (10 cm); (9) 5 inches (12·5 cm); (10) 6 inches (15 cm); (11) 7 inches (17·5 cm). Thus, little fish in my estimation measured under 7·5 cm and big fish over 7·5 cm. Judging from published figures (e.g. in Geiger 1957) on fish sizes collected from grebe stomachs, however, it seems very likely that I somewhat underestimated the sizes in some of the higher categories – perhaps by as much as two inches (5 cm). The maximum size of deep-bodied fish taken (see below) was thus about 8½ inches (21·5 cm) long though narrow-bodied fish may be longer. The main determining factor appears to be width and I estimated that Great Crested Grebes cannot swallow fish wider then 7·5 cm. Harrisson and Hollom (1932) stated that Roach and Perch up to 10 inches long (25 cm) may on occasion be eaten and given to the young but I suspect they overestimated the size of the fish in such cases.

Prey-size at the Berkshire gravel-pits

Records of 135 fish caught and eated (or sometimes lost) by adult Great Crested Grebes at these waters are given in Table 4, including a few records from 1967. From these limited data, it might tentatively be concluded that the Great Crested Grebes there took at least as many big as little fish, with the former, of course, providing a much larger biomass – remembering that 'the weight of an animal increases as the cube of its length' (Marler and Hamilton 1967). Thus, on waters with a large size-range of prey fish, it is more efficient to feed on the largest possible prey readily available, a category-10 fish being nearly 14,000 times the biomass of a category-1 fish. It also seems likely that males at the Berkshire gravel-pits tended to take more big fish than did females, in the ratio of 3·8:1. This may well be a function of relative size, females being smaller on average than males with shorter bills, and it is possible that such a system reduces intraspecific competition for food between the sexes – and particularly between members of the same pair. The problem is discussed in detail for birds generally by Selander (1966) who refers to the well-developed sexual dimorphism in bill-length reported in the Western Grebe by Rand (1952) and Palmer (1962). The largest sized fish known definitely to be caught by female Great Crested Grebes at the Berkshire gravel-pits were of category-9, of which there were only two records. In both cases, however, the fish were lost by the females concerned. As one female at Old Theale in 1957 was seen to eat four category-9 fish caught by the male of the pair, it is possible that though obviously capable of ingesting fish of this size females have greater difficulty in catching and, especially, in retaining them than males have – probably because of the females' smaller bills.

Table 4. Size-categories of 135 fish caught by adult Great Crested Grebes at certain Berkshire gravel-pits in various years

Sex (total fish)	% distribution of records: Little fish in categories							Big fish in categories					
	1	2	3	4	5	6	Total	7	8	9	10	11	Total
Males (75)	1·3	1·3	10·7	9·3	9·3	8·0	40·0	12·0	25·3	8·0	13·3	1·3	60·0
Females (49)	12·2	10·2	16·3	16·3	10·2	10·2	75·0	8·2	12·2	4·1	0·0	0·0	24·5
Uncertain (11)	0·0	0·0	0·0	0·0	0·0	0·0	0·0	9·1	36·4	44·5	9·1	0·0	100·0
Both (135)	5·2	4·4	11·8	11·1	8·8	8·1	49·6	10·4	21·5	9·6	8·1	0·7	50·4

Notes. (1) See text for estimated size of fish and other information.

However, bias of at least two kinds may affect these data on prey-size. Firstly, there might well have been a tendency for me to see and record mainly the big fish taken, for these were more conspicuous and were usually retained by the feeding bird longer before swallowing than little fish – except in the case of sticklebacks (see below). Secondly, more little than big fish may be swallowed by the grebes under water. The first caveat would

seem to apply only to 24 casual records used in Table 4 but not to the remainder. The second caveat is much more serious. I used to assume that Great Crested Grebes bring all prey, regardless of size, caught under water to the surface for ingestion (Simmons 1955). Later observations, however, indicated that this is not wholly the case and that, while all big fish are indeed normally eaten above water, some of the lower category little fish must be swallowed under water (see also Fjeldså 1973b on the Slavonian Grebe). Certainly, in times of emergency, i.e. when troubled by the piratical attention of gulls *Larus,* Great Crested Grebes can swallow even big fish (at least up to category-8) under water. Of the little fish taken, Three-spined Sticklebacks *Gasterosteus aculeatus* seem always to be eaten above water because their defensive spines are erected and 'locked' when an individual fish is caught by a predator (see Hoogland et al. 1957) and the grebe has to deal with these spines before ingestion.

To redress any bias towards the under-recording of little fish somewhat, the size-categories of prey brought to the young may be examined, for in parental feeding, of course, all food is brought to the surface for presentation by the adults to the young. The records for Old Theale in 1957 are given in Table 5. Here, if anything, there is bias towards little fish as these are more suitable for smaller young – though the chicks are, in fact, confined to little fish only during the first 2–3 weeks after hatching. The records confirm that many big fish were taken for the young by the Berkshire grebes and especially by the males. While the data in Tables 4 and 5 do not permit a definitive statement on the relative proportions of big and little fish in the diets of the adult population of Great Crested Grebes as a whole, they certainly do suggest that (1) big fish were an important part of the food of the gravel-pit birds (especially remembering their greater biomass and food-value per item), and (2) males took proportionally more big fish than did females.

Table 5. Size-categories of 560 fish brought by adult Great Crested Grebes for their young, Old Theale Gravel-pit, 1957

	% distribution of records										
Sex	Little fish in categories							Big fish in categories			
(total fish)	1	2	3	4	5	6	Total	7	8	9	Total
Males (251)	0·4	6·8	1·2	26·3	12·3	10·8	57·8	16·7	22·7	2·8	42·2
Females (261)	25·7	22·6	15·3	21·1	5·0	5·0	94·6	3·1	2·3	0·0	5·4
Uncertain (48)	4·2	10·4	8·3	33·3	14·6	14·6	85·6	8·3	6·2	0·0	14·6
Both (560)	12·5	14·5	8·4	24·5	9·1	8·4	77·3	9·6	11·8	1·2	22·7

Notes. (1) See text for estimated size of fish, etc. (2) There were no records for categories 10 and 11.

Prey-size at Chew Valley Lake

More extensive and critical observations at Chew during 1966–70 suggested a rather different situation there than at the Berkshire gravel-pits. In all, 1239 records were obtained of the size-categories of prey taken by adult Great Crested Grebes for their own consumption (Table 6). From these, it can be concluded with fair certainty that (1) the grebes at Chew took proportionally fewer big fish than those at the Berkshire gravel-pits, and (2) the tendency for males to take more big fish than did females, though present, was much less marked. The same trends are apparent in an analysis of the size-categories of 7870 feeds brought to the young (Table 7). Of the six category-11 fish caught by males at Chew, all were abandoned as they were too broad to swallow; all were coarse-fish and probably all Roach. All the three category-9 fish caught by females were similarly abandoned. The male on Herriott's Pool seemed to swallow most little fish and aquatic invertebrates while submerged but brought big fish, and stickle-backs, to the surface for eating. In addition to the records given in Tables 6 and 7, the Pool female was seen to catch large quantities of category-1 prey, probably larval fry, while surface-hunting (see later) during her recesses from incubation in June 1968. During six feeding spells, she took 440 such items – averaging one every 53 seconds. The Pool male was never seen to concentrate on prey of this minute size, even when feeding tiny young.

Thus it would certainly appear that, as big fish were of much less importance at Chew (stocked with trout) than at the Berkshire gravel-pits (stocked with coarse-fish), feeding conditions at Chew were less favourable

Table 6. Size-categories of 1239 fish caught by adult Great Crested Grebes at Chew Valley Lake, 1966–70

% distribution of records

Sex (total fish)	Little fish in categories							Big fish in categories					
	1	2	3	4	5	6	Total	7	8	9	10	11	Total
Males (520)	6·0	1·9	13·8	43·3	20·8	1·3	87·1	1·2	4·8	4·2	1·5	1·2	12·9
Females (650)	7·1	4·6	16·2	34·6	16·6	1·7	96·6	1·2	1·7	0·5	0·0	0·0	3·4
Uncertain (69)	2·9	4·3	7·2	21·7	52·2	7·2	95·7	1·4	0·0	0·0	2·9	0·0	4·3
Both (1239)	6·4	3·5	14·7	40·7	25·3	2·0	92·6	1·2	2·9	2·0	0·8	0·5	7·4

Note. See text for estimated size of fish, etc.

Table 7. Size-categories of 7870 fish brought by adult Great Crested Grebes for their young, Chew Valley Lake, 1967–69

% distribution of records

Sex (total fish)	Little fish in categories							Big fish in categories				
	1	2	3	4	5	6	Total	7	8	9	10	Total
Males (3913)	11·8	15·0	16·5	20·1	27·2	6·4	97·1	1·0	1·2	0·7	*	2·9
Females (3957)	8·2	10·4	11·6	25·7	36·9	6·0	98·9	0·8	0·3	0·0	0·0	1·1
Both (7870)	10·0	12·7	14·0	22·9	32·1	6·2	98·0	0·9	0·7	0·3	*	2·0

Notes. (1) See text for estimated size of fish, etc. (2) There were no records for category–11. (3) Asterisk indicates less than 0·05%.

– at least in summer. The Great Crested Grebes at Chew probably spent much more time hunting than did those at the gravel-pits, largely because it took them longer to obtain an equivalent biomass of food due to the smaller mean size of prey eaten. Time spent in hunting was not studied at the Berkshire waters during 1948–62, except at Old Theale in 1957 when rough time-budgets were obtained for the main study pair while incubating and rearing young. The following later examples, however, may be fairly typical. At New Theale Gravel-pit on 23 October 1967, one bird left a loafing flotilla of Great Crested Grebes and started diving; on its third dive, it caught a category-8 fish and ate it within two minutes of leaving the group, then returned to the latter at its leisure. A second bird started diving at 15.23 hrs and stopped at 15.55 hrs after eating a category-9 fish.

Helminth-eating

It is now well established that Great Crested Grebes not infrequently eat their own intestinal worms, almost certainly Cestoda (tapeworms), and give them to the young. For full details, and a record for the Red-necked Grebe *P. grisegena,* see Simmons (1975b).

FEEDING METHODS

Great Crested Grebes usually hunt singly though they may congregate at times to feed on dense shoals of fish – as at Chew in late summer when little fish, presumably the fry of course species, are the target (see Simmons 1974a, Vinicombe 1976). There are two main methods of hunting: (1) by *surface-diving* (food usually obtained well under water), and (2) by *surface-feeding* (food obtained just below the surface of the water, or on or just above it). Of these, the first plays the more important role in providing the chief bulk of the prey. At Chew, particularly, sexual differences in hunting method were obvious at times, females tending to dive in shallower water and in cover more than males and to feed more at the surface.

Surface-diving

The Great Crested Grebe is essentially a dive-hunter, tending to obtain its food mostly in water not choked with vegetation. It usually favours depths of 2—4 metres or less (Harrisson and Hollom 1932). During a spell of *dive-hunting,* the grebe carries out one or more series of *search-dives* or underwater excursions, periodically surfacing for breath. It typically surface-dives, submerging from a stationary position, first sinking lower in the water while depressing its contour feathers (including crest and tippets) to reduce buoyancy by pressing out surplus air from its plumage, and then smoothly disappearing bill-first with a rapid forward and downward swing of the neck, body following. Normally, this submergence causes little turbulence on the water; as the bird still holds its legs forward as it disappears, they are obviously not used to give propulsion until it is under the surface. This smooth manner of diving may be an adaptation against disturbing potential prey in the vicinity for in *escape-diving* the feet are used to give extra impetus for rapid submergence in emergency, often producing a noticeable splash (this may have secondary signal value at times, e.g. in warning the young of imminent danger). Such *kick-dives* are also used during intense bathing (see later).

Once submerged, the hunting grebe swims about, propelled by its feet, looking for prey with its neck extended and the wings, as usual, folded right away and hidden in the 'pocket' formed by the long flank feathers. It does not usually dive vertically from surface to bottom and then back to the same spot, in the manner of a Coot *Fulica atra* or diving duck (e.g. Pochard *Aythya ferina*), but travels horizontally for many metres before surfacing elsewhere. When sighted, the prey is overtaken by fast *power-swimming pursuit* and seized in the bill. Unless caught at the end of the submergence period, most smaller creatures are usually eaten under water, as we have seen; but the grebe surfaces to deal with sticklebacks and all larger fish. Big fish are often swallowed quite quickly — whole, head-first, sideways-on, and still alive, though usually incapacitated by strong pinching pressure from the bird's mandibles. Sometimes, however, in the case of a big fish of the maximum size eaten, some minutes may be spent ingesting it while the grebe repeatedly attempts to gulp it down with ducking movements of the elevated head and neck and strong paddling movements of the feet (almost as if it were trying to insert itself over the fish); the latter may be re-adjusted in the bill, even by replacing it momentarily in the water, but grebes do not toss up and catch their prey as do, for example, pelecaniform seabirds. Treatment of sticklebacks is quite different and often disproportionately prolonged, the grebe repeatedly flicking, pinching, and working them in and out of the bill — rather like a man eating a hot potato.

Diving-times

During my studies, I timed many feeding dives of the Great Crested Grebe but largely incidentally during the course of other work; plans for a more systematic investigation never materialised, including a comparison of the duration of dives in males, females, and young. Feeding dives in the Great Crested Grebe generally last under 30 seconds (Simmons 1955). In his classic and much underestimated book *The Bird as a Diver,* Dewar (1924) analysed the timings of 282 dives of the Great Crested Grebe, obtained mainly from birds on the sea where he found them to be typically 'long-shore' divers (i.e. they travelled on a course roughly parallel to the shore while feeding). The dives varied in duration between 13 and 50 seconds, most averaging between 22·1 and 33·3 seconds; a sample of 23 taken on Loch Broom, Scotland, had a mean of 19·7 seconds. Other examples from Britain (all times in seconds) include: (1) mean 26·0, range 15—41 (Harrisson and Hollom 1932); (2) mean 23.5, range 11—45, sample 21 (Ingram and Salmon 1941); (3) mean 18, range 5—45, sample 146 — all from Chew (Ladhams 1968); (4) mean 22·4, range 8—39, sample 30 — bird at one of the west waters, New Theale Gravel-pit (Hancock and Bacon 1970). My own data include timings obtained of (1) 482 dives by the male on Herriott's Pool, Chew, on various dates between July 1967 and August 1969; (2) 30 by a female near the dam at Blagdon Lake, North Somerset, on 18 February 1968; (3) 30 by two birds at New Theale east water on 23 October 1967; (4) 24 by birds at Marsworth Reservoir, Tring, Hertfordshire, on 25 October 1967; and (5) 74 by a lone bird feeding five large young at Old Theale on 12 August 1975 (obtained for me while we watched by Robert Gillmor). These timings are analysed in Table 8 though, for present purposes, I have not included the standard error of the mean as recommended by Simmons (1970a). It will be seen that over 70% of the 640 dives timed fell into the range of 16—25 seconds. The information for the various sources show that there is considerable variation in diving-times at different waters, with means as low as 18 seconds and as high as 33. For this reason, it is misleading to smooth over the phenomenon by lumping data from various waters in an attempt to produce one standard mean representing the species as a whole. Even the dives of the same

Table 8. Duration of feeding dives by Great Crested Grebes at various waters

Time (to nearest sec.) in 5-sec. intervals	% distribution of records at (1) Chew Valley Lake	(2) Blagdon Lake	(3) New Theale GP	(4) Marsworth Res. Tring	(5) Old Theale GP	(6) All these waters
6–10	1·7	0·0	0·0	0·0	1·3	1·4
11–15	12·9	10·0	0·0	0·0	0·0	10·2
16–20	50·0	16·7	0·0	0·0	12·2	39·8
21–25	30·3	26·7	46·7	12·5	41·9	31·6
26–30	4·8	26·7	50·0	33·3	31·1	12·0
31–35	0·4	20·0	3·3	33·3	8·1	3·6
36–40	0·0	0·0	0·0	20·8	4·0	1·2
over 40	0·0	0·0	0·0		1·3	0·2
Total Dives	482	30	30	24	74	640
Range (seconds)	6–31	12–33	22–30	24–37	10–47	–
Mean (seconds)	19·3	24·5	26·0	31·0	25·4	–
Median (seconds)	20·0	25·0	26·0	31·0	25·0	–

Note. See text for further information on locality, dates, and birds.

individual on the same water can differ significantly in mean duration on different occasions, as I was able to demonstrate in the Red-necked Grebe (Simmons 1970a). The same was evidently true of the male on Herriott's Pool where the mean duration of dives on different dates varied between 16·1 and 25·6 seconds, though mostly in the range of 18·7–20·5.

As I pointed out elsewhere (Simmons 1970a), several factors influence the duration of dives by grebes and other aquatic birds. As established by Dewar (1924), however, the depth of the water is probably the most important single factor determining the *mean duration* of a series of dives – preferably a fairly long sequence for, in the case of grebes at least, I am reluctant to rely on Dewar's opinion that the 'average period of three consecutive dives gives approximately the average depth of the water in which the dives were made', for short series of timings in birds such as the Great Crested Grebes can at times provide a wide spread of values due to factors other than depth of water. Dewar showed that 60 dives by Great Crested Grebes at a mean depth of 6ft 2ins (1·9 m) averaged 22·1 seconds; 135 at 9ft 10ins (3 m), 26·6 seconds; 56 at 14ft (4·3 m), 33·3 seconds; and eight at 21ft (6·4 m) 45·6 seconds. At Loch Broom, 23 dives measured at random gave a mean of 19·7 seconds, the mean depth of the loch being about 5 ft (1·5 m); this mean diving-time is close to that I obtained from the male on Herriott's Pool which is of similar average depth to Loch Broom. The highest mean I obtained (31 seconds) was on Marsworth Reservoir, Tring, which is a deep water of 18ft (5·5 m) maximum capacity. In the case of a Red-necked Grebe at Cheddar Reservoir, North Somerset, significant differences in the mean duration of dives on two dates were correlated with variation in mean water depth (Simmons 1970a); the same probably applied to the male on Herriott's Pool, Chew (see above), parts of the 20-ha catchment area being deeper than others, for example over the old bed of the River Chew itself which runs through the centre. The relationship between depth of water and average duration of feeding dive in the Great Crested Grebe implies that this species has a basic strategy when dive-hunting of descending, probably diagonally, towards the bottom and then proceeding on its course in search of fish. Some authors (e.g. Hanzák 1952, Simmons 1955; see also Lawrence 1950 for the Western Grebe) have maintained that the depth of water has no influence on the duration of dives; such a view, unsupported by figures, seems untenable however as regards feeding dives, though it might be true if all types of dive – e.g. travelling, threat, escape – were included. This said, it is very likely that grebes, having to seek, chase, and catch individual, mobile prey – at times in the water layer between the surface and the bottom – are rather less influenced by water depth than bottom-feeding birds such

as coots and diving ducks. Fjeldså (1973b) also demonstrated that the diving-times of the Slavonian Grebe are influenced by the benthic density of the prey. In the Great Crested Grebe, the mean duration of those feeding dives in which prey is brough to the surface is probably shorter than the overall average; thus, 19 such 'successful' dives by the Pool male averaged 15·4 seconds as against 19·3.

After diving, the Great Crested Grebe waits on the surface for a short period before diving again. Such intervals are of two types: (1) the true *pause* (brief interval between dives in the same series), and (2) the *lull* (somewhat longer interval between series of dives in the same feeding spell). These intervals have been by no means clearly distinguished in the literature, either from each other or from true loafing breaks at the shorter end of the scale, especially in the calculation of *dive:pause ratios* — which are used, for example, in assessing diving efficiency (see Dewar 1924), the higher the ratio the more efficient the diver (more time overall spent under water). Unfortunately, I managed to time very few true pauses during my study, but 16 typical ones by the male on Herriott's Pool averaged 10·1 seconds, range 7—13 seconds, giving a dive:pause ratio of 1·9:1. This may be compared to the ratios of from 1·5 to 1·8:1 recorded at different depths by Dewar (1924) for this species, the highest ratio being at mean depths of between 3 and 4·3 m. At Loch Broom (see above), the ratio — calculated from Dewar's data — was an apparent 1·3:1 only, suggesting that the intervals measured there were not all true pauses. As each dive and its pause lasted a mean of just under 30 seconds, the male on Herriott's Pool averaged about two dives a minute during a series of search-dives. On occasions, I counted the number of dives this bird actually made over periods of time. Thus, on 18 October 1967, there were 87 dives in 40 minutes; as 60 of these dives averaged 18·7 seconds, this gives a calculated total underwater time of 27·1 minutes, a total surface time of 12·9 minutes, and a mean pause of 9 seconds — with a corresponding dive-pause ratio of 2·1:1. On 22 April 1968, I counted 123 dives in all over a total period of 68 minutes (105 of them in one complete feeding spell of 58 minutes); as 51 of these dives averaged 19·6 seconds, the calcualted total underwater time was 40·2 minutes, the total surface time 19·8 minutes, and the mean pause 9·7 seconds — giving a dive-pause ratio of 2·0:1. The diving efficiency of the Great Crested Grebe may be judged by comparison with the dive:pause ratios of the following waterbird species taken from Dewar (1924), his highest figure being used in each ease (at least when based on a respectable sample): Coot 0·2:1; Eider *Somateria mollissima* 1·1:1; Common Scoter *Melanitta nigra* 1·5:1; Goldeneye *Buchephala clangula* 2·1:1; Red-throated Diver *Gavia stellata* 2·1:1; Pochard 2·2:1; Cormorant *Phalacrocorax carbo* 3·6:1; Razorbill *Alca torda* 3·7:1.

Surface-feeding

The Great Crested Grebe obtains some of its food while floating or swimming on the surface, largely by *surface-hunting* for prey (predominantly of the lower size-categories) just below the water — especially in shallow water or amongst submerged vegetation such as bistort *Polygonum* and crowfoot *Ranunculus.* The different methods involved have been largely overlooked by ornithologists, though see Bandorf (1970) and Fjeldså (1973b) for the Little and Slavonian Grebes respectively. Firstly, the Great Crested Grebe *peers* by looking under water with part of its head submerged, up to just beyond the level of the eyes, like a human diver 'snorkling' or 'goggling', and the neck well arched so that the chin is but a few inches in front of the breast for much of the time (see figure on p. 98 of Simmons 1955 for a good impression of this posture). Peering thus, it often pushes the head and bill forwards and brings them back with a continuous nodding action (*shovelling*), usually while moving forward (*swim-peering*). Occasionally, while peering, the head is swept laterally from one side to the other though such *scanning* is not so frequent in the Great Crested Grebe as, for example, in the Pied-billed (see Ladhams et al. 1967, Ladhams 1968). While prey may occasionally be caught while peering, this is usually only a method of detecting prey; sooner or later, the surface-hunting grebe sights food beneath it and actively tries to secure it, first *neck-dipping* by entirely submerging the head and most or all of the neck. If the prey still lies beyond reach, the grebe next starts *up-ending* by submerging most of its body as well, maintaining it in an almost vertical position in the water by vigorous paddling of the feet and with only the tail-end visible. If necessary, it will then *submerse* further so as partly or wholly disappear, 'screwing' itself down briefly by kicking movements of the feet usually to re-appear tail-first with a bob at the same spot, unlike when really surface-diving — though submersing will sometimes turn into normal pursuit-swimming. Little prey, probably mainly fish fry and aquatic inverebrates, may often be seen in the bill of the surface-hunting grebe as it withdraws its head from the water. Unlike the Pied-billed Grebe (King 1974), the Great Crested does not deliberately foot-paddle to stir up food in shallow water.

The last two methods used by the Great Crested Grebe when surface-hunting are of relatively little importance, at least to adults. It will pick up minute prey, such as insects, from the top of the water (*surface-seizing*) or from aquatic vegetation but is neither so adept or persistent as the Slavonian Grebe or, in particular, the Black-necked Grebe in *surface-skimming* large quantities of food (such as chironomids) from the top of the water, the last named species specialising in such behaviour with its characteristically shaped bill. Like the others, the Great Crested Grebe will also feed at times by *snatching*, reaching up and snapping at gnats and other flying insects over head (see also Crowe 1951), one individual being seen thus to snatch repeatedly at a low-flying Swallow *Hirundo rustica* (Winterbottom 1955).

DRINKING

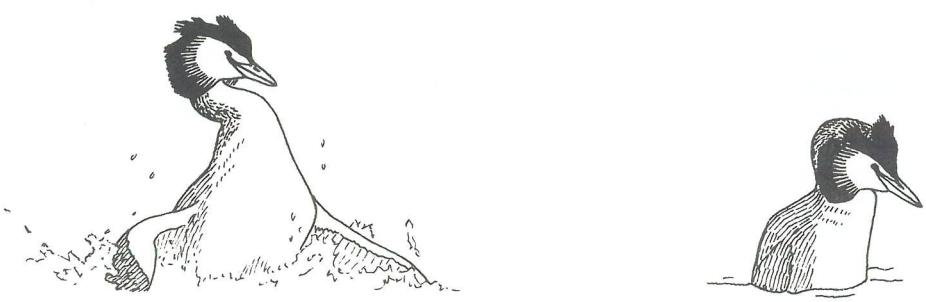
A Great Crested Grebe *drinks* by dipping the bill in the water and then raising it well above the horizontal, usually repeating this sequence one or more times. Frequently, however, it will *sip* instead by bill-dipping and then barely lifting the bill, repeating this *dip-sipping* quite quickly once or more, often intermittently over fairly long periods. Harrisson and Hollom (1932) reported that drinking (or sipping) is frequent after the eating of a particularly big fish but rare at other times.

COMFORT BEHAVIOUR

The comfort behaviour of the Great Crested Grebe consists of the following categories: (1) bathing, (2) oiling, (3) preening, (4) resting, and (5) comfort-movements. While thus engaged, the bird typically faces into the wind thus ensuring that its feathers are not blown about from the rear.

Bathing

As I pointed out in my earlier *Studies* (Simmons 1955), the Great Crested Grebe – being a specialised waterbird with waterproof plumage – has to use special movements to wet itself deliberately during bathing, the latter being the first in a functional series of *feathercare* (or 'feather-maintenance') activities (Simmons 1964). Each bird bathes several times a day, mostly by *surface-bathing*. When performing at full intensity, the grebe ruffles up its plumage (even the tail-tuft may be cocked at times) and repeatedly makes vigorous bathing movements on top of the water, including: (1) *ducking-and-rubbing* (in which the head, neck, and forebody are dipped under water with a 'bouncy' action and the wet head rubbed against the flanks, often to each side alternately); (2) *wing-thrashing* (in which the partly open wings are beaten against the water as the grebe rises somewhat by treading with its feet – see Fig. 1); (3) *wing-scissoring* (in which the folded wings are shuffled in the water); and (4) *barge-swimming* (in which the bird swims slowly along in a bizarre posture with its rear-end sunk and its forebody raised out of the water – see Fig. 2 – often while extending its wings backwards and downwards below the surface). Barge-swimming was



Figs 1–2. Bathing: wing-thrashing (Fig. 1); barge-swimming (Fig. 2).

originally termed 'escape-bathing' (Simmons 1955) before I fully understood its role as part of the cycle of functional bathing movements. Sometimes while barge-swimming, the bird will continue to duck-and-rub as it moves forward.

In brief surface-bathes, there may be only one or a few series of ducking-and-rubbing. On occasion, the bathing session may be very brief or perfunctory, consisting only of some *bill-dips* and *flank-preens* or even just of a few *dip-shakes* – in which the bill is momentarily submerged and then the head quickly shaken laterally (see later). Probably at least once a day, however, the Great Crested Grebe has a *thorough bathe*, getting its plumage very wet (but not waterlogged) by *dive-bathing* and *wallowing* between intense spells of surface-bathing. When dive-bathing, it makes a series of complete submergences, kick-diving vertically under the water with a quick flip-up of the folded wings while keeping its contour feathers ruffled up throughout and its wings held loosely – unlike when diving or submersing for food. Between these bathing-dives, it floats immobile on the surface, wallowing (or 'soaking') low sunk in the water and head hunched in shoulders.

Though details are few, the bathing behaviour of other Podicipedidae seems generally to be closely similar to that of the Great Crested Grebe. This is certainly true, from personal observation, of the surface-bathing of the Red-necked, Little, and Pied-billed Grebes – in all of which ducking-and-rubbing, wing-thrashing, and barge-swimming occur – and also for the Slavonian Grebe (Storer 1969). Surface-bathing is particularly vigorous in the Least Grebe, spray being raised 2–3 feet (Storer 1976). Dive-bathing has been recorded in the Slavonian Grebe (Storer 1969); in the New Zealand Hoary-headed Grebe *Poliocephalus rufopectus*, Storer (1971) found two types of bathing-dive, the birds either submerging head-first or breast-first (I suspect this may be the case also in the Great Crested Grebe). I found dive-bathing to be particularly spectacular in the Pied-billed Grebe. The vagrant individual studied at Blagdon in 1968 (see Simmons 1969) would at times perform series of 20 or more vertical 'bouncy' dives with the chest puffed out, neck retracted, feathers all fluffed up, and tail cocked; after each dive, it remained under water briefly before popping up at the same spot in an erect posture, remaining there briefly, sometimes with its wings extended backwards under water, before diving again. No grebe has been reported somersaulting during bathing as do many waterfowl (see McKinney 1965) and the divers *Gavia* (Selous 1927).

Oiling

After bathing, the Great Crested Grebe *oils* its feathers. Oiling is functionally associated with bathing; as I have argued elsewhere (Simmons 1964), the wetting of the plumage seems to act as much to facilitate the oiling as to clean the feathers – i.e. it is easier to spread preen-oil on damp feathers than on dry. Oiling is done both with the bill, as in ordinary preening (see later), and also with the head and even, at times, with the wings. In such an aquatic species, the habit is evidently of particular importance in maintaining the good condition and hence, at least indirectly, the waterproofing of the plumage. When *oiling with the bill*, the grebe obtains oil from its preen-gland, situated on the lower back just above the tail-tuft, by (1) turning the head and stretching the neck backwards dorsally, (2) nibbling the feathered orifice of the gland with the bill and stroking the bill across it, and (3) transferring the oil to the plumage by preening. When *oiling with the head,* it rubs its head on the preen-gland

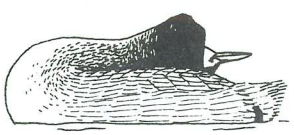


Fig. 3. Oiling: back-rubbing.

and then progressively over the rest of the accessible areas of its dorsal plumage, using all parts of the head (face, chin, crown, etc.) like an oily mop with a rubbing and rolling action (see Fig. 3). Such behaviour, of course, also serves to oil the head itself, both directly on the preen-gland and by secondary contact with other parts of the

plumage. Particularly characteristic are the oiling thus of the flanks (*flank-rubbing*), the mantle and mid-back area (*back-rubbing*), and the mantle while simultaneously rubbing the underside of the lower mandible against the front of the curved neck (*jugulum-mantle rubbing*). Finally, though most parts of the wings are oiled with the bill or head, the tips of the primaries are at times treated – usually only after a thorough bathe – by being repeatedly rubbed alternately on the preeen-gland direct with slow, deliberated *wing-twitching* movements; these continue throughout the succeeding bout of preening.

Oiling behaviour is probably essentially similar in all grebes, judging from my own observations on the Pied-billed, Little, and Red-necked Grebes in each of which I recorded both oiling with the bill and with the head, and also wing-twitching (which seems not to have been previously described in the grebe literature). From studying the Mallard *Anas platyrhynchos*, I would say that wing-twitching in the Podicipedidae is analogous with the behaviour termed 'wing-twitch and tail-fan' in the Anatidae by McKinney (1965), who suggested that it serves to dry the wing and tail feathers after bathing. Drying of the wings may well also be achieved, at least in part, by wing-twitching in the grebes but I believe that its primary function is the oiling of the flight-feathers, especially the primaries, and that drying of the plumage generally is effected mainly by certain comfort-movements and preening (see later). Woolfenden (1956) has given an excellent description of how a Slavonian Grebe oiled and dried its feathers by preening.

Preening

After bathing, the Great Crested Grebe starts preening its plumage, pure preening soon giving over to oiling and then back again gradually. If there has been no effective bathing, the grebe may leave out the oiling phase; in such cases, it often wets the bill intermittently between preens by dipping it in the water. Much preening is carried out with the bill (*true preening* or *preening with the bill*); also, but to a much lesser extent, with the foot as in head-scratching (see later), especially during prolonged bouts of feathercare. Such *scratch-preening* of the head parts is discussed, for birds generally, in Simmons (1974b). True preening consists largely of the usual *nibbling* and *drawing* bill movements found in most birds. When nibbling, the Great Crested Grebe passes an individual feather through the bill with tiny pecking actions; when drawing, it pulls the feather through the mandibles with a single movement of the head. The grebe also frequently *strops* its plumage; in this highly characteristic form of true preening, whole areas of feathers, particularly those of the flanks and underparts, are rapidly stroked with a smoothing or flicking action of the closed or part-open bill. Repeated stropping is especially effective in quickly removing surplus water, re-adjusting the plumage after disarrangement, and spreading preen-oil – all in a relatively rough, crude manner, leaving other functions (such as repairing breaks in barbs and barbules and working in preen-oil) to the more precise nibbling and drawing preening movements.

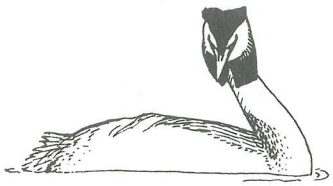
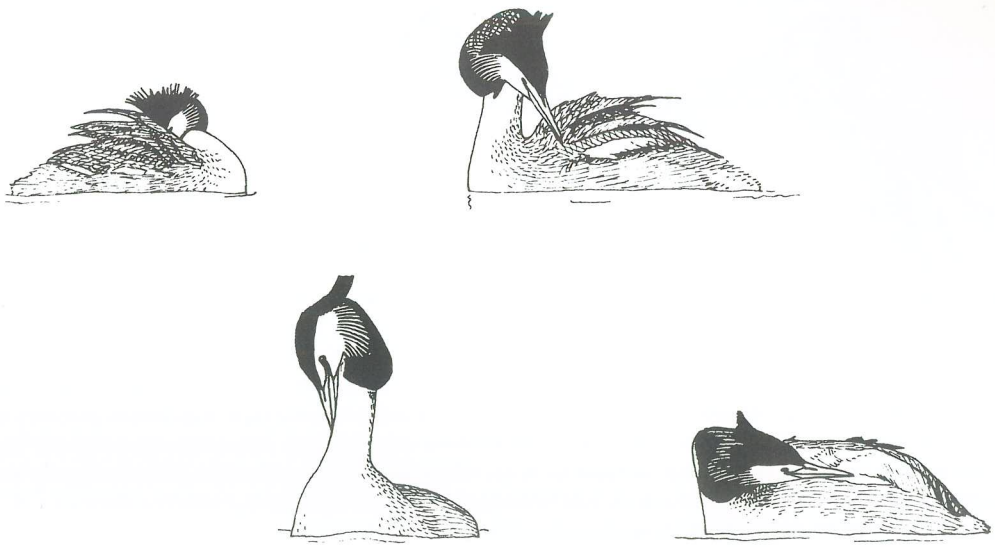


Fig. 4. Preening-roll

While preening with the bill, the Great Crested Grebe assumes a number of distinctive poses. The most characteristic of these is the *preening-roll* (this term being preferred to the version 'rolling preen' used in the American literature, e.g. by Palmer 1962): the bird lies over on its side to a greater or lesser extent (see Fig. 4) while paddling with its submerged foot and sculling on the surface with the other, its conspicuous white underparts exposed, and engages in *ventral preening* the lower breast, belly, and adjacent areas. While doing so, it may rotate on the water but the Great Crested Grebe does not 'spin' round to anything like the same extent as the Red-necked Grebe does when ventral preening. In *dorsal preening* (Figs. 5–6), the grebe turns its head and neck backwards to



Figs 5–8. Preening: dorsal preening – of mid-back area (Fig. 5); preen-behind-wing (Fig. 6); frontal preening – high-preen (Fig. 7); lateral preening – of underside of wing (Fig. 8).

preen the mantle, scapulars, wings, mid-back, rump, and tail-tuft areas; in dealing with the undersurface of the wing, it lifts the folded wing somewhat but this *preen-behind-wing* behaviour (see Fig. 6) is usually not so conspicuous as in the Anatidae. In *frontal preening*, the bill is lowered and the front and sides of the neck and the upper breast above the water-line are dealt with, the bird at times stretching up its neck and sharply tucking the bill to get at the higher parts (*high preening*; see Fig. 7). Finally, in *lateral preening*, the head is again turned back, this time to reach the 'edge' and underside of the wing and also the flanks at and just below the water-line – the grebe rolling over in the water a little when necessary to do so (Fig. 8).

Some of the terms used above were coined while I was watching Red-necked Grebes in Denmark in 1967 and, as far as I can tell, the preening movements and poses are broadly the same throughout the Podicipedidae, though smaller grebes (such as the Little) preen more rapidly than the larger ones (such as the Great Crested). In those species which, like the Little Grebe in breeding plumage, lack wholly white underparts, the preening-roll is much less conspicuous than in others such as the Great Crested or Western Grebes.

Feather-eating

Feathers that get detached during preening are either discarded or, in the case of smaller ones (especially from the underparts), often eaten. The function of this *feather-eating*, which is widespread in the Podicipedidae and apparently found in no other family, is much debated (see, e.g., Storer 1969). In the Great Crested Grebe, however, the ingested feathers – which form a spongy ball in the stomach, sometimes entirely filling it – evidently play a role, at least eventually, in pellet-formation (Hanzák 1952; Simmons 1956, 1973).

Resting

After completing a bout of feathercare – bathing, oiling, preening – the Great Crested Grebe often rests. Like other grebes, it adopts either the *relax-posture*, with neck arched and drawn back so that the nape comes near to or touches the mantle area, or the *full rest-posture* (the well-known 'pork-pie' attitude of Edmund Selous

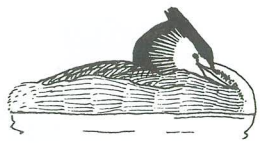


Fig. 9. Full rest-posture ('pork pie' attitude).

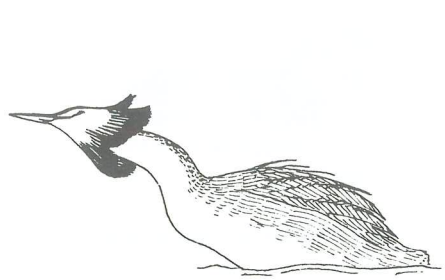
and Julian Huxley), with the back of the head lying on the mid-back area and the bill inserted laterally into the side of the neck (Fig. 9). When about to relax or rest fully, the bird usually shakes one foot, to rid it of surplus water, and then holds it up against the flank (*foot-resting*) or puts it right away under the closed wing (*foot-stowing*), slightly raising and then lowering the wing as the foot is 'shipped' against the flank and then encasing both foot and wing in the watertight 'pocket' formed by the flank feathers. In order to maintain maximum stability on the water while resting, the bill is almost invariably inserted into the neck on the same side of the body as the foot is stowed. The free foot is paddled if necessary and, at least at times, the grebe even swims along one-footed in the rest-posture (it may well have to do so – for instance, in order to keep its position against the wind or current – though it will at times deliberately move position thus). Occasionally, both feet are stowed simultaneously, particularly in cold weather (to reduce heat loss) or on very calm days.

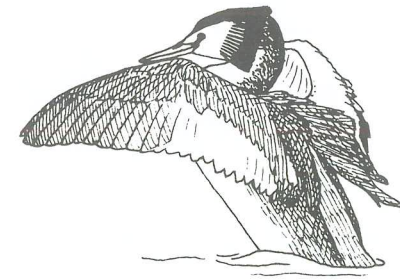
The full rest-posture of the Least Grebe *Lymnodytes* is peculiar in that the scapulars are raised tent-like, thus hiding the outline of the head and making the grebe look like a small tree-stump in the water rather than a bird (see Storer 1976); a similar posture has been recorded in the Little Grebe (Bandorf 1970), though I have never observed it myself. The presence of such a concealing posture in small grebes is not surprising, as they are much more vulnerable to predation than the larger species. I doubt if this indicates a close phylogenetic relationship, any more than in the case of sunning postures, and would be loath to put the Least Grebe in the genus *Tachybaptus* on such – or any other – grounds.

Comfort-movements

Most of the true *comfort-movements* of the Great Crested Grebe – to use the term in its stricter, more traditional sense – may be grouped under the heads *shaking-movements* and *stretching-movements* following, as much as possible, the names used by McKinney (1965) for the Anatidae (see Storer 1969). There are also three comfort-movements – the head-scratch, shoulder-rub, and throat-touch – which lie outside this classification. The first two of these were included in McKinney (1965) in his category 'cleaning movements' (not used here) while the third does not occur in Anatidae.

Shaking-movements. These include the head-shake, head-fling, body-shake, wing-flap, and foot-shake; understandably, there is no 'tail-wag' in the Podicipedidae as there is in the Anatidae. The most frequent, if least conspicuous of the shaking-movements is the *head-shake* in which the head is jerked laterally, usually from one side to the other and back again. Head-shaking is typically a direct response to irritation on the head, especially the bill; it is often used during preening, e.g. to detach feathers and other items from the mandibles, but is even more common during bathing and after diving of any sort when it helps to rid the bill and other parts of the head of surplus water. At moments of particularly intense stimulation, head-shaking develops into a much more vigorous and free movement, the *head-fling*, in which the head is rotated and thrown from side to side, often with the bill elevated; there seems, however, to be no consistent difference between head-shaking and head-flinging in grebes such as between the head-shake and 'head-flick' in the Anatidae. When performing the *body-shake* (Fig. 10), the Great Crested Grebe (1) ruffles up its feathers, especially those of the mantle and scapulars, and slightly lifts the wings; (2) raises itself by treading water while at the same time erecting its plumage more fully and extending and rotating head and neck; (3) subsides to the swimming position while 'tightening' its feathers up again. I call the whole





Figs 10–11. Shaking-movements: body-shake – 'rise-and-shake' (Fig. 10); wing-flap – 'rise-and-flap' (Fig. 11).

sequence the *rise-and-shake*; it is equivalent to the 'swimming-shake' of the Anatidae (McKinney 1965) but all body-shakes in the Podicipedidae are performed as swimming-shakes, there being no 'standing-shakes' (to use the term suggested to me by G. Collis) on land or in shallow water as in wildfowl. The rotary movement of the head during the body-shake is usually of small amplitude; sometimes, however, it is more exaggerated and then resembles the head-fling. The Great Crested Grebe will sometimes also include a partial *wing-shake* in its general body-shake but this movement is rare on its own, unlike in the Anatidae and certain other grebes (including, from personal experience, the Little and Pied-billed). When performing the *wing-flap*, the Great Crested Grebe (1) again raises itself, treading water, but now (2) opens its wings fully (Fig. 11) and (3) beats them deliberately a few times before (4) subsiding. Typically, such a *rise-and-flap* is followed – with or without intervening feathercare movements – by a rise-and-shake which settles the body feathers back over the closed wings. True wing-flapping should not be confused with *wing-waving*, a locomotory activity in which the wings are waved vigorously many times in order to maintain the bird in the rise position, e.g. when it looks about it; wing-waving is rare in the Great Crested Grebe though common in the Little and Pied-billed (Simmon 1968). In the final shaking-movement, the *foot-shake*, the leg is extended backwards and waved a few times in order to dry the toes, as prior to stowing the foot away for example (see above).

Stretching-movements. These include the leg-and-wing stretch, full-stretch, wing-glide, and jaw-stretch. The most common is the *leg-and-wing stretch* in which one leg and then the wing on the same side are extended backwards so that they are, more or less, unflexed (Fig. 12), the wing and then the leg being returned to their former positions after a slight pause. In its movement, the wing is stretched downwards over the back beyond the tail-tuft, primary tips clear of or barely touching the water. Sometimes, the leg is extended back on its own without any accompanying wing movement (the *leg-stretch*); also, following either form of stretch, the foot may be left behind for a while with all its digits spread (the *toes-stretch*; Fig. 13). Neither the toes-stretch nor the simple leg-

Figs 12–13. Stretching-movements: leg-and-wing stretch (Fig. 12); toes-stretch (Fig. 13).

stretch were classified as separate movements in the Anatidae by McKinney (1965) though common, for example, in the Mute Swan *Cygnus olor*. The *full-stretch* (Fig. 14) is more complex and, except during the annual wing moult, less frequent than the leg-and-wing stretch. The grebe (1) extends its neck low along and sometimes actually in the water (*neck-stretch*); (2) braces up the chin (*head-stretch*), sometimes also tilting the head slowly from side to side (*head-rotate*) – though this last movement is not so marked as in the Red-necked Grebe; (3) at the same time it

Figs 14–15. Stretching-movements: full-stretch – 'both-wings stretch', etc. (Fig. 14); wing-glide (Fig. 15).

raises the 'elbows' above the back and partly extends the 'wrists', thus lifting and partly opening the wings (*both-wings flex*). The term 'both-wings stretch', used by McKinney (1965) for the Anatidae, does not adequately cover this co-ordination – the components of which sometimes occur on their own – and could more appropriately refer to what I call 'wing-gliding', a quite different activity not observed in the Anatidae; moreover, 'both-wings stretch' implies a close relationship with the single wing-stretch whereas the movements involved are quite different. When performing the *wing-glide*, the Great Crested Grebe extends both wings sideways so that they are at right-angles to the body with their undersurfaces parallel with the water (Fig. 15); the posture is often maintained for several seconds at a time, sometimes with a slight waving action. The wing-glide can occur purely as a stretching-movement; during oiling, however, it facilitates access to the dorsal surface of the body, especially when the grebe is back-rubbing. The two final stretches involve the bill: in the *jaw-stretch*, both mandibles are opened but the movement of the upper one is greater than that of the lower (Fig. 16); in the *yawn*, the bill is again opened but particularly the lower mandible (Fig. 17), and the tongue arched up inside the mouth. With deference to Heinroth

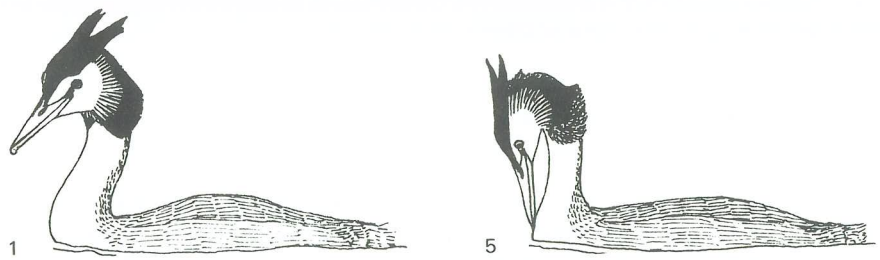
Figs 16–17. Stretching-movements; jaw-stretch (Fig. 16); yawn (Fig. 17).

(1930), there are good reasons to believe that this second bill movement is indeed a true yawn as in man; see also Sauer and Sauer (1967) on yawning in the Ostrich *Struthio camelus*. The yawn was not identified by McKinney (1965) for the Anatidae; the presence of both a yawn and a jaw-stretch in the repertoire of comfort-movements of a single species seems not often to have been described though probably not uncommon. In the Brown Booby *Sula leucogaster*, for instance, I found that a yawn is usually followed immediately by a jaw-stretch, as it is in certain cormorants (see also Ainley 1974).

Fig. 18. Comfort-movements; head-scratch.

Head-scratching and shoulder-rubbing. At all times, a true *head-scratch* by the Great Crested Grebe and other Podicipedidae is performed in the *direct* or *underwing* manner (Simmons 1957, 1961) in response to irritation on the head parts. When thus engaged, the grebe holds its head downwards and sideways close to the water to meet the foot, without any corresponding movement of the wing, and scratches away with the flattened nail of the longest toe (Fig. 18). Particularly during a prolonged head-scratch, the other foot is extended sideways and sculled to keep balance. Irritation in or near the eye itself, however, elicits a special *shoulder-rub* in which the side of the face is quickly brushed in the area of the carpal joint of the folded wing with a fast dipping movement of the neck. Shoulder-rubbing should not be confused with certain rather similar oiling-movements.

Throat-touching. When performing a *throat-touch*, the Great Crested Grebe – after first sometimes elongating its neck vertically – makes a quick, downward, rather formal-looking nod of the head to press the bill tip momentarily on the lower part of the foreneck just above the jugulum and water-line. This movement is common but is easily overlooked because it happens so rapidly and briefly. A frame-by-frame analysis of a filmed sequence taken at 24 frames per second revealed that (1) the downward nod of the head, bringing the bill into contact with the neck feathers, lasted four frames (1/6 sec); (2) the bill was held against the neck for six further frames (1/4 sec); and (3) it took a further four frames for the bill to be raised to the starting position – the whole movement taking 14 frames (7/12 sec). Two stages in this sequence are illustrated in Figs 19–20. Occasionally, the movement is



Figs 19–20. Comfort-movements; throat-touch – start of movement (Fig. 19) and throat-touch proper (Fig. 20). Small numbers indicate frames of cine-film at 24 frames per second.

incomplete and the bill does not actually touch the neck; I have termed this action a *head-nod*. Though throat-touching occurs in many situations, it is quite clear that the primary functional situations are those in which the grebe gets its bill or other head-parts wet, when it also often head-shakes as well as or instead of throat-touching. These head-shakes can clearly be seen to dispel excess water as a fine spray from the head generally, including the bill. The throat-touch itself, as shown by examination of film, drains any surplus water then remaining from the bill – perhaps that coming partly from within the nostrils or mandibles; this water runs down to collect as a large droplet at the bill tip (see Fig. 19) and is then disposed of against the feathers of the foreneck (Fig. 20).

Most of the comfort-movements are basically similar in all grebes, with some variation in the frequency of certain forms (such as the wing-shake mentioned above) and in detail. Thus, for example, Storer (1969) found interspecific differences in the both-wings flex component of the full-stretch: in the Slavonian Grebe, unlike most other Podicipedidae (including the Great Crested and Red-necked Grebes), the raised wings are not unfolded and the lifting movement is brief (as it is also, at least at times, in the Little Grebe). Throat-touching, which appears to be a unique behavioural character of the Podicipedidae, is common only among certain species – from personal observation, including the Little, Pied-billed, and Slavonian Grebes as well as the Great Crested; it also occurs in the Western Grebe but is largely replaced by other behaviour in the Red-necked and Black-necked Grebes. Although I drew attention to it some time ago (Simmons 1964), throat-touching has been largely overlooked by other students of grebes – but see Prinzinger (1974) who, however, was quite baffled by what he called 'breast-looking' ('das Vor-die-Brust-Schauen'). The distinctive wing-glide of grebes resembles the spread-wing 'drying' attitude of cormorants but is never so long sustained. I have seen similar briefly held postures in the Brown Booby and, very recently, a Fulmar *Fulmarus glacialis* engaging in a prolonged bathe (though that bird at times did hold its wings out for up to 17 seconds before beating them against the water again).

The occurrence of comfort behaviour

The Great Crested Grebe engages in persistent comfort behaviour usually only when loafing. After a feeding spell, it will often move to a favourite spot, tending to shelter under the lee bank on windy days. When not breeding, it may form loose flocks at such times, either on open water or in flooded vegetation – for example, the large reedbed at Chew. As a bird starts its break, often while still on the way to the loafing spot, it usually first bathes, then oils and preens before resting. After a prolonged bathe, the ensuing bout of feathercare may be extended, especially if sustained wing-twitching occurs. It is after bathing, and also before and after resting, that the grebe is most likely to perform various comfort-movements, notably wing-flaps and body-shakes. Comfort behaviour is much in evidence after change-over at the nest when the relieved bird moves away from the site indulging in those activities most inhibited while it was sitting, particularly ventral preening and head-scratching.

With the exception of throat-touching and head-shaking, and to a lesser extent some of the other comfort-movements, comfort behaviour is usually relatively infrequent during hunting spells. Immediately after emerging from a dive, a Great Crested Grebe often throat-touches and head-shakes: it can either do a head-shake only or a throat-touch only, but more usually it does both – a single head-shake typically being followed by a single throat-touch. Sometimes, this sequence is repeated, or there may be one or two more throat-touches, or, more rarely, the throat-touch comes first. The grebe will also throat-touch immediately after withdrawing its head from the water while surface-hunting, sometimes head-shaking first or afterwards. Though the head-shake/throat-touch sequence seems to be not infrequent in this situation, the throat-touch probably as often comes first or occurs on its own without any head-shaking. In a sample of 29 throat-touches by surface-hunting birds, only five followed a head-shake while 24 occurred on their own. This may be compared with a sample of 59 throat-touches in the post-dive situation: 52 were preceded by a head-shake and only seven occurred without one. Unfortunately, no comparable counts were made of head-shakes but these are probably more common on their own than are throat-touches.

During the brief pauses in surface-hunting, a Great Crested Grebe may head-scratch and shoulder-rub, while body-shaking and wing-flapping tend to occur towards the end of a prolonged bout of such feeding. Often, a bird engaged in a series of consecutive dives will just wait inactively on the surface before submerging again, especially during periods of intense food-searching. The pauses between dives then tend to be short and most other behaviour is, presumably, inhibited – even throat-touching and head-shaking to some extent. At other times, however, the grebe may preen briefly, shoulder-rub, head-scratch, rise and body-shake, rise and wing-flap, or do a linked wing-flap/body-shake sequence; such behaviour all seems to be in response to peripheral stimulation from water on the plumage or head parts. Sometimes, this other comfort behaviour replaces the throat-touch and head-shake. The following examples from Chew give some idea of the frequency of certain activities during dive pauses, excluding the throat-touch and head-shake. After 105 hunting dives on 22 April 1968, the Pool male was 'inactive' in 75 pauses, preened in 19, head-scratched in two, body-shook in four, wing-flapped/body-shook in one, and peered under water in four. After 107 dives, three other birds were inactive in 80 pauses, preened in 20 (also body-shaking twice, wing-flapping once, peering once, and drinking once during some of the same pauses), head-scratched in two, and wing-flapped/body-shook in one.

The preening that occurs during pauses or lulls in hunting may be directed at any part of the body, but perhaps most often dorsally or ventrally. While, like throat-touching, it may also at times help to dispel water from the bill – as in the Red-necked Grebe – such preening seems mainly to be a response to local irritation, possibly due to displaced feathers reducing the efficiency of the water-repelling properties of the plumage. In their turn, shoulder-rubbing results from irritation in the eye, head-scratching from irritation on the head or bill (Simmons 1961). The independent body-shake serves to dispel surplus water from the body plumage, the wing-flap from the wings – in both cases, the water can be seen at times as a fine spray; the linked, terminal body-shake re-settles the contour feathers generally. Unlike the head-shake, throat-touch, shoulder-rub, and head-scratch (which are all immediate responses to tactile stimulation), the body-shake and wing-flap tend to occur more towards the end of a long series of submersions, when the frequency of preening also increases, presumably as the plumage gets superficially wetter and somewhat heavier.

Sometimes, the grebe makes a quick frontal preen of its foreneck at more or less the spot on which it had just throat-touched. Such preening is clearly initiated by the preceding throat-touch, possibly due in part to

tactile stimulation but more probably through the process of postural facilitation, i.e. because the same initial movement, or 'transitional action' (Lind 1959) — head-nodding — is involved in both cases. Such facilitated preening also occurs quite frequently in other situations in which throat-touching is performed.

As the unique throat-touching of grebes is so little known, some further information on this behaviour in the Great Crested Grebe is given in the Appendix.

SUMMARY AND COMMENT

The main topics treated in this second of the *Further Studies* series on the Great Crested Grebe *Podiceps cristatus* are (1) routine, (2) food, (3) feeding methods, (4) drinking, and (5) comfort behaviour. In the section dealing with routine, numerical data are given on time-budgets (the percentage of time taking in feeding and loafing, the length of feeding spells and loafing breaks); on prey-size in that dealing with food; and on diving-times and pauses, including dive:pause ratios, in that dealing with feeding methods. In the latter section also, distinctions are made between pauses or lulls in feeding and true loafing breaks, and between the different types of feeding (including surface-diving and surface-feeding). In the section on comfort behaviour, feathercare (bathing, oiling, preening) is distinguished from resting and from comfort-movements (shaking, stretching, etc) — and special attention paid to throat-touching (see also Appendix). A final section deals with the occurrence of comfort behaviour during loafing breaks and feeding spells. As in the first paper in the series (Simmons 1975a), one of the aims here has been to provide further definitions and detailed descriptions, especially of feeding methods and comfort behaviour. Brief comparisons are made with equivalent behaviour in other species of grebes (Podicipedidae) and, in the case of comfort behaviour, with that of wildfowl (Anatidae).

Apart from their own intrinsic interest as natural phenomena, topics such as time-budgets and prey-size can provide information important in our better understanding of a species' behavioural ecology (some aspects of which were covered in my 1974 paper on the reproductive biology of the Great Crested Grebe). Much remains to be discovered, however, both in this and other species of grebes. Time spent feeding can determine how much time is available for other activities — not only essential feathercare but courting, nesting, tending the young, and so on — but does this depend solely on the availability and size of prey? Does the Great Crested Grebe, for instance, find so much time for courtship in late winter and spring because it can find food so easily or because it can build up fat reserves from intensive fishing earlier? The requirements of the female, who participates more or less equally in all reproductive activities, are different from those of the male when she has eggs to form. Does she then spend more time feeding than he does, or rely on stored fat? Certainly she does not get extra food in significant quantity from her mate, as uniquely in the Western Grebe. These and other questions remain to be fully investigated but I hope to publish what further information I have in full elsewhere at a later date.

In the first of these *Further Studies*, I drew attention to the derivation of the ritualised Habit-preening display from ordinary preening and of the ritualised Head-waggling movements from the head-shake comfort-movement. Unlike in Anatidae, for example, there seems to have been relatively little other use made of comfort behaviour as signals in grebes. The topic has been discussed briefly also by Storer (1969) and Fjeldså (1973a). In many *Podiceps* grebes, but not the Great Crested, the posture assumed by the Ghost-diver emerging on its way towards the Cat-bird in the Discovery Ceremony resembles the 'bouncy' posture of a bathing bird. The Wing-spread component of the Cat-display could be derived from the both-wings-flex component of the full-stretch but is perhaps more likely to be a ritualised pre-flight or defensive posture. The Wing-quivering component of the Rearing soliciting display seems likely to have originated from the wing-shake comfort-movement, as suggested by Schimdt (1970) for the Red-necked Grebe. However, in the Great Crested Grebe at least, comfort wing-shakes are relatively uncommon; their frequency may well have been adaptively reduced to enhance the effectiveness of the signal value of the Wing-quivering display. (This may be true of the 'swimming-shake' of the Mallard which is much more common as an 'Introductory-shake' or 'Upward-shake' in communal courtship than as a comfort-movement.) I once thought it possible that the Ghostly-penguin posture of the Ghost-diver was derived in part from throat-touching. As illustrated in Huxley (1914, see Figs 9—10), the bill appears to be lowered as in a throat-touch or head-nod; frame-by-frame analysis of film does not confirm this however, but the grebe does perform an unritualised head-shake as it

completes the display (Simmons 1975a, see Figs 35–39) and it is possible that some individuals may follow this up with an unritualised throat-touch, though this has yet to be confirmed.

Acknowledgements

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Appendix: Further notes on throat-touching

During most of the first ten years of my studies, 1948–57, I overlooked this habit almost entirely; it was not mentioned in my preliminary monograph (Simmons 1955) although I had first noted it at Burghfield Gravel-pit, Berkshire, on 11 April 1949. Its significance was not then clear to me and adequate investigation was delayed until the summer of 1957 at Old Theale Gravel-pit, Berkshire. During prolonged watching of three Great Crested Grebe pairs and their young, the main features of the behaviour were established: (1) both adults and young did it frequently; (2) it was especially likely to occur, with head-shaking, immediately after a bird surfaced from a dive or withdrew its head from the water while surface-hunting; (3) it appeared to drain water from the bill. During 1966–70, mostly at Chew Valley Lake, I made over 370 observations on throat-touching by adult Great Crested Grebes, mainly during work on other aspects of the species' biology; in September–October 1967, however, I kept a special look-out, noting every throat-touch seen (total 126) and classifying it according to situation. Thus: (1) 59 occurred immediately after a dive; (2) 29 during surface-hunting; (3) 17 after the eating of a fish or the giving of one to the young; (4) 13 while 'swimming along', i.e. moving on the surface from point to point; (5) four while preening; and (6) four while 'inactive'. Subsequent observations revealed that the grebes also throat-touch, to a greater or lesser extent, after (7) bathing, (8) certain comfort-movements, (9) eating a feather or giving one to the young, (10) drinking, (11) holding or touching weed, and (12) flight; also during (13) hostile encounters and (14) water-courtship.

As typically in the post-dive situation, throat-touching clearly functions at times to drain water from the bill in many of the other situations in which it occurs. This seems obviously the case with some of the throat-touches during preening when the plumage is wet, e.g. immediately after bathing. The frequency of both head-shaking and throat-touching increases when a grebe preens ventrally and often wets the bill in the process while rolling, much the same happening when it preens laterally at the water-line. It also often throat-touches after a head-scratch, the bill again being lowered with the tip in the water. Throat-touching is quite common too during hostile encounters when a threatening bird adopts the Forward-display: with head lowered close to the water, it may intermittently raise its head and neck to throat-touch in a sudden and seemingly incongruous manner; close observation shows that such throat-touching occurs only in those cases in which the grebe has its bill-tip obliquely in the water, as is typical of high-intensity threat, or the bill has got splashed when the water is choppy. A male retreating in the more defensive Hunched-display was also observed to throat-touch after lowering the bill into the water. Throat-touching (or head-nodding), with or without head-shaking, may at times be seen from a Great Crested Grebe performing the Inviting-on-the-water display in the early stages of site-seeking and platform building (see Simmons 1975a); as in the case of Forward-threat, the head is held low with the bill-tip often submerged. Throat-touching during resting may also sometimes be due to rough water wetting the bill, and can be frequent when waves wash against the bird. Similarly, in windy conditions, a grebe may throat-touch after alighting from flight by pitching and skidding forward along the water on its breast. Throat-touching and head-shaking also greatly increase in frequency during rain.

As would be expected, a Great Crested Grebe throat-touches sooner or later while drinking; but it seems rarely to do so after dip-sipping — which may often go on intermittently over quite long periods during loafing — though it may head-shake from time to time. Why throat-touching is not typically associated with dip-sipping, at least at the end of a series, is not clear. As in the case of ordinary sipping, throat-touching appears to be rare when a grebe bill-dips and dip-shakes after eating a fish or giving one to the young, that is if it is either a Roach or other coarse-fish of the 'big' size class or a Three-spined Stickleback. Throat-touching often does occur, however, after the eating of prey, other than sticklebacks, low in the 'little' category; these are eaten quickly or, when given to the chicks, repeatedly dunked in the water first. Although my field notes contain a number of descriptions of bathing behaviour, there is infrequent reference to throat-touching during the main bathing session itself in spite of the fact that the grebe's bill and head often get wet in the process. While some entries do mention odd head-shakes and throat-touches after head-ducking and rubbing, it would seem in general that both movements are usually inhibited to a large extent at this time, only becoming relatively more frequent during the ensuing oiling and preening. Inhibition of a movement — presumably by the central nervous system — would appear to be favoured in functional situations where repeated performances would be pointless, as when the bill is continuously wet in the case of throat-touching. No such inhibition would seem to operate, however, in a number of secondary situations when the throat-touching is not directly functional (see below).

In the interpretation of bird behaviour (displays or otherwise), it is often useful to distinguish between cause and effect (motivation and function). Throat-touching is essentially a *response* to water on the bill, whether or not such water really needs to be drained away; at times, it also appears to be a response to any 'irritation' (peripheral stimulation) on the bill. Thus, outside its primary adaptive context in the post-dive and similar situations, much throat-touching has the character of a habit divorced from any functional purpose. This seems to be the case with the throat-touching (or head-nodding) that occurs from time to time during much of the preening when the plumage is dry, or at best only somewhat damp, and there can be no question of draining water from the bill. It is especially true with a great deal of dorsal preening. The throat-touching may sometimes, when frontal preening of the neck is involved, be posturally facilitated (the process operating in the reverse sequence to that described earlier in the main text), but, in general, may be interpreted as merely a secondary response to peripheral stimulation from the feathers on the bill. Contact between bill and feathers may also account for throat-touching by a grebe that has just raised its head from the full rest-posture. This type of stimulation, rather than real wetting of the bill, may also be responsible for some of the throat-touching that follows the eating of a 'little' fish or the depositing of sodden weed or other wet material on the mating platform or nest and the poking or mandibulating of material there. (A bird that surfaced with weed and then throat-touched immediately after discarding it was, however, clearly draining water from the bill.) A grebe that throat-touches after shoulder-rubbing may do so because the bill got dipped in the water or touched the plumage.

At times, throat-touching would seem to be a 'delayed' or latent response — that is, induced by previous preening, etc. This appears to be so, in the main, with the occasional throat-touches that may follow a body-shake or wing-flap, or be inserted between the two when they occur in sequence. The same may well be true of those throat-touches that are performed from time to time for no obvious reason by otherwise inactive birds during loafing breaks; examination of records show that these often follow not long after a bout of preening. A similar interpretation may also apply to those throat-touches that occur suddenly, one or more at a time, usually without any associated head-shaking, as a grebe is surface swimming along and engaged in no other activity. Analysis of cases shows that it had been preening not long before in 12 (ventrally in at least five of these), diving in eleven, surface-hunting in six, taking food to the young in four; also had just deposited nest-material, performed another comfort-movement, or been resting (a few cases each).

During preening and otherwise, a throat-touch may also occur at times — more or less like a reflex and out of context — through what might be termed a process of 'associative facilitation'; that is after the performance of a movement, almost invariably a head-shake, with which it is usually linked functionally in ridding the head-parts of surplus water. In other words, the grebe throat-touches merely because it has just head-shaken. One notes with interest that this association seems to be maintained at times even when the head-shaking movements involved are the ritualised versions used in display. On about 25 occasions, I observed throat-touching (or sometimes head-nodding) by one or both members of a pair engaged in a bout of ritualised Head-shaking. In some 20 cases, this took place during 'independent' Head-shaking Ceremonies (see Simmons 1975a), either (1) at the end of complete sequences, usually as the birds turned away from one another after they had been performing Head-waggling, Head-turning, and Habit-preening; or (2) during brief, low-intensity bouts of Head-waggling only or of the latter and Head-turning. Throat-touching was also seen during the terminal Head-shaking phase of full Weed Ceremonies, after the Weed-dance and discarding of weed (four cases); and once during the terminal Head-shaking of a Discovery Ceremony, as the birds turned aside. The throat-touching in all such cases took place as the motivation for displaying was 'running down'. We may suppose that it is at that point that factors normally associated with throat-touching in other situations become responsible for its elicitation now, mainly as a delayed secondary response — peripheral stimulation of the bill from the feathers (Habit-preening) or weed (Weed Ceremony), the associative influence of the movements derived from ordinary head-shaking, and postural facilitation (the upright position of the neck being common to both throat-touching and display). In this last connection, I would add that I once saw a grebe throat-touch while performing the vocal Advertising-display in which the neck is also held erect.

Dr K.E.L. Simmons
Department of Psychology, The University, Leicester LE1 7RH.

NOTES

A Manx Shearwater surviving a winter in captivity

This narrative is a tribute to the late Eustace Smith who, in his later years and in spite of impaired sight, gave up many of the normal comforts of life in order to care for ill and maimed birds. He lived from about 1948 to 1955 in a remote Nissen hut (used during World War II as an air-raid wardens' quarters) situated on one of the heights overlooking Bath at Claverton, Somerset (now in Avon). The hut was partly hidden in a small wood and in this he built a few aviaries to house the varied collection of birds brought to him from time to time. In one a pair of Kestrels *Falco tinnunculus*, each with a broken wing, bred for two consecutive years and brought off young which were later released. During my many visits it was interesting to see that his favourite birds, one of which was an aberrant Magpie *Pica pica* (see *Brit. Birds* 62 (1969): 202), were allowed free access to his dwelling.

Following a letter received in September 1953 I found that a Manx Shearwater *Puffinus puffinus* which had been blown far inland to Lansdown near Bath, after gale force winds, had come into his possession. Eustace Smith's elation was incredible for this was the first true sea-bird he had cared for. At first the shearwater refused all food and so fairly small fish, cut into thin slivers, were forceably placed deep into its throat. This treatment was successful as within two days the bird was feeding on these from a flat tin, while it also enjoyed bathing in a shallow trough of water nearby. As the winter progressed the bird lost all natural feather oil and as the weather was very cold it was apt to seek the warmth of the Beeston stove. When I accidentally approached suddenly or one of the other birds bothered it the Manx Shearwater would lift its head to give a guttural and threatening croaking noise. This rather staccato note would be repeated a few times.

In January 1954 I received a message that Eustace Smith had been taken ill and the following day, a little after nightfall, I went to his home. As I approached a most infernal and continuous noise could be heard which increased in intensity the nearer I came. After gaining entry I was astonished to see the Manx Shearwater lying close to Smith in the warmth of the quilt on the bed. The bird's throat was vibrating and the weird song, for this was the noise I had heard, continued for a while. This behaviour, normally of course only associated with breeding-stations, sometimes occurred during the day in the period of his illness and it remains one of my most amazing experiences.

Unfortunately Smith, with sight increasingly failing, accidentally trod on the shearwater one day in March and the bird did not survive. It had lived through a full winter in captivity. My gentle and eccentric friend never quite recovered from the shock either.

Bernard King
Gull Cry, 9 Park Road, Newlyn, Penzance, Cornwall.

Little Auk attacked by Pike

On 18 December, 1955, following south-west gales, a Little Auk, *Plautus alle*, was present on Cheddar Reservoir, Somerset. For a storm vagrant it appeared to be in good condition and frequented the area of water near the tower on the Axbridge side of the reservoir. I noticed that on several occasions when the bird dived away from here it was attacked by a large Pike *Esox lucius.* On each attack there was much vigorous thrashing of the water when sometimes the predator was momentarily discernable. In order to escape, the Little Auk always dived in much alarm and then reappeared close to the tower. On the 28th the bird was still present but I found that attacks were more frequent and a few days later it had disappeared. It seems possible that the bird finally succumbed to these attacks as it became weaker.

Although the occurrence was unusual in that this sea-bird was on an inland water, I suspect that attacks by large fish on auks at sea may be fairly frequent, although probably seldom recorded. Professor Louis J. Halle

posed the question of what means do sea-birds have, if any, for coping with the dangers of underwater predators (*Brit. Birds* 64 (1971): 510). Unfortunately, he received no response to his letter. Searching through the literature at my disposal I find several papers have been written on the subject of aquatic predators of birds and the following relate specifically to attacks on auks by large fish.

Tuck (1960) mentioned that on at least two occasions large Cod *Gadus morhua* or *callarius* were caught on the Grand Banks, Newfoundland, with entire murres in their stomachs. He also observed at least three chicks swimming in shallow water off the Gannet Islands, Labrador, being gulped down by large Longhorn Sculpins *Myoxcephalus (Cottus) octodecemspinosus*. R. Legendre (1926) gives an instance of a North Atlantic Monkfish or Anglerfish *Lophius piscatorius* also taking a murre. Day in 1880 recorded prey of this species to include Razorbill *Alca torda* and Guillemot *Uria aalge* and Glegg to record a Cod as having taken the Black Guillemot *Cepphus grylle* (Harrison 1955). Murre is a common New World name for sea-birds of the genus *Uria*.

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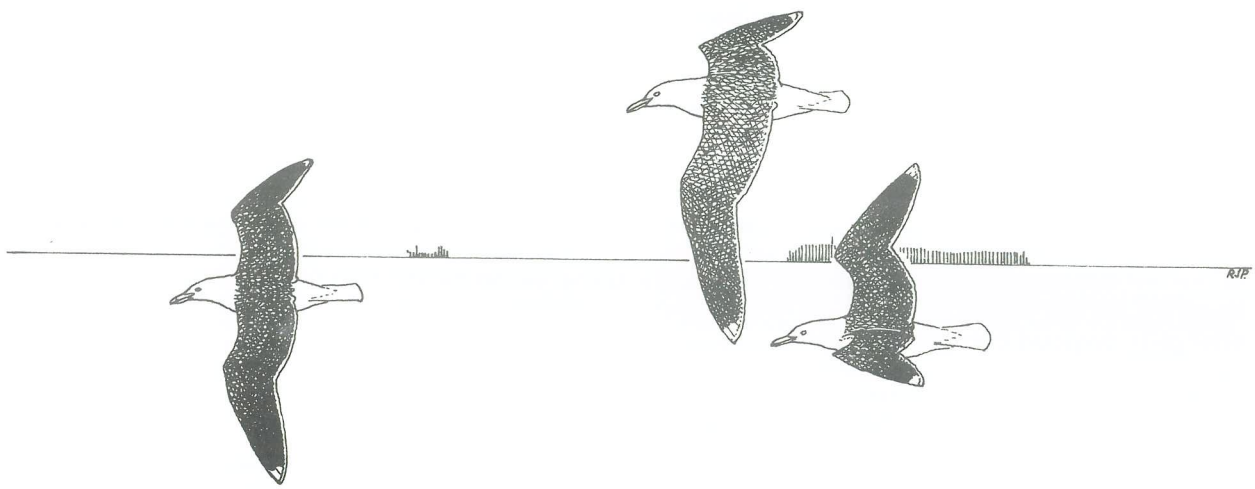
Bernard King
Gull Cry, 9 Park Road, Newlyn, Penzance, Cornwall



Spring movements of Scandinavian Lesser Black-backed Gulls

I have recently read the interesting paper by Bernard King (see *Bristol Ornith.* 5 (1972): 205–206) in which he describes in detail the spring influx of Scandinavian Lesser Black-backed Gulls *Laurus f. fuscus* through Chew Valley Lake (Avon). Occurrences of *fuscus* in late winter and early spring are not of course confined to inland localities in the West Country. For instance, Bernard King states in his paper (p.205) that David Ballance saw what were almost certainly 30 Scandinavian Lessers in the Bristol Channel, moving up-channel off Glenthorne, Somerset in March of either 1956 or 1957. Robert Moore, in *The Birds of Devon* (1969): 159–160, mentions that in addition to the numerous birds of the British form *L.f. graellsii* there are also a few *fuscus* in the Bristol Channel in February and March. It seems worth noting here my own personal experience of these birds in the area: 80 Scandinavian Lessers in scattered groups, during a 45 minute period, moving north-east off Morte Point, Devon, on 22 March 1974 and 33 of this form in twenty minutes, flying east in a loose flock past Ilfracombe on 28 March 1975.

That Scandinavian Lesser Black-backed Gull movements in spring in the Bristol Channel have a close affinity with those seen inland nearby seems in little doubt. In my opinion, nevertheless, it would be of great interest and value if organized studies were renewed at Chew Valley Lake and other inland waters and were co-ordinated with observations made from both sides of the Bristol Channel.

Robin Khan
32 Addison Close, Redhills, Exeter, Devon.

Spring migration of Garganey in Majorca, Spain

Garganey *Anas querquedula* are passage migrants in Majorca, Spain, when sometimes they are quite common in spring (J.D. Parrack *The Naturalist in Majorca* 1973:200). However he gives no indication of their numbers or behaviour so this additional information may be of some interest. During my visits to the marsh, La Albufera, in April 1973, I had the opportunity to count numbers of Garganey although this was somewhat difficult due to the heat haze. My counts were 120 on 11th, rising to 155 on 16th but then only 22 on 19th and 26 on 20th. Thereafter only very small numbers or single birds were present up to the first week of May.

All the Garganey were massed in the partly exposed area where there were shallow pools, though probably many others were concealed in the marshy tussocks around the perimeter of the pools. I managed, on most visits, to get fairly near to the Garganey without disturbing them. Many of them – up to 50 pairs in all – were in closely associated gatherings, continuously and excitedly chattering, especially in the forenoon and then lessening somewhat as the day advanced with the ducks then inclined to resting in deeper cover. There was little, if any, of the diagnostic 'scraping' calls by the drakes. The birds were either actively feeding with rapid forward or side to side head movements or involved in the subdued displays. As far as I could see, by rhythmically moving their heads to and fro the drakes caused themselves to swim backwards for short distances.

The Garganey were occasionally briefly disturbed by Marsh Harriers *Circus aeruginosus*. The ducks would rise together in alarm when a harrier quartered the ground near them. It flew on unconcerned, whereas the Garganey, with incessant chatterings including a few 'scraping' calls, flew around before resettling back into the marsh. When Purple Herons *Ardea purpurea* flew nearby they sometimes caused a deal of head lifting with momentary flight, but when Little Egrets *Egretta garzetta* came into the vicinity, which they frequently did, the Garganey were quite unconcerned.

Bernard King
Gull Cry, 9 Park Road, Newlyn, Penzance, Cornwall.

Feral Pigeons drinking and bathing in hot mineral water

From 1945 to 1971 I visited Bath, Somerset (now Avon) almost daily during my working week and was always intrigued by the large population of Feral Pigeons *Columba livia* which drank and bathed in the hot mineral water at the Roman Baths. This was particularly noticeable at the fountain in the centre of Kings Bath. Here the water flows over the shallow stone troughs directly from the reservoir beneath. According to A.W. Nunn, Spa Director (*in litt.*) the temperature at that point is about 40.5°C while the average surface temperature over the bath area is about 32.0°C. The pigeons mainly drank at the fountain but often they were seen either squatting or standing with their under-parts wholly or partially submerged. A little tail-swishing occurred in the water with sporadic preening while others lolled onto one side and extended a wing when some 'fuss-preening' would take place with quick bill movements and shaking of body feathers. This preening behaviour is well described by D. Goodwin in *Pigeons and Doves of the World* (1967:22–23) by both wild and domestic pigeons. However it would appear to be most unusual for them to bath in or drink warm water in this country, although in tropical countries this might be expected, but

even so, at lower water temperatures than at the baths. D. Goodwin (*in litt.*) comments: 'basically there are three possibly unusual features here, all of which may be present – the bathing movements and whether the hot water is preferred for bathing; whether hot water is preferred for drinking or whether mineral water is preferred'. Here then is a subject worthy of further study, which I hope a member of the Club will be able to pursue.

Bernard King
Gull Cry, 9 Park Road, Newlyn, Penzance, Cornwall.

CLUB ACTIVITIES, 1976

Club membership remained fairly stable during the year, at an average of just over 500. Once again, joint film shows were held with the RSPB in February, and with the Wildfowl Trust in December. During the early summer, several members participated in the BTO National Nightingale Survey. We had also been involved in discussions with the Severn Estuary Conservation Group.

The highlight of the year, however, occurred in December, when the Club celebrated its tenth anniversary. The occasion was marked with a dinner, attended by just over 100 people, at the Royal Hotel in Bristol, at which Robert Gillmor was the guest of honour.

Field Meetings

The year started off with a new venture – a New Year's Day Tally Hunt – but clearly this was not a popular date since only two teams competed. The Summer Social was more successful: it took the form of a canal trip from Bath to Bathford and back, with refreshments in a pub at the halfway stage.

Three weekend trips were held during the year: to Tregaron at the end of January, to Kent in May, and to Cornwall in October. Beginners' meetings were held at Chew Valley Lake in February and the Frome Valley in November, and several members continued to participate in the Bristol Channel Seabird Survey.

Indoor Meetings

Once again, we were fortunate to have the facilities of St Mary Redcliffe and Temple School Hall in which to hold our indoor meetings, as follows:

15. 1.76	– Members' Evening
12. 2.76	– Thames Transformed – Dr & Mrs J. Harrison
11. 3.76	– Birdwatching in Scandinavia – Patrick Sellar
16. 9.76	– Past & Future of Bird Recording – Peter Copeland
14.10.76	– Dartford Warblers – Colin Bibby
11.11.76	– Birdwatching in the Gambia – Nick Dymond
16.12.76	– A.G.M. and Film Show

Publications

Bird News continued to make a monthly appearance, while *Bristol Ornithology* 8 was distributed in February. Once again, postal charges were considerably reduced by hand-delivering as many of these two publications as possible.

Wendy Dickson *Honorary Secretary*