

On the behaviour of the White-headed Duck with especial reference to breeding

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Introduction

The White-headed Duck *Oxyura leucocephala* is one of the rarer Eurasian ducks, with a total world population of around 15,000. The main wintering areas are in Turkey, Tunisia and Pakistan. A few nest in southern Spain, North Africa and Turkey, but breeding appears to centre on Kazakhstan in the Soviet Union.

Remarkably little was known about this duck's breeding behaviour in the wild and it had only once been kept for any time in captivity (Duran, 1961). These birds did not breed, despite a mistaken reference in the Zoological Record (Lassaletta, 1963). Attempts were therefore made to establish a breeding group at the Wildfowl Trust, Slimbridge. Mr Christopher Savage caught flightless moulting birds on Lake Khabbaki, Pakistan, and after several attempts three males (A, B, C) and three females (D, E, F) were established. A, C, D, F arrived on 16 January 1968, B and E on 13 December 1969.

Courtship display was observed in 1970, and over the next two summers a general picture of the display patterns was built up. However, activity petered out towards the end of each June. While in S. Africa Mike Lubbock, the Curator, had noticed the related Maccoa Duck utilized disused nests of other waterfowl. Also there were Soviet reports (e.g. Dementiev & Gladkov, 1952) of Whiteheads using old nests of coots and diving ducks. He therefore provided seven potential nest-sites in June 1973. Two were actual disused Coot *Fulica atra* nests. The others were constructions of bamboo and reeds on wire-netting bases staked out over the water.

The strategem was a success and on 24 July one female was found to have laid. Observations, which had been stopped when two males had lost the blue of their bills, were resumed as intensively as possible. The study continued piecemeal, no full-time ethologist being available. Attention was concentrated on the incubation behaviour and on the behaviour of the subsequent young, but other activities were noted, particularly the feeding behaviour. Thus a general picture of daily routines emerged, albeit related to one period of the year, July to October.

The scene of observations

The birds, pinioned when brought into captivity, lived on a pond 60 × 30 m. The water varied from shallows barely awash, down to 2 m. The bottom was muddy, but most of the edge was rough-concreted to prevent erosion. Clumps of vegetation were scattered along the margin but the water itself was open. The pond and surrounding grassy paddock of 0.7 ha were shared with a score of European species of ducks and geese, mostly also pinioned and totalling some seventy individuals.

The Whiteheads seldom left the water and did not become hand-tame for food as did many other species. Rather, they were indifferent to humans. This meant that the natural behaviour patterns were likely to be relatively unmodified. Observations could be made without any hide, the birds often being within 5 m and seldom as far away as 30 m.

The adult individuals were easy to tell apart at such close quarters. Savage (1965) had already remarked on the individual variability in the species. Of the males, A had many white feathers in the black crown and his bill was still blue; B had distinct black spots on the white cheeks; C had black bars extending down from crown to the eyes. Of the females, D had a large splotch of white above the cheek stripe; E a much smaller, V-shaped mark; F no additional mark at all.

General activities

An estimate of the time spent in various activities was arrived at simply by noting at intervals what each individual was doing. These activity 'snapshots' were scattered throughout the day and the intervals were not less than 15 minutes. For the three males and the one female (F) which did not nest, 311 snapshots were collected, giving the divisions of activity shown in Table 1. The middle of the day was largely spent in sleeping, the birds being more active during the early morning and late afternoon. When awake (i.e. not resting with the bill tucked back among the scapulars) the commonest activity was preening. This may have been particularly intense because the moult was in progress. Nevertheless, casual observations at other seasons indicate that these are

Table 1. Division (%) of activities of four adult White-headed Ducks throughout the day (311 behaviour snapshots)

Time	Sleeping	Preening	Diving	Swimming	No. snapshots
Before 09.00 hours	35	27	12	26	21
09.00–12.00 hours	55	29	10	6	121
12.00–15.00 hours	64	22	9	5	49
After 15.00 hours	45	25	10	20	120
Overall	51	26	10	13	311

Table 2. Division (%) of day-time activities in four adult White-headed ducks (311 behaviour snapshots)

Bird	Sleeping	Preening	Diving	Swimming
A	43	33	11	13
B	56	22	10	12
C	52	27	9	12
F	56	23	8	13

noticeably 'itchy' ducks and spend a great deal of time and effort on re-arranging their close-packed plumage. Quite often the Whiteheads came to the pond edge to preen, particularly their bellies. They then stood near-upright with no sign of leg weakness such as in grebes. The Whiteheads stand firmly and steadily, one individual for over half an hour. On a few occasions the birds walked for short distances, stomping along, penguin-like, without indications of strain.

One male (A) spent more time preening than the other adults (Table 2). Again this may be related to the state of moult, as he was still blue-billed.

Feeding behaviour

Food for the collection birds (mainly barley, but with some biscuit crumbs) was strewn along one stretch of shore and into the water there, at about 08.30 hours and 16.30 hours. From Table 1 it will be seen that the Whiteheads' diving bouts were not tied to these artificial feedings, but evenly scattered throughout the day. They did not gather in the feeding area when the food was thrown, as did most of the other species. While they clearly make some use of this bounty, they also spent a lot of time feeding in other parts of the pond. What the Whiteheads were feeding on is uncertain, as food was always swallowed under water. There was no floating or emergent vegetation; some seeds might fall from the trees and other vegetation on the steep little artificial hill at one end of the pond. Soviet studies speak mainly of vege-

table matter, especially seeds, in the guts of shot birds. A single specimen examined by Savage contained seeds. Possibly the Slim-bridge birds were also collecting animal matter, such as chironomid worms known to abound in the detritus.

Rather few studies have been made on the diving of any ducks (e.g. Dewar, 1939; Willi, 1970) so data on this aspect of behaviour was collected; twelve hundred dives, 200 for all of the six adults. Table 3 gives the maximum and mean dive lengths and a measure of the variability of dive-length, the coefficient of variation, (i.e. standard deviation divided by the mean and multiplied by 100). The lower the coefficient, the closer lie the diving times about the mean. The coefficients for the four adults were similar, but male C consistently made longer dives than the others, although feeding in the same parts of the pond. (D and E were timed the next April/June).

Feeding occurred in long bouts, as many as fifty dives in succession being noted. A smaller sample of times spent on the surface between dives during a bout was noted and showed more difference between individuals and also more variability (Table 4). Maximum times on the surface are not relevant, the arbitrary upper limit (30 seconds) being imposed to decide that one diving bout had ended. Male B, which made the shortest dives, did spend the shortest time on the surface. Inspection of the full data showed there was also a general tendency for short dives to be followed by the shorter pauses, and the long dives by longer pauses. However, the relationship is by no means straightforward. Clearly, physiological limitations are not

Table 3. Diving times (seconds) of adult White-headed Ducks, 200 dives per bird

Bird	♂ A	♂ B	♂ C	♀ D	♀ E	♀ F	All
Maximum	33	34	40	34	34	33	40
Mean	18.8	18.5	25.0	23.1	22.6	19.0	21.9
Variation	31	29	29	27	31	31	32

Table 4. Times (seconds) on surface between dives in adult White-headed Ducks

Bird	♂ A	♂ B	♂ C	♀ D	♀ E	♀ F	All
Number	122	105	63	131	144	35	600
Mean	6.4	5.8	8.8	7.9	8.7	9.5	7.6
Variation	65	45	48	37	44	54	5.1

deciding the length of the shorter dives, and the pause after a longer dive may have had as much to do with taking a general look around, and possibly getting more food down the gullet, as with regaining the breath.

The dives themselves appeared almost as effortless as a grebe's, the bird heading under with a barely perceptible kick. In most cases the dive was so deep that no eddies appeared on the surface as evidence of the bird kicking down below.

Social behaviour: courtship

The other main division of activity, swimming, covered not only casual movements between bouts of sleep, preening or feeding, but also directed activities of a social nature. Aggression towards another member of the species was usually in the sexual context. Typical was *open-bill threat*, with the head thrust low, the body hunched and scapulars raised (Figure 1). The posture was sometimes held with the bill closed while the bird swivelled round to follow a moving opponent. Often a *hunched-rush* (Figure 2) across the water followed, head pulled into shoulders and scapulars raised. The opponent usually escaped by diving. The attacker then often gave a *side-ways shake* of the head, sometimes with the bill in the water to produce a splash. Actual physical contact was rare and seldom lasted more than a few seconds. Females attacked males as well as *vice versa*, but the females were more prone to give a simple *open-bill threat*. On the whole, however, the Whiteheads went about their daily business without getting involved in fights. There were no indications of territorial defence by the males, in contrast to the Maccoa Duck (Clark, 1964). The nesting females did defend the nest and its immediate surrounds.

The initial form of courtship appeared in

late March with the development of *flotilla-swimming*. Males and females swam in close formation at considerable speed, about 1 m/second, up and down the pond for as much as an hour at a time. Positions within the formation changed, but often a female was in the lead, with its *head-high*, the tail at 45° or flat in the water. *Sideways-flicks* of the head appeared to be flight intention movements and sometimes led (in these pinioned birds) to scutter-rushes across the water. In unpinioned birds these would presumably have developed into group flights like the *ringing-rush* described in other *Oxyura* (Johnsgard, 1967). Generally *flotilla-swimming* birds were silent, but a female sometimes uttered a very soft *gek* and a male a harsh grunt. Several ritualized movements occurred in *flotilla-swimming* (as well as in other contexts). *Dip-diving*, the body being very briefly immersed in a down-up movement, and *cheeking*, the head rubbed on the shoulder, derive from body-care movements. *Wing-shuffling*, the folded wings raised and lowered rapidly, is possibly a thermoregulatory movement, according to Siegfried (1973a). *Dab-preening*, the bill rapidly and repeatedly jabbed into the breast feathers, has probably given rise to the mistaken impression of field observers that the Whitehead has a *bubbling* display like the Ruddy Duck *O. jamaicensis* (e.g. Dementiev & Gladkov

Figure 1. Open-bill threat by female D.

Mary Evans



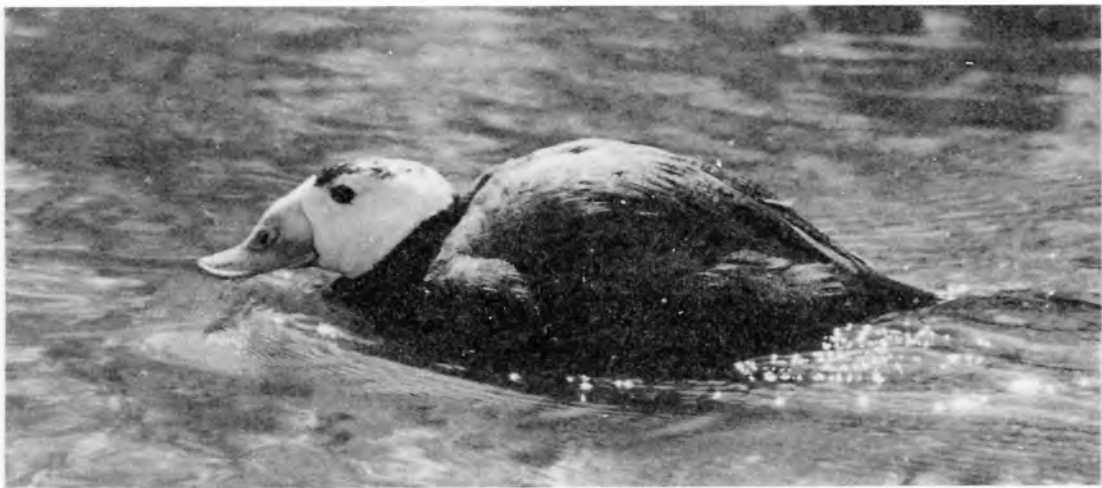


Figure 2. Hunched-rush.

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1952; Mountfort, 1958). However, the *dab-preen* was not accompanied by any inflation of the air-sacs nor any mechanically produced sound (or vocalization). The tracheal structure in the male Whitehead, undescribed according to Johnsgard (1967), is simple, there being no bullae or other protruberances. A similar *dab-preen* movement has been described in the Australian Blue-billed Duck *Oxyura australis* (Johnsgard, 1966). Since *dab-preen* frequently appeared after a *hunched-rush* at another male, it may be a ritualized displacement behaviour deriving from conflicting tendencies of attacking and fleeing.

More elaborate group displays appeared next. The males swam rapidly in various directions making a *tickering-purr*. This is somewhat reminiscent of the rattle of the male Garganey *Anas querquedula*, but softer and more continuous. Analogy has also been made with the rapid bouncing of a ping-pong ball on a table. Certainly the rather delightful impression of a clock-work toy results.

A male would *hunch-rush* first another male, then, rather less aggressively, a female. It then swung broadside on to the female, in a *sideways-hunch*. Both the head and the tail, spread in the water, were twisted towards the female (Figure 3). The *tickering-purr* con-

tinued, the tail was vibrated and the legs paddled rapidly. The male then swam away and, if the female did not follow, *hunch-rushed* back to do another *sideways-hunch*.

The series of *sideways-hunchings* might peter out or give rise to an explosive movement, the *kick-flap*. The male's bill, and sometimes the whole head, plunged vertically into the water, the folded wings were jerked upwards and the legs kicked vigorously, often both at the beginning and end of the movement. There would seem to be elements in this display common to the *sousing* described by Johnsgard (1966) in the Australian Blue-billed Duck, but there was no inflation of the neck. After the *kick-flap* there followed a high intensity version of the *sideways-hunch*, *sideways-piping*. The bill was opened and pointed at the female and a series of high, bi-syllabic, reedy cries made. In timbre these resembled the sound produced by the male Black Scoter *Melanitta nigra*. The tail was twisted towards the female, fully spread and strongly vibrated between each double pipe; the folded wings were also slightly raised and lowered. Half a dozen pipe-pipe/tail-vibrate/pipe-pipe/tail-vibrate sequences might follow before he subsided.

The male then performed the *head-high-tail-cock*. The head was raised, with the bill horizontal, and the *closed* tail (*contra* Dementiev & Gladkov, 1952) cocked until it just passed the vertical (Figure 4). The head and tail raisings were synchronized and rather slow and deliberate as if they were being pulled up by puppet-strings. If the tail was in the water at the start, however, it flicked into the upright position more rapidly. The posture was held for a few seconds and then both head and tail were lowered, again quite slowly. Although looking very like the Ruddy Duck at the start of its *bubbling* display, the Whitehead does *not* beat its bill on the breast, the neck does not appear inflated,

Figure 3. Sideways-hunch.

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and no sound is produced. Again, the Whitehead does not insistently manoeuvre itself in front of the female, exposing to her its white under-tail coverts, as does the Ruddy. Once a Whitehead male doing the *head-high-tail-cock* was observed to have its penis protruding stiffly as the tail flicked up. Apart from this evidence of excitement, the *head-high-tail-cock* may well be a low-intensity movement. We shall see later that the downy young takes up a similar posture when agitated, as when separated from its mother. The *head-high-tail-cock* tends to come at the end of more intense display movements, as after a series of *sideways-hunches* peter out, or even when the male has not for some time been engaging in overt displays. In such circumstances as many as nine *head-high-tail-cocks* have been observed in succession, with intervals of up to 10 seconds between them. There is a variant of this posture in which the tail remains cocked but the head is lowered, and then raised again.

The female reaction to even the most intense male displays in the spring was minimal. There might be *open-bill* threat against an importunate male; if she followed him, the feathers on the top of her head might be slightly erected. There seemed to be no greeting behaviour between male and female. Indeed, no definite pair-bond appeared to be established for the birds were not seen to separate off in pairs. Copulatory behaviour was not observed. In other stiff-tails it is brief and unspectacular. No nest-showing behaviour was seen. Curiously enough, in September, after breeding and with all the birds in eclipse plumage, bouts of group courtship activity occurred and the females then indulged in male-like behaviour, producing *sideways-hunching*, with open bill but only a wheezy sound emitted, *kick-splashes* and *head-high-tail-cocks*. The movements were not to be distinguished from those of the males (which had then also lost their *pipe-pipe* at this time). Some fascinating conjectures about hormonal balances must be held in check until many more displays have been observed.

Nest building and egg-laying

When it was discovered on 25 July that laying had started in one of the Coot's nests, female D already had five eggs. Two more were laid in the following 2 days, but three were kicked out of the nest on 30 July. These, and one other, were removed and incubated artificially, leaving her with three to incubate. Female E was seen to enter this nest on

25 July (opening a doubt whether all the eggs therein belonged to D). However, E thereafter became more interested in the second clump containing another Coot's nest and was seen sitting there, making *sideways-passing* nest building movements on 26 July, and driving other birds away from it the next day. More nest-building and defence were observed on 31 July and 4 August. On 9 August the nest-site was inspected early in the day and found to have two eggs. Two more had been laid by the morning of 11 August and the clutch was complete, at five, by 13 August. It would thus appear that eggs are laid at daily intervals. This is quite a prodigious performance in view of the large size of the eggs; a sample of ten gave an average weight of 97 g. Thus a clutch of seven represents about 100% of a female's body weight.

The third female, F, was observed on another nest clump-site on 19 September, making several bursts of nest-building movements. She had then completed wing and tail moult. Several further bouts of nest-building occurred in the next few days but no structure was formed, and this bird was considered to be a non-breeder. However, when she died 5 months later (27 February 1974), avian tuberculosis being diagnosed, the oviduct was found to be expanded, as if egg-laying had occurred, and a finger-nail-sized piece of egg shell was extracted. What happened to the egg(s) she produced is not known, but obviously she should have been classified as a failed-breeder.

Another behavioural oddity that came to light was nest-building by a male, B. He was first observed doing this on 14 August, in a nest-clump not favoured by any of the females. He seized vertical reeds, pulled them

Figure 4. Head-high-tail-cock. Philippa Scott



to him and then *trampled* them under (a difficult manoeuvre with the legs mounted so far back). He even tried to pull down the bamboo rods supporting the nest-clump. Reeds in the water were picked up and *side-ways-passed* in typical fashion. On this occasion persistent and unmistakable nest-building movements continued for 17 minutes and a photographic record was obtained (Figure 5). Similar activity was seen several times during the next two weeks and a distinct platform became visible. Indeed it is probable that this behaviour is to be considered on a par with the pre-breeding platform-building described in both sexes of the Ruddy Duck by Siegfried (1973a). However, the thermo-regulatory function therein proposed (the platform enabling that essentially southern species to get out of the cold water) can hardly apply at this season. Again, we resist the temptation to speculate on hormonal balances (the bird being well into the eclipse moult) that could lead to sexually ambivalent behaviour.

Incubation behaviour

Although the nest and eggs have been described in the wild (summary in Bauer & Glutz, 1969) no ornithologist had ever seen the female sitting on the nest. This, coupled with a report of eggs hatching after being kept at room temperature for a week, led to the legend that they required no incubation by the female, except perhaps for the first few days. We were now presented with the opportunity to check reality and watches were maintained as often and as long as possible once incubation began. Close investigation was impossible as no disturbance of the birds was acceptable. Female D was only partly visible when on the eggs, E wholly hidden.

In the 25 days between clutch completion and hatching, D's nest was watched on 21

days in thirty-three sessions totalling 49.7 hours, and timed between 06.46 hours and 21.00 hours. In the comparable period E's nest was watched on 16 days in twenty-nine sessions totalling 67.3 hours. D was seen off the nest on twenty-five occasions, E on twenty-three. The time spent off the nest varied from 2 to 38 minutes. Several minutes prior to the departure from the nest D would become restive. Both birds when they appeared at the ramp leading down to the water, made some *sideways-passing* and other nest-building movements. They would then slip into the water and dive, reappearing well away from the nest. Feeding dives were of rather briefer duration than normal (Table 3). Much of the time off the nest was spent in preening and bathing. The nest would then be approached cautiously, in a series of dives, until the foot of the ramp was reached. As the bird climbed out it would briefly repeat the *sideways-passing* nest-building movements. Female D could be seen pulling down surrounding stems to form a canopy while on the eggs. The females did *not* line the nest with down (*contra* Dementiev & Gladkov, 1952). Only a few flecks of down were found in the nest at the end of incubation, such as could have been accumulated by chance.

The frequency of absence by D from the nest increased as incubation progressed (Table 5). Thus she left the nest about once every 3 hours during the day in the first half of incubation. E left rather more frequently and for longer periods. In the second half of D's incubation the frequency of exodus was nearly doubled although the length of absence was similar. Watch on the second half of E's incubation was not extensive enough to give comparable figures. There is thus some support for the contention that the embryos become more self-sufficient as incubation progresses.

The eggs hatched with startling rapidity. Thus none of D's showed any crack when examined late in the afternoon of 19 August but the one young was on the water by 08.35 hours the next morning. Those hatched in incubators did so in little more than 12 hours from the appearance of the first crack. Weights of those raised artificially were on the first day 57, 58, 59, 60, 64, 65 g. In all cases the incubation period appeared to be 25 days.

Figure 5. Nest- (or platform-) building in an eclipse male.

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Mother/young behaviour

The single young hatched by female D had a rather abrupt entry into the outside world. It was kicked on to the water when its mother attacked a full-winged Red-billed Whistling

Table 5. Incubation activity of female White-headed Ducks

Female	Incubation period	Observation		Times off	Mean duration	Observation time per exodus (minutes)
		Days	Minutes			
D	Days 1-13	10	922	5	13.4	184
E	Days 1-13	12	3494	22	18.5	159
D	Days 14-25	11	2060	20	12.3	103

Duck *Dendrocygna autumnalis* that poked into the nest. The mother then returned to the nest, apparently not noticing her loss. The duckling swam vigorously, high in the water and with both head and tail held up, looking very large for its size. It approached any duck it saw, but they shied away. The male A approached and did several *sideways-hunches* at it (perhaps analogous to male Ruddy Ducks giving the *bubbling* display to newly hatched young). Female F approached, gave the antagonistic *open-bill* display, shied away and dived. The duckling also dived, for 5 seconds, and that after only 7 minutes on the water. It then approached Red-crested Pochards *Netta ruffina*, Common Eiders *Somateria mollissima* and White-eyed Pochards *Aythya nyroca* but these either avoided or poked at it. Finally at 08.53 hours the mother came off the nest, went straight to the young, dived in front of it and led it back on to the nest at 09.00 hours. They both came off for 9 minutes at 09.40 hours and for at least four other short excursions during the day.

The two ducklings left with E had a less traumatic emergence on 9 September, remaining until 14.30 hours, although E had briefly emerged, by herself, at 09.05 hours. They were then eased on to the water by a warden inspecting the situation. One duckling dived for 2 seconds after 7 minutes, and up to 7 seconds within 14 minutes. They were on the water for 97 minutes before the mother led them back to the nest, apparently for the rest of the day.

Both females, on this and the next 2 days, were several times seen to approach a duckling with the bill slightly open and scapulars smoothed (as if in low intensity threat) and to touch it lightly and briefly on the head (Figure 7). This *head-touching* presumably served to strengthen the family bond. The female also produced a low *rattling-purr* especially when the duckling had strayed. For their part the latter have a bi-syllabic *whit-whit* call in this situation and the head and tail were sometimes raised in a facsimile of the *head-high-tail-cock* of the adult. There was also a distinctly different low *twitter*,

apparently a general contact, contentment call between the young themselves.

On the 2nd day D's duckling was on the water for at least three periods, one more than an hour, returning for prolonged sojourns on the old nest. The female still made building movements when leaving and returning to the nest. Use of the nest continued into the 4th day, when it became difficult because of a temporary (artificial) lowering of water level. Other clumps were used on the 5th to 7th day, but with the restoration of the water level the original nest site was used again, mainly only at night, until at least the 12th day. Thereafter it became trampled, by other birds(?), and waterlogged and had been abandoned by the 20th day. This duckling fledged successfully. It was able to fly by the 58th day.

The ducklings of E spent more time on the water during their second day, including bouts of sleeping. One water-borne session lasted over 4 hours before the nest was re-entered. This nest remained in good condition for much longer and was still being used for resting, at least at night, until the end of the 23rd day. One of the two ducklings was picked up dead on the 7th morning. The other continued in apparent good health for nearly a month. But its growth then began to fall behind in comparison with its three siblings being reared artificially. Possibly, as

Figure 6. Female E on nest ramp, with young.

Mary Evans



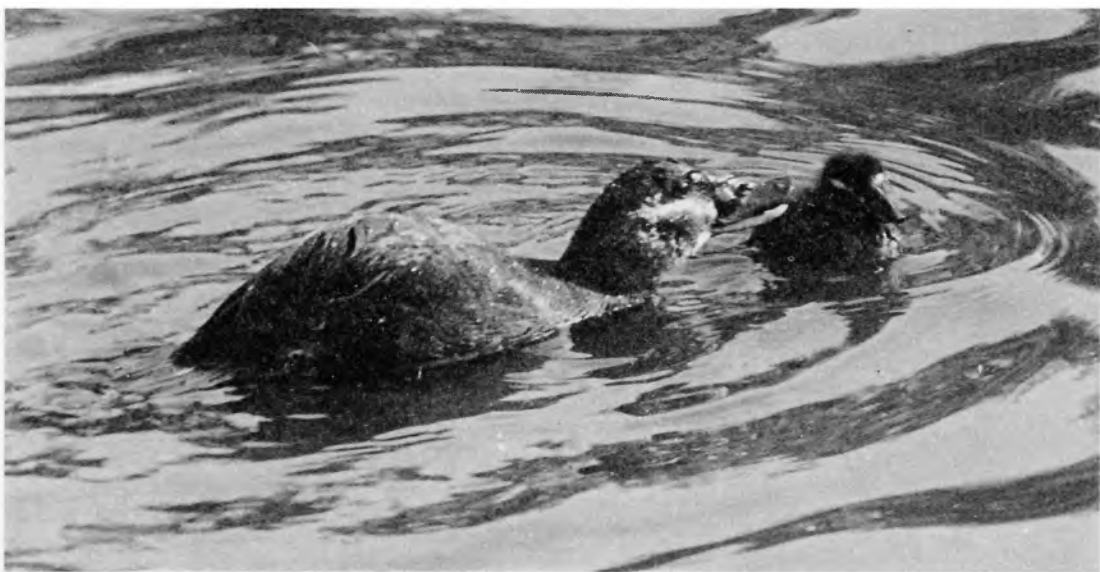


Figure 7. Head-touching by female E to young.

Mary Evans

it was now mid-October, the natural food (perhaps chironomid larvae) was increasingly difficult to obtain. It was not seen after the 37th day.

Both females proved to be excellent mothers; having only one young apiece may have eased their task. They defended their young against all comers, driving off birds as large as Greenland White-fronted Geese *Anser albifrons flavirostris*. *Open-bill threat* (Figure 1) frequently sufficed, but *hunched-rushes* and actual physical attacks were seen. The mother remained within a few yards of the young for the first 2 weeks, spending more time diving (Table 6) but

making much shorter dives than usual (Table 7). Thus in the 1st week the average dive length was about half that which the individual would do when by itself. Occasionally full-length dives would be made, greatly increasing the coefficient of variation. In the 3rd week the chick was left more and more on its own and the mother's diving times lengthened. By the 5th week they were virtually independent of each other.

None of the males paid any attention to the chicks, except for the one immediate post-hatching instance already noted.

An *Oedipus*-like behaviour was observed in the duckling of D. This bird, subsequently

Table 6. Division (%) of day-time activities of two female (Ad) and two young (Y) White-headed Ducks, post-hatching

Period	Sleeping		Preening		Diving		Swimming		No. snapshots
	Ad	Y	Ad	Y	Ad	Y	Ad	Y	
Day 1/2	61	62	8	8	11	13	20	17	71
Day 3/7	43	40	11	10	22	38	24	12	122
Week 2	36	46	22	11	22	38	20	5	65
Week 3/4	36	39	20	12	13	40	31	9	111
Week 5/7	42	40	18	17	6	23	34	20	98

Table 7. Diving times (seconds) of two adult female White-headed Ducks, in relation to family responsibilities (cf. Table 3)

Condition	Incubating		Accompanying young					
			1st week		2nd week		3rd + week	
	D	E	D	E	D	E	D	E
Bird Number	15	35	63	246	47	135	177	73
Maximum	28	25	22	25	30	26	33	27
Mean	18.7	15.1	9.9	9.1	12.3	15.0	22.4	18.0
Variation	28	21	50	52	47	43	24	31

checked as a male by its cloaca, was apparently stimulated by an outburst of courtship activity in the adults to go through a series of sexual movements, clearly directed at its own mother. This was on its 32nd, 33rd and 42nd days. The duckling produced very definite, if slightly sketchy, *sideways-hunches*, *kick-flaps*, *sideways-pipings* (but with only a wheezy sound) and *head-high-tail-cocks*. Female D, for her part, responded, even more astonishingly, with all these typically male movements, looking very much as if she were 'teaching' them to her offspring. One can only speculate about the psycho-physiological states of mother and child that produced these remarkable antics. Fortunately they were captured on ciné-film and sceptics can be convinced at leisure.

Maturation of diving ability in the young

With such readily observable birds the attempt was made to follow closely the development of diving ability. The aim was to record at least fifty dives for each life-day up to 7 weeks. In the event nearly three thousand dives were timed and in the first 6 weeks only the 10th day is without data. In the 7th week data was obtained on the 46th, 48th and 49th days. When dives of the two ducklings were compared at the same ages, no significant differences emerged and the material is therefore lumped together. The second duckling only contributed data up to the end of the 4th week.

The results for the 1st week are set out in Table 8. The rapid occurrence of the first dive after leaving the nest has already been mentioned, but in the 1st day dives were infrequent. The young spent some time dabbled along the water's edge, and this feeding method was also in evidence during the 2nd

day. Thereafter nearly all the food was obtained by diving. The dives were slightly longer on the 2nd day, but the main improvement came on the 3rd day when both maximum and average dives reached a level maintained through the rest of the week.

The subsequent increase in the diving times was a slow process and setting out the data day-by-day would occupy too much space. They are therefore lumped by weeks in Table 9. In the 2nd week there was little improvement. The 3rd week saw an increase which was maintained through the 4th. Another step-up was clear by the 5th week and again this was maintained during the 6th. By the end of the 7th week the duckling had a diving performance not very dissimilar from those of the adult males A and B (see Table 4). In the following spring 200 dives by this young bird gave the following data: maximum 32 seconds, mean 20.1, variance 20.

It will be seen from Table 6 that, after the initial 2 days, diving was the major activity of the ducklings' day. This continued until the surviving young became feathered (weeks 5/7), but even then it was doing about twice as much diving as the unattached adults (Table 1). Its preening activity was then also approaching the adult level.

The newly hatched young obviously had difficulty in plunging its downy body through the water and had to take a distinct leap up and over, when immersing. This leap, and the twin water jets kicked up, were still noticeable well into the 4th week. There was also typically a slight water splash after the duckling emerged from the dive, produced by a sideways flick of the bill and probably disposing of water in the gullet. By the 6th week, with the feathers now well developed, the duckling was diving almost like an adult, with hardly any forward leap. Indeed it is clear that changes in bodily proportions as

Table 8. Diving times (seconds) of two young White-headed Ducks in the 1st week of life

Day	1	2	3	4	5	6	7
Number	22	129	189	95	101	141	68
Maximum	11	12	17	16	16	15	15
Mean	5.9	7.7	11.8	12.5	12.1	12.2	11.5
Variation	40	26	18	11	9	18	13

Table 9. Diving times (seconds) of two young White-headed Ducks in the first 7 weeks of life

Week	1	2	3	4	5	6	7
Number	745	495	557	426	387	306	85
Maximum	17	17	19	22	28	30	28
Mean	10.9	12.6	14.2	14.9	17.1	17.5	18.1
Variation	25	17	14	23	20	21	24



Figure 8. Female E and young, preening.

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well as feather development govern the development of diving ability, but a much more detailed study is required properly to relate these factors.

Although making shorter dives than the adults, the young spent more time on the surface between dives (Table 10). There was

Table 10. Times (seconds) on surface between dives of young White-headed Ducks

Birds	D's	E's
Number	303	227
Mean	8.9	10.7
Variation	36	26

also less variability than in adults and even less relationship to the length of the preceding dive. Presumably while under the care of the mother they do not have to spend time looking around for danger. The tightness of the diving times around the means (Tables 8 and 9) also suggests that the young birds were diving near their physiological limits. (Next spring 144 pauses by D's averaged 8.4, variation 51.)

Artificial rearing

Of the three birds left with their mothers, one was reared. All four eggs taken from female D for artificial incubation were hatched but the ducklings were not reared. One newly hatched young and two near-hatching eggs were taken from female E. All three were successfully reared. The diet consisted of protein-rich 'Pro Nutro' and some duckweed

and millet. The rearing compartments were modified to provide a large deep water tank right from the start. Their average weights, taken at weekly intervals, increased from 58 to 75, 146 and 243 g. This rate of growth was similar to that obtained with Ruddy Ducks (Siegfried, 1973b)

Taxonomic considerations

Johnsgard (1967), summarizing the information then available on the behaviour of stiff-tails, proposed a dichotomy within the *Oxyura* group. On the one hand were the Ruddy Duck *jamaicensis* and White-headed Duck *leucocephala*, while on the other were the southern stiff-tails, the African Maccoa Duck *maccoa*, the Argentinian Ruddy Duck *vittata* and the Australian Blue-billed Duck *australis* (the Masked Duck *dominica* appeared rather separate). Our present observations suggest that *leucocephala* has more in common with the southern group. The *dab-preen* appears similar to that of *australis* and the *kick-flap* has elements of *sousing*. *Bill-dipping* and *water-flicking* was also seen in *leucocephala* and the *ringing-rush* would probably occur in full-winged birds. The *bubbling* of the *jamaicensis* is absent, as was calling during *head-high-tail-cock*. There appeared to be no inflated neck display, either using the oesophagus or air sacs.

One can argue taxonomics indefinitely and not to much avail. Perhaps it is best to say that radical divergences within the group do not appear to be indicated by these further behavioural studies.

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Summary

The first breeding in captivity of the White-headed Duck *Oxyura leucocephala* at Slimbridge enabled studies to be made of courtship, nesting, incubation and mother/young behaviour. Many undescribed courtship movements are reported. Two females nested in disused Coot *Fulica atra* nests. Nest building movements were observed in a female which failed to breed and also in a male. Incubation was for 25 days, the females only coming off the nest for short periods during the day. They made excellent mothers. An Oedipus-like display of a duckling to its mother was observed, and adult females occasionally showed male courtship gestures. The males took no part in rearing the young and no definite pair-bond appeared to be established. One duckling was reared to maturity by its mother, and three others artificially.

The diving ability of the adults, and its maturation in the ducklings, was examined in detail, over 5,000 dives being timed. There is a brief discussion of taxonomic considerations.

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Postscript

In 1974 both females laid earlier. D starting on 30 June (6 eggs), E on 8 July (5 eggs). Both clutches were removed to incubators on 15 July. Second clutches were started, by D on 31 July (4 eggs), by E on 24 July (7 eggs) after an interval of only 9 days and still producing an egg a day. All 22 eggs were successfully incubator-hatched and 20 young reared.

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