The White-winged Wood Duck

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This is an interim report dealing largely with aspects of the conservation of the rare White-winged Wood Duck *Cairina scutulata* of south-east Asia. Although the species has been protected in India since 1937 and has been on the Special Protected List since 1952, the International Waterfowl Research Bureau (I.W.R.B.) census figures of 1966 indicated that immediate measures were needed if it were to survive in Assam. Project 406 of the World Wildlife Fund was initiated in 1968 and has been reported in that organization's Year Books since, by C. D. W. Savage, M.J.S.M. and J. K. The three aims were:—

1. To collect young White-winged Wood Duck in order to establish a number of captive flocks in Assam, India; at Slimbridge, England; and at Washington DC, USA.
2. To study and breed the species in captivity.
3. To create a sanctuary, following a thorough ecological survey, in a suitable area of unspoiled Assam primary rain forest. Captive-bred White-winged Wood Duck might then be re-introduced there or, alternatively, put on to a suitable sanctuary in a country previously inhabited by the species, such as Thailand or Malaysia.

In 1975 an Endangered Waterfowl Group was sponsored jointly by I.W.R.B., the Wildfowl Trust, the International Council for Bird Preservation and the International Union for the Conservation of Nature (Survival Service Commission). This group considered it important that all recent information on threatened waterfowl should be made available in published form, and the White-winged Wood Duck is the first species to be dealt with.

The White-winged Wood Duck is a large duck, with a black body, a white head thickly spotted with black, conspicuous white patches on the wings and red or orange eyes. Its voice is distinctive and ghostly, and accounts for the Assamese name 'Deo Hans' or Spirit Duck. In Burma, it is called 'Mandali',

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and in Indonesia 'Itik Hutan', or Forest Duck.

In the following account, the first section, on the conservation of the wild bird, is contributed largely by M.J.S.M., and is based on experience obtained while stationed in Assam in 1953–1954 and 1956–1970 and on a special mission carried out for the Endangered Waterfowl Group in 1975. The second section, which covers observations of the species in captivity, is mainly the work of J.K.

Past distribution

Baker (1921) wrote that the White-winged Wood Duck was 'Common in Eastern Assam and extends throughout Burma being common in Arakan and less so as one proceeds southwards, though it has been met with in some numbers in Tenasserim'. It was also recorded from East Bengal, Cachar, the Malay Peninsula, Sumatra and Java. The Sadiya district of north-eastern Assam was one of the most favourable areas for the White-winged Wood Duck even in Baker's time. Smythies (1940) said it was 'A Malaysian species extending through Burma and Assam. By no means uncommon in the evergreen forests of Northern Burma, as far south as the upper part of the Mu valley, and in the Shiveli valley in Mongmit State; also the evergreen forests of Arakan Yomas in the Bassein district'. Delacour (1959) summarized the distribution as: eastern Assam, Burma, Thailand, Indo-China, Malaysia, Sumatra and Java, and said: 'They are not particularly rare in suitable parts of their extensive range, although never numerous'. Figure 1 shows the past range of the species, and the areas to which it is now confined.

Present distribution

In north-eastern Assam there are at present known populations of White-winged Wood Duck in the Reserve Forests of Dibrugarh,

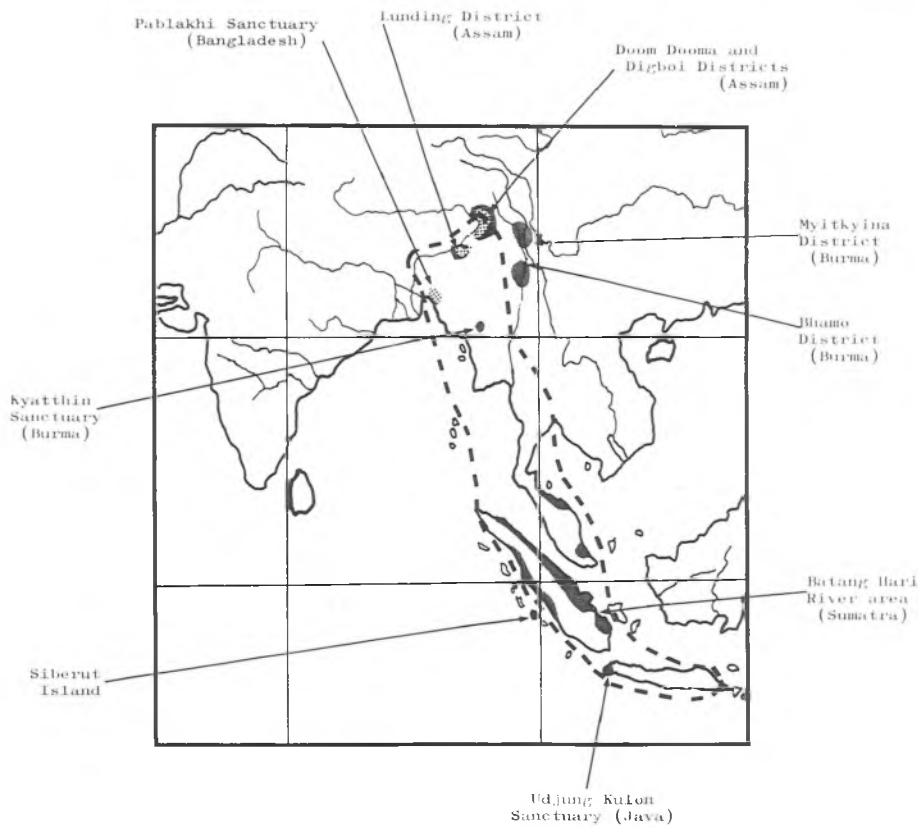

Figure 1. The distribution of the White-winged Wood Duck. The broken line encloses the range in 1923, when Phillips published his *Natural History of the Ducks*. Delacour (1959) also included Indo-China. Areas where the bird is known to occur today are shown in light stippling. Denser stippling indicates regions where the species may still be found.

Doom Dooma, Dehing West, Duamara and Dirok, and in the Namchick river area. The confirmed population for all these areas totals only 15 pairs, a reduction since 1969–1970 of some 18 pairs, although the Dibrugarh Reserve Forest is once again inhabited. It is likely that a number of other Reserve Forests on the north bank of the Brahmaputra (Sadiya to Buri Suti/Jamjing area, Pobo Chopri, and east of Doom Dooma and Digboi, plus those covering plains forest in Arunchal Pradesh) also have resident populations. The forests between Golaghat and Lumding, and Lumding north-west towards Nowgong, some 320 km from the main north-eastern population area, may still be inhabited.

As late as 1971, C. D. W. Savage (pers. com.) reported that in Bangladesh two isolated groups were resident, one on the Pablakhali Sanctuary, and the other in the Rangamati forest tract near Chittagong. The situation in Burma (Stanford 1931; Smythies 1940) is at present unknown but, in the light of Mr. Tun Yin's information (*in litt.*), it seems extremely likely there are still a number of suitable forest areas in that country, such as Kyatthin Sanctuary (last reported by U. Maung Gale in 1955), Pidaring Sanctuary in the Myitkyina Forest Division (last reported by Oliver Milton in 1959) and the Mansi Tract, Bhamo district of Kachin State (U. Htang Wa). Information from Thailand, through Dr Boonsong Lekagul in 1972 (pers. com.) is that no sighting has been made for over 17 years (see also Deignan 1963; Boonsong Lekagul and Cronin 1974), nor are there any recent records from Malaysia or Indo-China. In Sumatra, a pair has been sighted recently by Holmes (1976) close to the Batang Hari river some 60 km west of Jambi, on a swamp near an area of secondary woodland. Also off the west coast of Sumatra on the island of Siberut, A. J. Whitten (pers. com.) has reports of a population, although he has not yet seen any birds. C. D. W. Savage (pers. com.) had reported to him another likely population in the Udjung Kulon reserve area in north-western Java but also has not made a sighting. It seems possible that there are several isolated groups surviving in suitable forests of Indonesia, and in some quite extensive areas on Sumatra, current population levels may even be substantial.

Habitat requirements

White-winged Wood Duck ideally require the shelter of heavy primary plains rain forest well interspersed with slow running streams and sheltered pools. For limited periods of dry weather, they may frequent larger open swamps within easy reach of suitable patches of forest in which they roost during the day. Should groups of birds become isolated in open swamp away from suitable forest, as happened in parts of Assam after the 1950 earthquake, breeding success seems to be reduced and the population dwindles eventually to extinction (for example, in the Buri Suti-Jamjing Bheel this took 11 years).

The habitat requirement limits the species within the great primary forest tracts of north-east India, Burma, Thailand and Indonesia. Owing to the difficulty of access for forestry operations, most of the remaining primary forest is to be found in mountainous terrain with fast flowing rivers unsuitable for White-winged Wood Duck. In northern Thailand, Deignan (1945) met a flock of five or six as high as 1,500 m (5,000 ft) so altitude alone is probably not limiting.

Diurnal rhythm

When the ducks need to leave the forest roost to feed (as in the dry season), they flight just before dusk. If not disturbed, they may remain on the water until the sun is high enough to shine directly on to the water (about two or three hours after dawn). When suitable feeding is available within the forest, or they have young, they may remain on shaded waters all day, sometimes roosting on driftwood or on low branches over the water.

White-winged Wood Duck are seldom found on open water or large 'bheels', preferring well shaded, weed-infested pools and sluggish streams. Whilst on the water they are alert, rising easily and flying low over the surrounding bush or 'kugri', or through the trees of the primary forest. The report in Baker (1921) of four White-winged Wood Duck, one of which was shot, flying 'at a great height' is exceptional.

When roosting in the forest, they are less likely to take flight at human approach, unfortunately often not moving until well within gunshot range. They possibly rely on their natural camouflage, being surprisingly difficult to see in the sombre dappled light of the forest.

Food

Observations by M.J.S.M. agree with those of Baker (1908), except for his statement that the birds would not take green food. Adults are largely omnivorous, their diet being governed by local seasonal availability of seed, floating duckweed *Lemna,* insects,

worms, molluscs, frogs, small reptiles such as snakes, and small fish. The ducklings seem to start feeding entirely on small animals, progressively expanding their diet to include insects, worms, small fish, and small water snails. This diet is most easily available in Assam during the birds' breeding season: water levels are high (Figure 2), many species of fish have spawned during the early high floods, and insects are numerous. Conversely, by mid-January, when water levels are low and small animal life less prolific, a vegetable diet is more readily obtained, since many species of grass, including wild rice, have shed seed into the shallow open waters beyond the forest. We do not know whether these variations in diet pertain to White-winged Wood Duck inhabiting regions nearer the equator, such as Java and Sumatra, but expect that conditions in Burma would be similar to those in north-east Assam. Wet stubble, where streams run out into fields, were feeding areas in Burma (Smythies 1940), and rice-fields are noted in Phillips (1923).

Flock size

The ducks are generally seen in pairs in Assam, but occasionally singly during the early summer. By mid-summer, family parties may be observed and this grouping often continues into the early dry season. However, during the dry season when suitable forest feeding areas are reduced, flocks of several birds (nine is the maximum observed), possibly family groups, may be seen feeding together on suitable water, although they arrive and leave in pairs, often in varying directions. In Assam, the forest is extremely difficult to penetrate during the summer, so this period of dry weather collective feeding is a most useful time at which to carry out a census.

Voice

The flight call, which is best heard during the evening, is a prolonged, vibrant, wailing honk sometimes breaking to a nasal whistle at the end, and seems to be used between a pair. Stanford (1931) believed that the male called with a low 'cronk cronk' and the female with a whistle. However, further observation is required to confirm that the female alone is responsible for the whistling. Whilst on the water, or when disturbed, a shorter harsh honk is used, often sounding as though the bird were losing its voice or there were two calling simultaneously in different keys. When threatening, the birds hiss, holding the head low and, on occasion, lifting the wings to display the speculum and white patches in threat (Figure 3).

When locating White-winged Wood Duck populations and feeding areas, the evening flight call can be most helpful, but is not

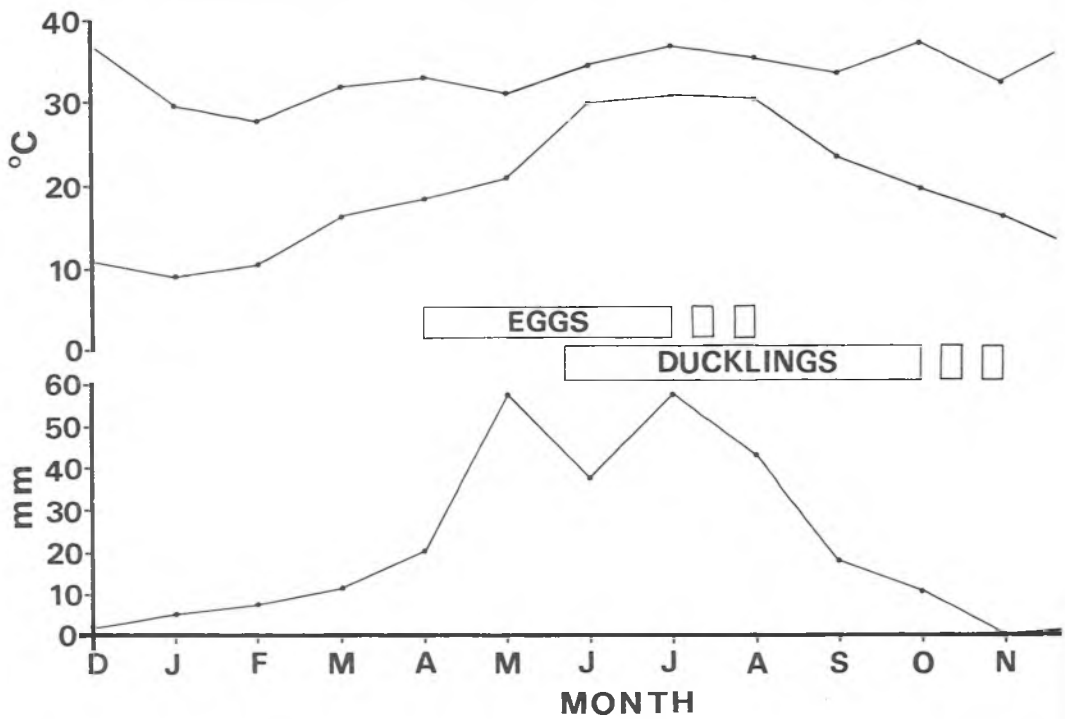

Figure 2. The breeding season of the White-winged Wood Duck in Upper Assam in relation to (a) the mean maximum monthly temperature, (b) the mean minimum temperature, and (c) mean rainfall.

Figure 3. White-winged Wood Duck threatening an Assam Cobra. The white patches are exposed as the wings are raised to attack.

satisfactory for accurate census figures as little idea can be obtained of how many birds are involved. However, single birds never seem to call in flight.

Population density

Population density appears to be governed by two main factors: first, the availability of adequate feeding waters during dry seasons within a couple of kilometres of a suitable roosting forest; and secondly, by the contiguous area of *undisturbed* primary rain forest suitably interspersed with sluggish streams and pools for the remainder of the year. A possible third requirement is that, should the dry season feeding areas not be within or adjacent to the main forest, there must be a safe river, bheel or forest 'flyway' between the two to enable the ducks to travel from one area to the other.

Duamara Reserve Forest in Upper Assam (733 ha), much of which was ideal rain forest environment with plenty of pools and the meandering Doom Dooma river (Figure 1) flowing the length of one side, had in

1969–1970 a known adult population of four pairs. Apart from two family groupings in the late summer and early cold weather period, when it was estimated that a total population of at least fourteen birds was resident, by mid-January 1970 only eight were counted. In May 1970 only two pairs were sighted, although locals reported having seen all eight a week previously. Given the forest and waterways to fly over, these ducks move from one area to another as the seasons dictate, but once isolated without suitable connecting flyways, the population is controlled by dry season feeding. In north-east Assam, one pair per 100 ha of *ideal* environment is probably maximal.

Reasons for decline

Although White-winged Wood Duck populations have been dwindling over almost all of the range during the recent half century (Figure 1), sightings have been especially limited since the Second World War (Gee 1958; Ripley 1961). The causes for the decline in eastern Assam are probably similar to those over the rest of the range at various times.

The primary factor affecting the Wood Duck is the disturbance and destruction of the rain forest habitat. In nearly all instances this has been due to the activities of man. The heavy flooding of the plains of Upper Assam following the 1950 earthquake is an exception; then, important forest tracts of Sadiya to Lakhimpur North and the Dibrugarh Reserve Forest were swamped and largely destroyed. However, even in this case, man's subsequent cane cutting, hunting, buffalo grazing, fishing and flight netting hastened the Wood Ducks' decline.

With the development of plantations in Assam, which started some 100 to 150 years ago, much tea and other crops were planted on previously forested land. However, this effect was limited because the contiguous forest tracts were not much reduced. With the influx of imported labour to tea estates and subsequent increase in the demand for land outside Reserve Forests, areas were rapidly cleared for plantations and farms, especially after 1945. The trend separated many of the Reserve Forests and this in turn subjected isolated White-winged Wood Duck to the direct effects of hunting and logging disturbance from which they could not escape. The interchange and replacement of populations thus became severely restricted.

To make matters worse, the demand for forest produce during the 1960s and 1970s has made it economically necessary to develop clear felling and replanting with fast growing tree species over a large percentage of the Reserve Forest blocks, in place of a selective felling system. This is resulting in forest unsuitable for the ducks, with thin overhead canopy and little intermediate vegetation. In many cases the increased demand has made it necessary to build roads into forests and access by unauthorized people and their animals becomes commonplace. In summary, the following main factors are thought to be responsible for the increasingly rapid decline of the species in Assam:—

1. Decrease in the total area of suitable habitat.
2. Isolation of groups of ducks.
3. Increased disturbance within the forests.
4. Increased risk from illegal hunting, both inside and outside forests, and the collection of young by villagers with easy access into forests.
5. Increased risk of pollution of available waters, by industrialized small towns, wood mills, and tea waste.

Conservation measures

Increased legal protection has proved inadequate because the key problem of loss of habitat has not been controlled.

Unfortunately, natural mixed primary rain forest does not provide optimum yields of commercially valuable timber, often as little as 10% of possible production. Mature hollong *Dipterocarpus macrocarpus*, teak *Tectona grandis* or mekai *Shorea assamica* plantations may prove suitable habitat for the Wood Duck, but thinning every 30 years and clean-sweep destruction every 45 precludes them as long-term, undisturbed sanctuaries for many birds and mammals.

From the wildlife conservation viewpoint, it is obviously desirable to establish sanctuaries that are representative of primary plains rain forest. Should the practice of intensive production of timber in plantations continue, as it almost certainly will, much of the natural forest flora will vanish. The maintenance of several representative natural forest blocks as sanctuaries for a wide variety of native wildlife would be essential should any of these species prove economically valuable in future, or regeneration of plantation material become necessary. For instance, the value of hollong for plywood was appreciated only as recently as the last World

War and it is now the primary source of plywood timber in Assam.

In Assam, there is a recently developed scheme reserving one square mile (259 ha) blocks within each Reserve Forest as wildlife sanctuaries. These are, of necessity, randomly chosen; however, an ecological survey on behalf of the White-winged Wood Duck should reveal the best sites for these sanctuaries. A reduced number of larger blocks could be selected without increasing the total protected area, but incorporating the widest possible spectrum of animal and plant species.

Unfortunately, primary rain forest sanctuaries would not prove of value to the tourist trade, except on a small scale, since undue disturbance must be avoided. Overhead viewing from especially constructed platforms, so that birds and mammals in the canopy can be seen without interference, is probably essential.

Comprehensive ecological surveys are now required in areas believed to hold White-winged Wood Duck. The present population levels must be ascertained, and the suitability of the habitat and on-going forestry plans for the area examined in an endeavour to plan long-term effective protection measures. If suitable populated forests are located, the local authorities should be encouraged to recognize the value of maintaining these undisturbed until sanctuary areas can be established. The forest sanctuaries, which might be as little as 1,000 ha, should be free of all forest operations, fishing, shooting, or grazing by domestic animals. The area should not be penetrated by roads. Sanctuary blocks should be surrounded by a buffer zone in which selective logging operations continued but all cane cutting, fishing, shooting and grazing are strictly prohibited, this being enforced by an adequate full-time staff.

Sanctuaries must not be chosen purely on behalf of the White-winged Wood Duck, but rather as nucleus conservation areas for as wide a spectrum of rain forest trees, plants, mammals, birds and insects as possible. Careful consideration should be given to dry season conditions, both in and surrounding the sanctuary, and protection planned for linking waterways and flyways of the sanctuary and buffer zone. Both birds and mammals will then have scope for seasonal movements.

The high success of captive breeding by the Wildfowl Trust gives hope for similar results in Assam, and makes the re-populating of a suitable sanctuary a distinct possibility. In this way it is hoped that the wild populations in Assam, Sumatra, Java and Burma may not only be saved but improved. Should such efforts be successful, captive-bred ducks could be used to re-populate suitable forest sanctuaries at present devoid of White-winged Wood Duck, possibly in countries previously part of its range, such as Thailand and Malaysia.

To reduce the risk from hunters, all human activity within buffer zones or flyway stream areas should be restricted to daylight hours, and firearms prohibited. Collection of young ducks by villagers can be controlled initially by legislation (as in Assam) and by protecting the forest area from unauthorized penetration. Continuous publicity at school, village and newspaper levels will greatly help forest protection authorities.

History in captivity

White-winged Wood Duck have never been common in captivity, although a pair was exhibited at the London Zoo as early as 1851 (Sclater 1880). Others were held from time to time in England, the Netherlands and in France. Baker (1908, 1921) kept many birds in confinement in Assam, and sent some to Calcutta Zoo. None bred until 1936 when the female of a pair, imported two years earlier to a waterfowl collection near Rotterdam, laid eggs from which five ducklings were hatched and reared. They had been kept in a small pen, measuring 15 m × 15 m, shaded by trees and long grass, and containing a small central pond (Schuyl 1937).

A shipment of ten Wood Duck to the Wildfowl Trust at Slimbridge, England, from Thailand was made in 1955 but none of these birds nested. Then in 1969, as part of World Wildlife Fund Project 406, M.J.S.M. sent five males and one female (hand-reared from wild-caught ducklings in Upper Assam) to the Wildfowl Trust, and these were joined by two more males and four females in 1970. The second breeding in captivity occurred at Slimbridge in 1971; the first captive-bred female to lay did so at the Trust's refuge at Peakirk in 1973, and in 1974 a pair, both members of which were second-generation captives, bred at Slimbridge. Production in England is shown in Table 1 (see Johnstone 1972; Lubbock 1975, 1976).

Two ducklings have also been reared at Gauhati Zoo, Assam, from birds supplied by M.J.S.M. Captive adults are currently held at Gauhati (9 individuals), Koomsong Tea Estate, Assam (5), by the Wildfowl Trust (three reserves holding 41 birds), at Bentley, Sussex (2), Jersey Zoo (2), Clères, France (6), Washington Zoo, USA. (4), and the Botanic

Table 1. Numbers of White-winged Wood Duck reared by the Wildfowl Trust.

	Ducklings reared at: Slimbridge	Peakirk	
1971	9		
1972	14		
1973	3	2	
1974	30		
1975	26	2	
Totals	82	4	86

Gardens, Hong Kong (2), and so total about 70 individuals. All captive birds outside India are related to the Slimbridge stock, and those in Assam come from the same wild area as the Slimbridge birds.

Breeding biology

Adult weight

Three adult females at Slimbridge, of Upper Assam origin, weighed 1·86 kg on average, and three drakes were 2·70 kg (the female is thus 69% of the male). The latter figure agrees with the range of 2·5–2·8 kg for a large number of males collected in southern Sumatra by Pieters (Hoogerwerf 1950). However, Baker (1908) gave much heavier weights: 3·8–4·3 kg for males (with one particularly fat bird in captivity at 4·87 kg) and 2·1–3·6 kg for females. As he was stationed at Dibrugarh in Assam, Baker's weights were probably of local birds, so that the discrepancy between his figures and those obtained at Slimbridge is unexpected. A male bird taken by M.J.S.M. in Upper Assam in February weighed 2·7 kg, and captives at Koomsong weighed on average 2·25 kg for two drakes and 1·75 kg for three females (A. H. Pirie, pers. com.). Hoogerwerf (1950) used differences between Baker's weights of continental birds and Pieters' of specimens from islands in Sumatra as one reason for suggesting that there were two races of White-winged Wood Duck. This proposal now seems to have less support.

Breeding seasons

In Assam, wild birds nest from May, through the rains (see Figure 2), and appear to moult in September (Baker 1908). A captive pair at Koomsong, Assam, laid the first egg of a clutch on 16th April and hatched a single egg on 4th June (A. H. Pirie, pers. com.), and at Gauhati Zoo (26°N) clutches have been started between 18th March and 21st May. The median date of first eggs at Slimbridge (52°N) over six years is 13th April; the earliest egg ever was laid on 30th March and the laying of the latest clutch began on 5th June—a potential season of 58 days. At Peakirk (53°N) first eggs have been laid between 10th and 30th May, and near Rotterdam in the Netherlands (52°N) eggs were again produced in May (Schuyl 1937). Wing moult in adult birds at Slimbridge occurs during July, following breeding.

The picture that emerges is of a duck that has a rather short laying season and which, in Europe, spontaneously ceases to breed in the late spring while day-lengths should still be stimulatory. The species appears to develop the refractory period that is characteristic of most temperate-zone birds, unlike its tropical relatives, the wild Muscovy *Cairina moschata,* the Comb Duck *Sarkidiornis melanotos* and Hartlaub's Duck *Cairina hartlaubi,* which have much longer breeding seasons extending, at Slimbridge, over the summer solstice into October. The implication of this pattern of photo-response is unexpected. It suggests a species that evolved in temperate latitudes and has invaded the tropics secondarily (Murton & Kear 1976). For the tropical part of the wild range, Hoogerwerf (1950) recorded December breeding in southern Sumatra, and February breeding in Java.

Age of maturity

Three females have laid at Slimbridge or at Peakirk at two years of age, but the majority of fertile birds are aged three years and older.

Nest site

The only published description of a wild nest seems to be a doubtful one from the Cachar Hills in Baker (1908). It was in a deep hollow of a tree, caused by decay at a point where a large trunk bifurcated. The nest was said to be 20 feet (6 m) from the ground and consisted of a mass of grass and other rubbish with a lining of down. Baker admitted that he had not seen the nest nor the down, and he earlier (1896) expressed doubt about whether it belonged to a White-winged Wood Duck. The single egg collected had measurements slightly under the average he gave for Comb Duck. Clearly, Baker himself never saw a nest. In Sadiya he was told that the birds sometimes built in holes in trees, or roughly on masses of branches, or in scrub-jungle and grass at the edge of pieces of water. Gee (1958) was told (at second hand) that they built their nests about three to five feet (1–1·8 m) off the

ground in tree stumps. Hoogerwerf (1950) stated that the species nested in trees, on heavy branches near the main stem, and sometimes in natural cavities.

In captivity, the birds have always used boxes. Schuyl's (1937) female laid in one set about 1 m from the ground. At Slimbridge a structure something like a dog kennel and measuring roughly 60 × 45 cm, with 16 cm sides was selected (Johnstone 1972), and a similar box has been used at Peakirk. Lubbock (1975) advocated boxes 60 cm in length, 30 cm wide and 30 cm high.

The egg

Seventy-three eggs laid at Slimbridge by birds originating in Assam have weighed on average 89 g with a range of 66–106·5 g, the smallest eggs coming from birds laying for the first time. Forty eggshells (which are white with a faint green tinge) measured 67·0 × 49·5 mm on average, and are somewhat larger than others recorded. Two eggs from Java measured 63·0 × 44·2 and 61·8 × 44·7 mm, and the range in Sumatra is said to be 64–66 × 45–48 mm (Hoogerwerf 1950). Schonwetter (1960–1961) gave 62·5 × 45·5 mm as the average and 59·7–70·0 × 42·9–50 mm as the range of 16 eggs, but did not record his source. He calculated their average fresh weight to have been 72 g. The eggs laid by Schuyl's captive female were apparently not measured; Delacour (1959) gave 65 × 48 mm, but no indication of his source, and 2·1″ × 1·38″ (53 × 35 mm) is the measurement of Baker's (1896) egg from the Cachar Hills. As already explained, he was uncertain whether this was laid by a White-winged Wood Duck, and he did not repeat the egg measurements in his 1908 publication of *Indian Ducks and their Allies* (although he, and other authors, continued to print the description of the nest).

Using Baker's (1908) body weights and Schonwetter's (1960–1961) calculated egg weight, Lack (1968) found that, at 2·5%, the White-winged Wood Duck had a relatively smaller egg than any other waterfowl species. Using Slimbridge data, however, the average egg is calculated to constitute 4·6% of the adult female, a figure closer to that of other perching ducks (Cairinini).

Clutch size

Nineteen clutches laid at Slimbridge and Peakirk have contained between six and 13 eggs, the most common number being ten. Second clutches have been produced on at least four occasions following the removal of the first. Schuyl's bird laid seven eggs, and Pieters (Hoogerwerf 1950) mentioned one clutch of six and another of nine in Sumatra, but said that natives reported clutches of more than ten eggs.

Incubation period

The incubation period recorded in captivity in Holland was uncertain, but at least 30 days (Schuyl 1937). Johnstone (1972) suggested 33 days to the stage when the eggs were chipping, and 35 days incubation has been recorded at Peakirk. This compares with 31 days for the Comb Duck, 32 days for Hartlaub's and 35 for the Muscovy.

The duckling (Figure 4)

When the plates for the third volume of Delacour (1959) were prepared by Sir Peter Scott, showing on page 140 the ducklings of the Cairinini, only an inadequate description of the White-winged Wood Duck was available. Johnstone (1972) later described those hatched at Slimbridge as 'dark brown

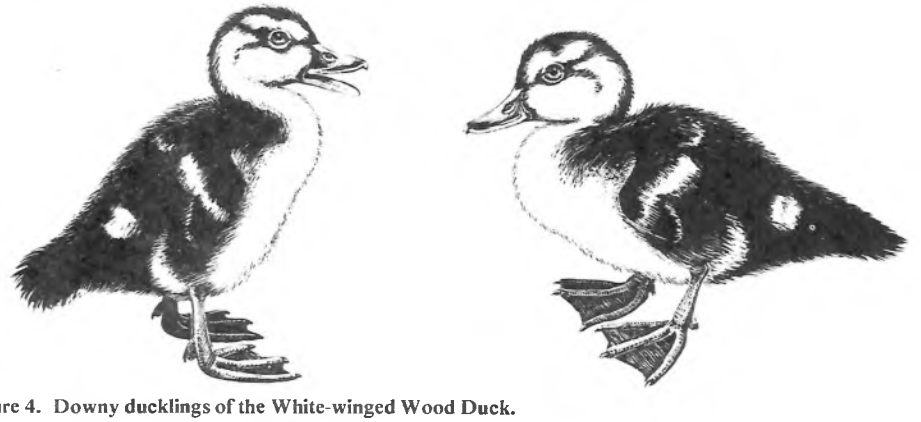

Figure 4. Downy ducklings of the White-winged Wood Duck.

and yellow, rather like large Mallard ducklings except that the post orbital stripe turns up almost at a right angle to the dark brown cap'. The divided eye-stripe is indeed their most distinctive feature (Figure 4), and is not found in other species.

Fifteen female ducklings at 24 hours weighed 48·7 g, and 21 males were 48·4 g (the difference is not significant). The birds grow fairly slowly; fledging takes place at about 14 weeks, and the immature plumage is brownish rather than black. The white wing-patches *are* present in the juvenile plumage, unlike other *Cairina* species, such as the Muscovy (Johnsgard 1965).

Avicultural requirements and problems

M.J.S.M. fed his young birds minced beef to start with, but soon added minced earthworms. At one-and-a-half months of age, the ducklings were taking live worms and duckweed; later, snails, frogs, grasshoppers and fish, and finally grain, were added to the diet. Johnstone (1972) recommended turkey starter crumbs, wheat, brown bread, biscuit meal, minced beef, minced eel and dried shrimp, together with duckweed, for the adult Slimbridge birds. Lubbock (1975, 1976) later simplified this diet to grain, dog biscuit meal and poultry layers pellets, and fed the young on a high protein starter crumb (26%) and duckweed, but dropped the protein content to 18% after ten days.

A number of nesting boxes per female will be needed if eggs are going to be taken for artificial incubation (from the bird's point of view this is equivalent to predation, and she will not usually renest in a predated site). Lubbock (1975) recommended that these boxes are given entrance holes of 15 cm diameter and are placed 0·8–1 m from the ground with ramps leading to them. A 5 cm layer of earth followed by another 5 cm of peat and a sprinkling of dried grass is placed on the floor of the box. Incubation at Slimbridge is either left to the female, or eggs are placed under a domestic hen for 10–14 days, and then transferred to and hatched in an artificial incubator. Growth problems are now largely controlled by hand-rearing in small groups on commercial diets (Lubbock 1975, 1976).

Adults kept full-winged in an aviary and others which were pinioned have both nested. The pen in which a pair is kept can be quite small but must be shady (Schuyl 1937). When maintained on open ponds with little cover, they do not breed. Baker (1908) reported that his captive birds in Assam retired indoors as soon as the sun was up and, even in cold weather, kept under cover from 10.00 to 14.00. As in other forest ducks, bright light may actually depress activity, including sexual display.

As Johnsgard (1965) pointed out, the sexes of the White-winged Wood Duck tend to remain together more than is the case in the Muscovy and the Comb Duck. The fact that the birds so often occur in pairs and small groups (perhaps family parties) in the wild suggests that the male has not the promiscuous tendencies of the other two species. Thus far, most successful captive breeding has occurred when a single male and female have been put together, but small groups of two or three pairs have also reproduced. The males may need removing from the pen during the rearing period, although paternal aggression on ducklings has been seen on only one occasion (Johnstone 1972) and may be abnormal except in very close confinement. The species is probably not cold-hardy—in the wild in Assam the temperature does not drop below 5°C (see Figure 2)—so it is sensible to ensure that shelter and heat are available in severe weather. The water supply to the pen must flow sufficiently fast to ensure that no concentration of *Daphnia* (water fleas) builds up, as these are the secondary hosts of the intestinal worm *Acuaria*, to which the ducks are susceptible.

Of an original shipment of ten wild-caught birds from Thailand to Slimbridge in 1955, the last bird died during 1961 after six years in captivity. Six post-mortem reports are available: one bird died of aspergillosis soon after arrival, and five others succumbed to avian tuberculosis. The oldest individual of the 1969 and 1970 shipments is now aged seven-and-a-half years. Twenty-three of these birds and their offspring have died aged six months or over, and all except three had tuberculosis. Two individuals developed lead poisoning after ingesting shot-gun pellets, three had *Acuaria* infestations (two as well as tuberculosis) and two also had aspergillosis. Juveniles have died from *Acuaria*, tapeworms, nephritis, aspergillosis and pneumonia. One young female left with her parent in an aviary died, aged only 4½ months, of a combination of tuberculosis and *Acuaria*. As sometimes happens with other near-tropical waterfowl, some young reared by their mothers became stunted—growing slowly in comparison with the rest of the brood—and some of these runts developed rickets.

Of 29 diagnosis of adult deaths, 25 or 86% refer to tuberculosis and, clearly, birds can

contract this disease at an early age. Tuberculosis is acquired from food and water contaminated by infected droppings, and the bacillus is extremely difficult to eradicate. The best long-term control is to replace the soil of the pen frequently, and to expose any resting bacilli to the sterilizing effects of ultra-violet radiation from sunlight. Here is a particular problem inherent in the captive husbandry of the White-winged Wood Duck—the species appears to demand plenty of shade in order to breed successfully, but tuberculosis can turn a pen sheltered from the sun into a death trap. This probably applies especially when captive birds are forced into the close proximity of their own and their pen-mates droppings.

To summarize the breeding potential in captivity, every female White-winged Wood Duck from the age of two years should in theory be capable of producing two clutches every spring, each containing ten eggs. We still do not know for how much of their lifespan the birds will lay efficiently. Currently, the most worrying aspect of captive husbandry is the species' susceptibility to avian tuberculosis. A weakness in the eggs and ducklings, due to inbreeding, may also be affecting the Slimbridge stock as second generation reproduction proceeds (M. R. Lubbock, pers. com.). The wild birds from Assam reared by M.J.S.M. were thought to be siblings and, as is often the case with very rare species, their parents may have been related as well. Male fertility is not yet declining, although this is common in other waterfowl species that have been inbred. Current efforts are centred on finding a suitable vaccine for using on all young Wood Duck, so that a resistance to tuberculosis can be built up at an early stage, and on obtaining a few unrelated specimens from the wild.

Discussion

A number of points have puzzled previous writers on the White-winged Wood Duck. First, the amount of white on the head, which is reportedly much more extensive in birds from the southern part of the range. Hume and Marshall (1880) proposed a distinct southern race, *leucoptera* = white-headed, and Hoogerwerf (1950), agreeing with this, sought to show that Wood Duck from the

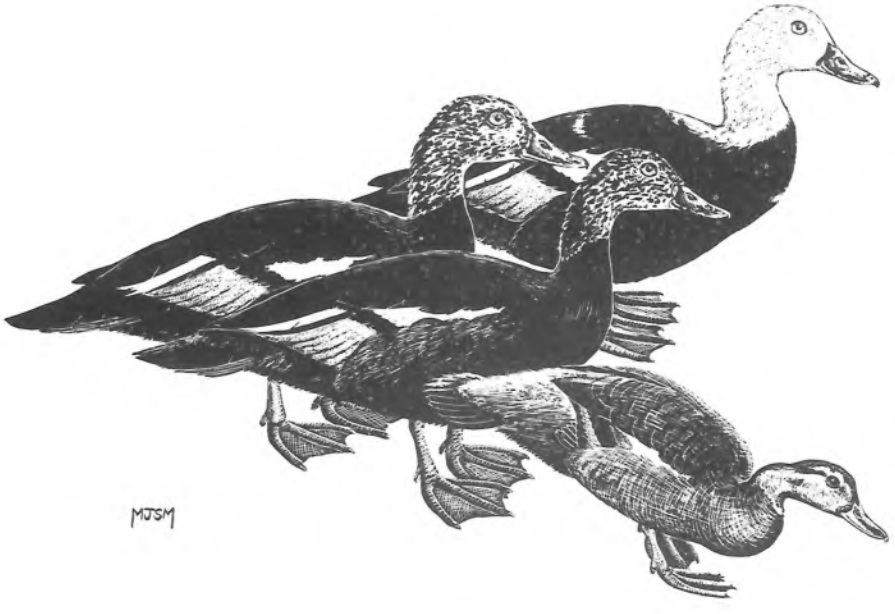

Figure 5. At the centre is an adult pair of White-winged Wood Duck, the drake on the left. Behind is the whitest of the Wood Duck, of Assam origin, at present at Slimbridge (compare with the photograph of birds in Sumatra on page 136 of the Eighth Wildfowl Trust Annual Report). In the foreground is a bird in juvenile plumage showing the white wing-coverts starting to appear.

Table 2. Measurements and weights of adult White-winged Wood Duck at Slimbridge.

	Bill (mm)			Head (mm)			Tarsus (mm)			Wing (mm)			Live weight (kg)		
	Mean	Range	No.	Mean	Range	No.	Mean	Range	No.	Mean	Range	No.	Mean	Range	No.
Males	64·7	62·0–67·1	4	132·3	129·0–135·9	4	65·4	60·5–75·8	4	385	366–410	3	2·70	2·50–3·00	3
Females	59·5	56·0–60·7	5	121·8	115·0–126·7	5	59·3	55·5–67·4	5	354	334–381	4	1·86	1·80–1·90	3

Greater Sunda Islands could be distinguished from continental birds by the conspicuous albinism of breast, abdomen, mantle, back, and even of the outer primaries. A photograph in the Eighth Annual Report of the Wildfowl Trust (1957) shows birds in Sumatra that have totally white heads and necks, and D. A. Holmes *(in litt.)* wrote of the pair that he saw in Sumatra: 'The back of one or both birds was white, though strongly mottled black, but there was little black on the neck, only visible as fine specks at close range.'. Domestication was excluded as a possible explanation for a tendency to produce white plumage by both Phillips (1926) and Hoogerwerf (1950), since the birds live in inaccessible jungle, there is no record of their being bred by the natives and, as Phillips remarked, 'the species has given no evidence of easy domestication'. Two offspring of the first Assam birds to breed at Slimbridge were much whiter in the head and neck, with more white blotches over the body, than the other juveniles (Johnstone 1972). These birds—a male and a female—were mated (Lubbock 1975), and their offspring show an even greater degree of whiteness (Figure 5); so a tendency to albinism is clearly not confined to Javan and Sumatran birds, and might well be due, as Delacour (1959) suggested, to local inbreeding.

The second puzzle has been an apparent variation in body size in different parts of the range. Table 2 gives the average measurements of Assam birds at Slimbridge. These are not significantly different from published figures of birds taken elsewhere. The smaller (and whiter) birds that Hoogerwerf (1950) suggested were found only in Sumatra depend largely on Baker's weights which seem aberrant.

Thirdly, there are reported differences in the diet of wild birds. Hoogerwerf (1950) stated that an examination of the stomach contents of many Sumatran birds revealed that there the birds were exclusively vegetarian, while Baker (1908) found them omnivorous and even capable of catching fish. Mackenzie (1971) found the Assam juveniles in captivity inclined to take only live food but, as stated earlier, the adults are vegetarian in the dry season. Probably, discrepancies in reports of feeding habits in the wild are due to seasonal differences, but further investigation is required, especially of the use that White-winged Wood Duck can make of cultivated land.

The strict spring-time nesting season and the reluctance of the species to breed freely in captivity, suggest that it is not so closely related to the other large perching duck as is often supposed. It is clearly not just another Muscovy, with all that that implies in terms of easy domestication.

The countries in which the White-winged Wood Duck still occurs should, so far as possible, follow and enlarge upon the example set by the Assam authorities in an endeavour to protect this species in the wild. Dry season photographic surveys from the air should be useful in locating suitable forest. These surveys, however, must not substitute for ecological study on the ground. We need further information on a number of aspects such as: why population densities are so low, even in undisturbed forest; why disturbance matters so much and the birds do not easily move from disturbed forest blocks to alternative areas free from interference; how mature the forest needs to be before it becomes suitable Wood Duck habitat both for feeding and breeding; and how extensive a water area is required for feeding both in the dry season and when the ducks have young.

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Summary

The conservation of the rare White-winged Wood Duck *Cairina scutulata* in the wild, and its potential for breeding in captivity, are examined. The survival of the species appears to depend on the continued existence of dense, undisturbed primary rain forest in south-east Asia. The timber in these forests is valuable economically, and the clear-fell and replant programmes frequently adopted seem not to suit the duck.

In captivity in England, the duck breeds well provided that it is kept in shady conditions. Unfortunately, however, reducing the sunlight in their pens also seems to increase the likelihood of birds contracting avian tuberculosis. It has been possible to obtain, for the first time, accurate information on body weight, age of maturity, breeding season, egg size, incubation period, and the downy young pattern. A tendency to white-headedness is not, as previously reported, confined to birds from Sumatra, but seems to be due to local inbreeding. The species is probably not so closely related to the Muscovy Duck *Cairina moschata* as is often supposed.

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Addendum

After this paper had gone to press, letters were received from U Tun Yin about recent observations of White-winged Wood Duck in Burma by U Sein Chit. In December 1974, U Sein Chit shot one of six birds seen at the mouth of the Wai Chaung river, a tributary of the Irrawaddy in the Katha District. Earlier in April 1974, he flushed one duck near the Shur-U-Daung Sanctuary, Shan State. U Sein Chit believes that the species is now mainly confined to the Katha Bhamo and Myitkyina districts of northern Burma, although we have no information of population levels in these areas.