Aviculture at WWT over half a century

A. RICHARDSON

In the early days of the Severn Wildfowl Trust, birds were 'collected' from wherever they could be found. This was often from the wild and, in common with other zoos, birds were brought in to increase the variety on show and in order to have the 'set'. As staff avicultural skills increased, however, limitations on what could not be kept in the English climate became apparent. Arguably, the avicultural heyday of WWT was in the 1970s, when the emphasis was on maximising breeding, and birds were still imported, often from private breeders and dealers who helped to maintain an interest in the more unusual species. The Wildfowl & Wetlands Trust, in its 51st year, still maintains one of the most substantial collections in the world. However, some species, especially seaducks, are not kept because conditions are not 'right'. WWT now plays to its own strengths aviculturally, and the collection is part of a much wider, more wetland habitat orientated organisation.

The first 50 years

In 1947, the accommodation for captive wildfowl at the New Grounds, Slimbridge consisted of 6.9 ha of low lying rushy fields around the Berkeley New Decoy. A 2.4 m fox-proof fence was put up, and the few ponds were fed from the nearby rhine (drainage ditch). The first birds were added on 20th September 1946, many of them geese lent to WWT by Major Gavin Maxwell. Amongst these early arrivals were Emperor Geese *Anser canagicus*, Ross's Goose *A. rossii*, Red-breasted Geese *Branta ruficollis*, a Lesser Whitefront *Anser erythropus* and a Magpie Goose *Anseranas semipalmata*. In 1947, these and other imports totalled 440 individuals of over 70 different species. The remaining 12 birds from Peter Scott's original, pre-war collection were also sent to the New Grounds.

The first Curator of Slimbridge was John Yealland, who later went to London Zoo, and who had to cope immediately with the severe winter weather of 1947; although this did not cause huge problems, some birds were lost. A number of eggs were received from Iceland the following spring, and among these were three Red-breasted Mergansers *Mergus serrator serrator*. It was recorded that 600 Sticklebacks per day were required to feed the resulting ducklings, and that this diet was later augmented with Eels. In these early days, the proprietary diets that exist in the 1990s were not available, and not all the birds survived; deaths occurred, for instance, from Stickleback spines getting stuck in the ducklings throats.

Birds came in from, and were sent to, North America and from Clères, Jean Delacour's famous collection in Normandy. One Red-breasted Goose travelled to America in a box aboard the Queen Mary. A 30-year-old Spur-winged Goose *Plectropterus gambensis gambensis* arrived from Whipsnade Zoo in 1933. Her original mate was killed by a bomb, making her a war widow.

In 1947-48, the first Marbled Teal *Marmaronetta (Anas) angustirostris* came by air to Slimbridge from the marshes at

the confluence of the Tigres and the Euphrates Rivers, via a gentleman living in Basrah in modern Iraq. This was the first time for more than 30 years that the species had reached Britain alive; they apparently settled in well. In 1948 a Colonel Ranking brought waterfowl from Canada to Slimbridge, including Canada Geese *Branta canadensis*, Pacific Black Brant *B. bernicla orientalis*, Canvasbacks *Aythya valisineria*, Philippines *Anas luzonica* and Redheads *Aythya americana*. Peter Scott travelled widely round the world exchanging information and collecting birds. One shipment from the United States, following a visit by Peter, was of North American Ruddy Duck *Oxyura jamaicensis jamaicensis*, some of whose offspring were destined to escape and establish themselves in the wild in Britain (Hudson 1976). In 1948, 106 different forms, and 654 individuals were to be seen at Slimbridge. Many of these were single, and it was a 'collection' of birds rather than one of breeding groups. The most important addition in 1949 was a pair of Nene (Hawaiian Geese) *Branta sandvicensis*, brought back from Hawaii by the Curator from Herbert Shipman of Keaau in Hawaii. At that time, only 22 Nene were known to exist. Seventeen new species were added to the collection, including Andean Crested Duck *Lophonetta specularioides alticola* and Falkland Island Steamer Duck *Tachyeres brachypterus*. Some initially did not do well, often arriving before their precise requirements were understood, so losses did occur.

Members throughout the world were told that WWT needed certain new birds and that, if the opportunity arose, they should contact Slimbridge, try to catch and send them to us. A list that WWT was "anxious to obtain additional specimens of or begin new species" was published. The first *Key to the Wildfowl of the World* by Peter Scott was produced in 1948, and, although it was not in colour, was available for identification. Interestingly, a shortage of staff meant that members of the public were asked not to call upon their service to help identify birds but to use this key! How time and priorities change.

When it came to the rearing season, food used for goslings was fine soaked biscuit meal in addition to the grass and clover in the pens. The diets for ducklings included biscuit meal, dried milk, raw egg, meat meal believed to be made from dried liver or whale meat, dried and fresh ant eggs, cod liver oil, various invertebrates including small Shrimps which were found in the River Severn and local duckweed (*Lemna* spp.). Seaducks were reared on minced sheep's heart, ant eggs, a small amount of biscuit meal, aquatic insects and cod liver oil.

The first wild birds were soon in evidence. Teal *Anas crecca* in the Orchard Pen were joined by Pintail *A. acuta* and Wigeon *A. penelope* on the water of the Rushy Pen.

However, flying waterfowl at Slimbridge, other than the wild geese and ducks in winter, were still an unusual sight. One question asked at the time was, "is it safe or advisable to keep some exotic species full-winged". It was the view then that immense pleasure was derived by hundreds of people from the sight of birds flying free and, in the great majority of cases, not flying away. So certain birds were left to come and go as they pleased.

In 1952 the first successful breeding of Hawaiian Geese was recorded, by WWT. From two females and a single male, nine young were hatched and reared from four clutches. This was a triumph for Tommy Johnstone, who had become Curator in 1950. He was to remain in this position until 1972. On 19 June 1952, five males and one female Long-tailed Duck *Clangula hyemalis*, four male and three female Harlequin Duck *Histrionicus*, and a male and female Common Scoter *Melanitta nigra nigra* were collected in Iceland by John Yealland; the comment has been added to the records that none of these survived for more than six months. Very full and detailed records of breeding, numbers and dates of eggs, those addled, hatched, parental behaviour, etc. were and still are kept. These records helped the publication of many scientific papers, for instance, those of Murton & Kear (1978) on the importance of photoperiods, and also provided authors with biological statistics

on egg size, clutch size, duckling and adult weights, parental care, etc. where no information existed from the wild (e.g. Lack 1968; Kear 1970). The first proprietary diets were used in the early 1950s when trials were carried out using Blue Cross pellets with vitamins and trace elements included. In 1952, five Trumpeter Swans *Cygnus Cygnus buccinator* were presented to Her Majesty the Queen in Canada. They were sent to Slimbridge and eventually bred successfully.

In 1953 an electronically heated brooder was tested and used to hatch and rear several ducks and a brood of Canada goslings; this was an alternative to broody hens which were thought to carry disease. Improvements to the pumps installed in 1954 meant that the Duckery area had fewer Water Fleas, *Daphnia*, the host of Acuaria, a parasitic worm that causes serious problems in the gizzards of young birds.

In 1954 it was reported that North American Ruddy Duck had been 'singularly successful in breeding their own young' and that our efforts to rear them under foster parents were equally unsuccessful.

1956 saw the first breeding of Magpie Geese with three birds being reared. The first Bewick's Swans *Cygnus columbianus bewickii* bred, and the Hawaiian Geese did well, with 15 young reared, giving a total of 37 Nene alive and well in Europe.

In 1957 Slimbridge added seven acres to the area within the fox-proof fence which allowed the Asian and European Pens, the Guiness Aviaries and the Tump Pond to be created. That year, 770 birds were reared at Slimbridge , and 146 of 15 species at Peakirk Waterfowl Gardens which had opened near Peterborough. The first New Zealand Brown Duck *Anas aucklandica chlorotis* bred in 1957, and surprised us by laying as late as 17 September (we now know that many tropical and southern hemisphere wildfowl continue to lay beyond mid-summer).

In 1960 Flamingos came into the collection when Greater *Phoenicopterus ruber roseus*, Lesser *Phoeniconaias minor* and Chilean *Phoenicopterus chilensis* Flamingos were imported form the wild.

In 1961 a duckery for artificial rearing was purpose built. Early beneficiaries of the new facility were King Eiders *Somateria spectabilis* which were kept in reasonable numbers and first bred in 1961.

In 1962 two Caribbean Flamingos *Phoenicopterus ruber ruber* arrived from Antwerp Zoo with an additional eight coming from Miami later that year. This was also the year that 30 Nene were sent back to Hawaii, to be released on the island of Maui where they had been extinct for perhaps 100 years (Kear & Berger 1980).

In 1963, Frank McKinney's doctoral thesis was published; he had been the first of many students to make comparative use of the many related species living and breeding in close proximity. Large numbers of birds were now being raised, over a thousand at Slimbridge with 2,200 adult birds, much time and effort was spent in maintenance. Birds were bred, not only in order to keep viable populations at Slimbridge and Peakirk, but also to sell and exchange with other wildfowl keepers throughout the world. However, in 1964, difficulties were experienced in disposing of certain species. As a consequence, it was decided to limit the number of birds that were hand-reared. Parent birds were left to hatch and rear their first clutches, or at least to incubate their own eggs.

By 1965, it was considered that WWT had the finest collection of Flamingos in the country with over 100 individuals; 50 Chileans, 26 Caribbeans, 14 Greater, nine Lessers, five Andeans *Phoenicoparrus andinus* and three James' *P. jamesi* – the last two being true rarities. Paul Johnsgard published his classic book on wildfowl behaviour, based on his observations made at Slimbridge. In 1965 the last captive Harlequin died, but in 1966 the species was once more represented following an expedition to Iceland. It had been decided to time the project so that only adolescent birds were caught since it was considered that their chances of survival were greater than those of adults. Most of these Harlequins survived, although they never bred.

In 1967 the Tropical House was built, made possible by an anonymous gift of £5,000. It was constructed on different

levels with advice being taken from Len Hill, Harry Horswell and also from the Royal Botanical Gardens at Kew.

1968 saw the first breeding of Caribbean Flamingos. Their diet, as that of all Flamingos, was then home-made; wheat, dried Shrimp, maize, breeder pellet and dog biscuits ground to a powder with Carophyll colourant added (not much like the proprietary diet that is used today). Caribbean nests were constructed and the first egg laid on 15 May, the second egg appearing on the 19th. Following a disturbance by a window-cleaner whose visit no-one had remembered to cancel, one bird kicked out its egg and this had to be incubated artificially, eventually replacing the other egg that had addled. This chick was reared successfully by its foster parents.

In 1969, the Chilean and Andean Flamingos bred, the Andeans for the first time ever in captivity. Also in 1969, a further 50 Hawaiian Geese were returned to the wild in Hawaii, and seven male and five female White-winged Wood Ducks *Cairina scutulata* arrived via Sam McKenzie from Assam. These were to found a significant captive breeding programme for this endangered species.

In 1970, the new propagation centre at the 'top hut', still in use today, was constructed containing an incubation room, general store, food store, work shops and, of course, an indoor duckery.

In 1971, 54 out of 58 Nene goslings hatched at Slimbridge were reared; this was a record. The breeding of the White-winged Wood Duck was also regarded as a triumph, as this was the first time birds had been reared in captivity for over 50 years, and only the second time ever. The mother reared her seven young in the old Guiness Aviary, after her mate had been removed for 'over attentiveness'. They were fed on a diet of minced Shrimp, turkey-starter crumbs and duckweed.

In 1972 changes in artificial incubation and rearing techniques were made. Broody bantams had been used for incubating and rearing for years with varying success. Incubator technology had improved significantly (paraffin giving way to electric heaters and thermostats) and so had the skills of WWT's avicultural staff. Bantams were banished from now on, expect for one occasion in 1990 (see below).

1973 was an excellent season, with 1,750 birds being reared including, for the first time in captivity, White-headed Duck *Oxyura leucocephala* (Matthews & Evans 1974). This followed the placement of old Coot nests in the European pen. Observations made in the wild, by Mike Lubbock, the new Curator, suggested that stifftail ducks, including the African Maccoa *O. maccoa*, would lay in such sites. Floating rafts were also constructed and planted with reed and sedge so that in 1974, 20 out of 22 White-headed Duck eggs were incubated artificially and successfully hatched and reared. The first International Flamingo Symposium (Kear & Duplaix-Hall 1975) took place at Slimbridge in July 1973, unfortunately coinciding with one of our driest seasons, when only the Chileans produced young. The *International Zoo Yearbook* that year had a special section on waterfowl in captivity, and included nine contributions by WWT staff.

In 1974, the African Maccoa first bred in captivity, and 30 White-winged Wood Ducks were produced, some of which were lent to Jersey Zoo. Slimbridge started to supply captive birds to WWT's new Centres at Washington, Martin Mere and Arundel which were to open over the following two years.

The highlights of 1975 were Spectacled Eiders *Somateria fischeri* and Falkland Island Steamer Ducks. Five Steamers were reared, having laid in a small pen at the back of the Rushy Pen. Long-tailed Ducks *Clangula hyemalis*, Stellers Eiders *Polysticta stelleri*, Pacific Eiders *Somateria mollissima v-nigra* and Velvet Scoters *Melanitta fusca fusca* were added to the collections, all from hatching eggs flown in portable incubators from Alaska, or in the case of the Scoters, from Finland.

In 1977 the numbers of captive wildfowl had reached 6,227, of which 2,430 were at Slimbridge, 588 at Peakirk, 1,496 at Martin Mere, 1,047 at Washington and 666 at Arundel. A total of 2,676 birds was reared, including 103 Hawaiian Geese. Another first for Slimbridge was the successful

breeding of Black-headed Ducks *Heteronetta atricapilla*, a South American stiff-tailed type that lays its eggs only in other birds' nests who then hatch and rear the ducklings. This species has the shortest of all incubation periods (21 days), thus ensuring that its eggs always hatch before or with the foster bird's own brood (Rees & Hillgarth 1994). This was also the year of a particularly exciting research project, the study of incubation in the nest, using an artificial "bionic" egg. These radio eggs were capable of transmitting information directly to a computer and recorded temperature, humidity, movement and the attitude of the egg. Water loss and oxygen consumption were also measured. Data from these experiments, which were conducted by Dr Paul Howey, were useful in determining exact incubation requirements, and greatly assisted in the technical development of the incubators that are used today (Howey *et al.* 1984).

1978 saw co-ordinated breeding programmes at all WWT Centres, so that they could concentrate on different species, especially ones that they were good at producing. This was to ensure that resources were not wasted, and birds were not being over-produced. The rearing of Stifftails, White-headed Ducks, Argentine Ruddy Duck *Oxyura vittata*, Maccoa, etc., had become Slimbridge's forte; a second rearing unit, incorporating a special swimming tank, was established and is in use today. There was a particularly successful hatching of nine Spectacled Eiders, which would have been more so had they not been all males! WWT struggled to maintain numbers of this seaduck from then on and, in 1995, the only pair of aged Spectacled Eiders sadly died. Another pair has since been acquired, and will go on display to the public in due course.

In 1979 Slimbridge reared six Magpie Geese from a pair of birds that had been at WWT since 1974; they began a very successful sequence of breeding that continued to 1996. In 1980 11 Magpie Geese were reared. That success was bettered by the first successful rearing of Pink-eared Duck *Malacorhynchus membranaceus* outside Australia, when four young birds were reared by a pair in the Tropical House. For the past decade, Slimbridge has not had Pink-eared Ducks but, in 1996, two pairs of captive bred birds were acquired from a private breeder, Keith Zabell, and these will be exhibited in the Freckled Duck *Stictonetta noevosa* Aviary during the latter half of 1996.

The Magpie Geese success story continued in 1981. Nine more birds were reared from the same breeding pair. On the night of 12/13 December 1981, a severe tidal surge of the River Severn broke through the banks of the sea wall, flooding much of the area between the canal and the river and sending salt water cascading through WWT pools and flooding much of the grounds. This occurred on a particularly cold night with snow on the ground and ice on the ponds. The majority of our delicate birds, including Magpie Geese, Orinocos *Neochen jubatus* and many species of Whistling Duck *Dendrocygna* spp., were in heated accommodation around the propagation centre. Power failed, and up to two feet of icy water engulfed the site in the middle of the night, inevitably causing losses, indeed, ten Magpie Geese were amongst a total of nearly 140 birds which died that night.

The old pair of Magpie Geese bred again in 1982, however, and continue to do so in 1996, 24 years after they arrived at Slimbridge. All WWT Centres now exhibit offspring of this pair, supplemented by one or two birds imported from the United States. During the 1982 breeding season, a study of artificial incubation humidity requirements was carried out by Nick French and Ron Board (French & Board 1983). Egg shell porosity and water loss from the incubating egg were studied in detail. Highlights of 1982 included the production of 21 African Maccoas, 25 Argentine Ruddy Duck, 11 Black-headed Duck, 60 White-headed Duck, 14 Goosanders *Mergus merganser merganser*, 25 Hooded Mergansers *M. cullatus* and 11 Bufflehead *Bucephala albeoli*. In this year, two Andaman Teal *Anas gibberifrons albogularis* were reared, having laid eggs in the Tropical House, another first but one sadly not to be repeated.

The 1983 census revealed 6,746 birds of 194 kinds. American Eider *Somateria mollissima dresseri* were first bred at Slimbridge and two Long-tailed Ducks were reared at Arundel, as were Bewick's Swans.

In 1984 13 South Georgian Teal *Anas georgica georgica* were reared. This was particularly exciting, as it was only two years earlier that a single breeding pair had been brought to Britain from the island of South Georgia. They had travelled to England with the assistance of the Ministry of Defence following the invasion of the Falkland Islands. These birds have been responsible for all the South Georgian Teal now living in captivity in Britain.

Fifty-nine White-headed Duck eggs were sent to Hungary as part of a reintroduction scheme; this did not stop WWT Centres rearing another 29 birds of this species. The scheme in Hungary was ultimately unsuccessful, despite the fact that Hungarian scientists and avicultural staff had come to Slimbridge to learn WWT techniques, had constructed rearing units, and bred the birds successfully. The process of introducing the birds to the wild went well, but they did not perhaps learn the best migration routes, and were not re-established. Lessons learnt from this exercise, however, have proved to be invaluable. WWT has been in the forefront of research into reintroduction techniques (Kear & Berger 1980; Ounsted 1991; Black 1992) and in the best methods of maintaining populations of endangered species in captivity (Matthews 1973; Tomlinson *et al.* 1991).

In 1985 four Freckled Ducks *Stictonetta noevosa*, the first to be held in captivity outside Australia, arrived from the Commonwealth Scientific and Industrial Research Organisation project in Canberra. They were placed in a purpose-built aviary next to the Tropical House, following their statutory five week period of quarantine.

WWT had a holding of 31 New Zealand Brown Teal in 1985, having reared just four birds in that year (and still today rears these birds successfully in a joint programme with other breeders in the UK). Information gleaned from captivity is passed to aviculturalists working in New Zealand and, we hope, assists, the captive breeding programmes for the more threatened Campbell Island *Anas aucklandica nesiotis* and Auckland Islands Teal *A. a. aucklandica*. 1985 was the most successful year for Black-headed Duck *Heteronetta atricapilla*; 27 birds were reared at Slimbridge, plus 38 Goosander, most of them hatched at Martin Mere.

In 1986, six Bewick's Swans, ten Caribbean Flamingos, and three Andean Flamingos were produced. The New Zealand Wildlife Service presented WWT with two pairs of captive-bred New Zealand Blue Duck *Hymenolaimus malacrhynchos*. These birds were placed in purpose-built aviaries at Arundel where they remain today. They have bred sporadically over the years, with some 14 birds being reared since then, including a single male duckling in 1996, the first for several years.

Amongst WWT successes in 1987 were 11 Magpie Geese, six Bewick's Swans, five Light-bellied Brent Geese *Branta bernicla hrota* and seven Falkland Island Steamer Ducks. The Steamers soon developed problems when duck virus enteritis occurred, initially at Slimbridge; they proved highly susceptible. Fortunately, it is now possible to vaccinate annually, and we lose very few birds to DVE today.

1988 was the first year for some time that the Andean Flamingos did not lay, and indeed, they have not done so since. The flock spent some time during the late 1980s and early 1990s with the Chilean Flamingos, but in 1995 were moved back to their original site with new facilities and a new house. Hopes remain high that they will lay again; their behaviour is encouraging, despite the fact that the majority of them are over 30 years old.

Arguably WWT's most ambitious avicultural undertaking occurred in 1989. This was the establishment of our entire wildfowl collection at our Llanelli Centre in Wales, from eggs and the occasional downy young. Eggs were moved from Slimbridge, Martin Mere, Arundel, Washington and Peakirk, as well as from some private breeders, and 186 birds were reared, mainly of native species. This followed a strict stocking policy which set out to avoid the spread of any disease

from other collections. 1990 took the project into full swing and, by the end of the year, 750 birds were held at Llanelli prior to its opening in April 1991. Over 600 birds of 81 species were reared there in 1990 including Eyton's Whistling Duck *Dendrocygna eytoni*, Australian Shelduck *Tadorna tadornoides*, Bronze-winged Duck *Anas specularis*, Goosander, White-headed Duck, White-winged Wood Duck, Hawaiian Geese and N.Z. Blue Duck which were moved from Arundel as eggs under a broody Bantam in the Centre Manager's car. The eggs moved from Slimbridge and other Centres to Llanelli travelled in portable, battery-driven incubators, and were hatched and reared in purpose-built facilities at the new site.

1990 also saw the opening to the public of WWT's Castle Espie Centre at Comber in Northern Ireland on the shores of Strangford Loch. This famous collection is run in partnership with its owner, Paddy Mackie, who has been a successful private waterfowl breeder for many years. The site is well known for wintering Light-bellied Brent Geese and for the successful captive breeding of that goose, of Red-breasted Mergansers and other seaducks.

In 1991, 33 Caribbean Flamingos were moved to Llanelli, the only birds not to be reared from eggs (Flamingos are not susceptible to Avian TB, the main disease that we were trying to avoid). They had all been captive-bred at Slimbridge. Captive-bred Flamingos have been established at Washington, and used to "top up" the Chilean and the Greater Flamingo flocks at Martin Mere. They have also been sent to private collections and zoos throughout Europe. In 1991 the Tropical House at Slimbridge was successfully producing young birds other than wildfowl; Fairy Bluebirds *Irena puella* and Turquoise Tanagers *Tetangara mexicana* were reared for the first time in the UK.

The Conservation Assessment Management Plan (CAMP), which highlights those species most threatened, was used to help set all WWT breeding requirements in 1992. The Chilean flock of Flamingos at Washington bred for the first time, in 1992, and Llanelli become virtually self-sufficient, with 855 of the youngsters reared having been bred at the Centre. This was the first year of breeding success by the Freckled Ducks. One of the original two pairs laid and a single bird was reared at Slimbridge, and from a second clutch, four birds were sent to and reared at Llanelli. This coincided with the arrival of five more pairs from Australia; the CSIRO project was closing, and these five pairs settled well in the Vaughan Aviary.

1993 saw the first meeting of the Wildfowl Taxonomic Advisory Group (TAG) sponsored by the Zoological Federation in Britain and chaired by The Wildfowl & Wetlands Trust. It identifies those species held in captivity that appear threatened or endangered in the wild. It then helps to co-ordinate their management between participating collections and promotes best practice in maintaining them well in captivity. A strategy of parent-rearing in Hawaiian Geese was established in order to assist captive-based research that was being carried out at Slimbridge and other Centres.

In the aviary, the Freckled Ducks produced 23 young birds, thanks to the original laying females and the recent arrivals. Four different females produced eggs and three of the clutches were left to be hatched and parent-raised in the aviary. This was one of The Wildfowl & Wetlands Trust's greatest avicultural triumphs, and further Freckled Ducks were reared successfully in 1994 and 1995.

Llanelli had established seaducks particularly well, with Barrow's Goldeneye *Bucephala islandica* and Smew *Mergus albellus* hatching in numbers in 1994. This was also the year that the Laysan Teal *Anas laysanensis* population in the wild dropped to a mere 38 birds which, by coincidence, was also the number of individuals reared at WWT Centres.

In 1995 the WWT wildfowl collection stood at 8,459 birds, with a total of 1,514 youngsters being reared.

Conclusion and postscript

WWT now recognises the limitations that captivity holds for certain breeds, particularly seaduck, and does not

endeavour to maintain all species at all Centres. Indeed, within WWT as a whole, certain wildfowl are not kept at all. We feel that it is important to maintain those birds that are kept in good conditions, and not to breed a surplus of the commoner species. Our achievement in Aviculture in the last 50 years has been to target those species that can give an excellent wetland message, are themselves threatened or endangered in the wild, and that can assist in many research projects. Opportunities for behavioural research, in particular, have been second to none, and WWT is proud that the unique facility of its numerous related captive birds has been used so successfully over half a century by, for instance, Boyd & Fabricius (1965), Johnsgard (1965), Kear (1964,1967,1968), Lack (1974), McKinney (1963) and many others. We feel that our strategy benefits wild populations, and brings people and wildfowl together to mutual benefit.

This article has been compiled using avicultural reports from previous issues of *Wildfowl*. Some written over the years, especially in the early days of WWT, are worth reading in full.

References

Black, J.M. 1992. Guideline for bird recovery programmes: reintroduction and re-stocking. *Bird Conservation International* 1:329-434.

Boyd, H. & Fabricius, E. 1965. Observations on the incidence of following of visual and auditory stimuli in naive Mallard ducklings. *Behaviour* 25:1-15.

Ellis-Joseph, S., Hewston, N. & Green, A. 1992. *Global Waterfowl Conservation Assessment & Management Plan.* Captive Breeding Specialist Group.

French, N.A. & Board, R.G. 1983. Water vapour conductance in wildfowl eggs and incubator humidity. *Wildfowl* 34:144-52.

Howey, P., Board, R.G., Davis, D. & Kear, J. 1984. The microclimate of the nests of waterfowl. *Ibis* 126:16-32.

Hudson, R. 1976. Ruddy Ducks in Britain. *Brit.Birds* 69:132-43

Johnsqard, P. 1965. *Handbook of Waterfowl Behaviour.* Ithaca, Cornell U. Press.

Kear, J. 1964. Colour preference in young anatidae. *Ibis* 106:361-369.

Kear, J. 1967. Experiments with young nidifugous birds on a visual cliff. *Wildfowl* 18:122-124.

Kear, J. 1968. The calls of very young anatidae. *Vogelwelt Beihefte* 1:93-113.

Kear, J. 1970. The adaptive radiation of parental care in waterfowl. In: Crook, J. H. (Ed.). *Social behaviour in birds and mammals.* London, Academic Press. Pp. 257-392.

Kear, J. & Berger, A. 1980. *Hawaiian Goose - an experiment in conservation.* Calton: Poyser.

Kear, J. & Duplaix-Hall, N. (Eds.). 1975. *Flamingos.* Berkhamsted: Poyser.

Lack, D. 1968. *Ecological adaptations for breeding in birds.* London: Methuen.

Lack, D. 1974. *Evolution illustrated by waterfowl.* Oxford University Press.

McKinney, F. 1963. The comfort movement of Anatidae. *Behaviour* 25:120-220.

Matthews, G.V.T. 1973. Some problems facing captive breeding and restoration programmes for waterfowl. *International Zoo Yearbook* 13:8-11.

Matthews, G.V.T. & Evans, M.E. 1974. On the behaviour of the White-headed Duck with especial reference to breeding. *Wildfowl* 25:56-66.

Murton, R.K. & Kear, J. 1978. Photoperiodism in waterfowl: phasing of breeding cycles and zoogeography. *J.Zool., Lond.* 186:243-83.

Ounsted, M.L. 1991. Reintroducing birds: lessons to be learnt for mammals. In: Gipps, J.H.W. (Ed.). Beyond captive breeding. *Symp. Z. SL.* No.62.

Rees, E.C. & Hillgarth, N. 1984. The breeding biology of captive Black-headed Ducks and the behaviour of their young. *Condor* 86:242-250.

Scott, P. 1948. *Key to the wildfowl of the world.* London. Country Life.

Tomlinson, C., Mace, G.M., Black, J.M. & Hewston, N. 1991. Improving the management of a highly inbred species: the case of the White-winged Wood Duck in captivity. *Wildfowl* 42:123-133

A. Richardson, The Wildfowl & Wetlands Trust, Slimbridge, Glos. GL2 7BT, UK