

Hand-rearing Greater flamingos

Phoenicopterus ruber roseus

for translocation from WWT Slimbridge to Auckland Zoo

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Twenty Greater flamingo *Phoenicopterus ruber roseus* eggs, originating from a flock held at the Wildfowl & Wetlands Trust, Slimbridge, UK, were hatched in incubators. The chicks were hand-reared in a pre-export isolation facility before being successfully translocated to Auckland Zoo, New Zealand, at 33–71 days of age. At Auckland Zoo the flamingos were held in a quarantine facility for 30 days prior to being introduced to an enclosure on view to the public.

Key-words: artificial incubation, greater flamingo, hand-rearing, quarantine, translocation

Flamingos are colonial-breeding birds with colourful plumage and an elegant body form. They are not only extremely popular with zoo visitors but also effective species for exhibits with wetland conservation themes (Ounsted, 1989). In 1996 Greater flamingos *Phoenicopterus ruber roseus* were selected as the flagship bird species for a wetland area in the African savannah exhibit at Auckland Zoo, New Zealand. At the time only one Greater flamingo was held in Australasia (Adelaide Zoo, Australia) and a search began for available birds from outside the region.

In 2001 1925 Greater flamingos were maintained in 74 zoos worldwide (ISIS, 2001). At that time the Wildfowl & Wet-

lands Trust (WWT), UK, maintained 230 Greater flamingos at its centres in Slimbridge and Martin Mere (12% of the captive population). These were descended from 44 wild-caught birds imported from East Africa in the 1960s. Since 1970 this population produced 2–30 young in all but 2 years.

In 2001 WWT agreed to provide Auckland Zoo with 20 hand-reared Greater flamingos from the Slimbridge flock (178 birds). New Zealand's Ministry of Agriculture and Forestry carried out a detailed analysis of the disease risks associated with the importation of flamingos from the UK, which resulted in the development of an Import Health Standard (IHS) to document the procedures undertaken during importation.

HEALTH STATUS OF SLIMBRIDGE FLOCK

In order to comply with the IHS, the post-mortem and veterinary records of the Slimbridge flock were examined to confirm that birds had not been exposed to salmonellosis and mycoplasmosis, and to live Newcastle disease vaccine, respectively. On 27 January 2001 cloacal swabs were taken from 26 flamingos known to have produced fertile eggs in 2000, in

order to test for *Salmonella* spp. All screened birds were negative for these bacteria.

THE PRE-EXPORT ISOLATION FACILITY

The eggs were hatched and the chicks hand-reared in a quarantine station that was the designated pre-export isolation facility (PEIF). The PEIF was located 4 km away from the Slimbridge centre in a permanent covered building 14 m × 11 m × 3 m high, surrounded by a 2.5 m-high chain-link fence and supplied with electricity and water. A footbath containing 10% Virkon S disinfectant solution was placed outside the single entry door. All working surfaces, walls, floors and ceilings in the PEIF were smooth and impervious.

A sign was displayed at the entrance to indicate the PEIF status of the building. Throughout the isolation period access was restricted to the operator (M.B.), who had overall responsibility for the maintenance and operation of the PEIF, the assistant to the operator (S.O.) and the veterinary supervisor (N.F.), working on behalf of the UK's veterinary administration to ensure that the IHS protocols were met. The operator and assistant had no contact with other birds for 7 days before or during the pre-export isolation period. Protective clothing and footwear were worn at all times.

EGG-LAYING

On 15 March 2001, 50 nest sites were moulded from clay soil on the nest island of the donor flock by two keepers using buckets and spades. The nest sites were smooth-sided, conical-shaped hillocks measuring *c.* 0.3 m high, 0.7 m diameter at the base and 0.3 m diameter at the top. From 1 April 2001 the nest-building and egg-laying activity of the flock was recorded twice daily, at 1000 and 1400 hours. Eggs were collected daily at 1500 hours and were replaced with resin dummy eggs, which were painted white and each fitted with a 10 cm-long metal

spike to anchor them to the nests. After collection an alphanumeric code was marked on the side of each egg using a soft-lead pencil. The eggs were placed in a basket containing goose-nest down and carried 1.5 km to the Slimbridge centre incubation facility (SCIF).

Eggs were laid on 34 (68%) of the 50 nest sites. The first egg was laid on 4 April and the last on 27 May, 53 days later. A total of 81 eggs was laid by 28 ♀♀. Thirty-four eggs (42%) were laid by 16 of the 26 ♀♀ screened for *Salmonella* spp. Of these, 28 were fertile and 26 were incubated at the SCIF and moved to the PEIF for hatching: two eggs were laid before the PEIF was operational and were foster-parent-hatched. Forty-five eggs were laid by 12 ♀♀ that were not screened for *Salmonella* spp: 15 eggs (33%) were fertile and were incubated at the SCIF until embryos had internally pipped (entered the air space of the egg). Three of these eggs were transferred to the PEIF for hatching because there were concerns that <20 fertile eggs from the screened ♀♀ may hatch. The rest (12 eggs) were returned to the parents or to foster parents for hatching and rearing.

The first egg removed for hand-rearing was laid on 17 April and the last on 27 May, 40 days later. A total of 27 of 29 eggs (93%) hatched successfully in the PEIF with a mean incubation time of 27.8 days (range 26–29 days), and a mean mass loss of 17% by the internal-pipping stage (range 13–22%).

Two eggs from first-laid clutches failed to hatch. Post-mortem examination indicated embryo malpositioning: one embryo had its head between its legs while the other had its head positioned under the left rather than the right wing. One chick from a second-laid clutch was successfully assisted from the egg and hand-reared. This embryo had rotated along the longitudinal axis of the egg so that its head was positioned at the side of the egg and not near the air cell.

INCUBATION

On arrival at the SCIF eggshells were disinfected by 10 minute exposure to ultra-violet light. Egg mass was recorded to the nearest 0.1 g using an electronic balance. Eggs were incubated in Brinsea Poly-hatcher incubators operating at 37.8°C (top of egg) and *c.* 65% relative humidity (RH), and the eggs were automatically turned 180° every 30 minutes. In order to achieve an egg-mass loss of 14.5–17.5% by the expected date of internal pipping (i.e. by day 27 of the 28–29 day incubation period), eggs were moved between three different incubators operating at different RH [avian eggs lose *c.* 16% of their initial mass at an almost linear rate during incubation, almost entirely owing to the diffusive water loss through the eggshell pores (e.g. Rahn & Ar, 1974)]. Egg mass was recorded daily at 1400 hours. If eggs were below or above expected mass they were moved to a drier (*c.* 55% RH) or wetter (*c.* 80% RH) incubator, respectively. Embryonic development was assessed using a Brinsea Superlume egg candler. Eggs were candled at 5, 10, 15, 20 and 25 days. At 26 days eggs were transferred to an incubator operating at 36.5°C (top of egg) and *c.* 65% RH. Eggs were then candled up to seven times a day at *c.* 3 hour intervals between 0700 and 2200 hours. If candling revealed that an embryo had internally pipped, the egg was sprayed with 1% Virkon S solution at 40°C, dried with a paper towel and transferred to a sterile polystyrene box containing polystyrene beads to protect it during transit to the PEIF. On arrival at the PEIF the eggs were transferred to a Brinsea Hatchmaker incubator operating at 37°C (top of egg) and 70% RH. Eggs were placed on a clean cotton towel, which was dampened with distilled water. Egg turning was discontinued.

HOUSING AND DEVELOPMENT

Twenty-seven chicks hatched at the PEIF. Post-hatch and daily before the first feed, body mass was recorded to the nearest 1 g

using an electronic balance. The umbilicus was swabbed with Nolvasan antiseptic. Immediately post-hatch, chicks were placed in a nest bowl inside a Brinsea Hatchmaker incubator operating at 35°C. Nest bowls were 0.15 m-diameter and 0.07 m-deep plastic bowls lined with a cotton towel. At 4–12 hours post-hatch chicks were transferred to brooder boxes, measuring 0.6 m × 0.8 m × 0.4 m high, constructed from concrete and painted with water-resistant white paint. Brooder boxes were maintained at 35°C using red 250 W lamps suspended above each nest bowl. As flamingo chicks eat eggshell post-hatch, the eggshell was moved to the brooder box with the chick. The size of the brooder box could be adjusted using hardboard dividers. The floor of the brooder box was covered with a woven-nylon carpet to provide a non-slip surface to walk on when the chicks left the nest bowl. The carpet was replaced daily. Nest bowls, towel liners, carpets and brooders were scrubbed with 10% Virkon S solution and rinsed with cold water daily. At 3–7 days of age the chicks were pinioned using scissors and the wing tip was used for chromosomal-DNA gender determination.

Brooder temperature was lowered to 30°C and 20°C when chicks were *c.* 7 and 14 days old, respectively. At 11 days two to three chicks were placed together in brooder boxes measuring 0.6 m × 1.2 m × 0.4 m high. Lamps were positioned at one end and a plastic water dish, 0.16 m diameter and 0.03 m deep, at the other. Coloured, flat plastic leg bands were fitted to the tibiotarsus of each bird for identification.

At 14–22 days old chicks were moved to one of three rearing rooms measuring 1.8 m × 2.4 m × 2.1 m high. The rooms had smooth concrete floors and walls, and contained a pool area measuring 0.7 m × 0.7 m × 0.15 m deep lined with rubber pond liner. The floors were covered with woven-nylon carpets which were scrubbed with 10% Virkon S solution and

rinsed with cold water daily. A red 250 W lamp was suspended above the floor area in each room and air temperature was 15–20°C. Rearing rooms were accessed via wire-fronted doors from a central corridor. When rooms were being cleaned, groups of chicks were moved to a 5 m × 1.5 m area in the central corridor. One week prior to export 10.10 chicks had microchip transponders inserted intramuscularly in the caudal part of the superficial pectoral muscle, 10 mm lateral to the carina and 10 mm proximal to the caudal edge of the sternal keel.

The first chick hatched on 17 May and the last on 24 June. Mean mass at hatch was 88.8 g (range 83–105 g). Chicks lost body mass for *c.* 60 hours post-hatch but mass at hatch was usually regained by day 6. The daily rate of mass increase was 10% for chicks aged 5–15 days, stabilizing at 6% at 23 days until chicks were self-feeding at, on average, day 36 (Fig. 1).

To minimize aggressive interactions when first housed together in the same brooder box, chicks were allowed to socialize with others while in their nest bowls before becoming mobile. Mesh screens were used as dividers so that chicks could sit alongside each other without physical contact. When put together at 11 days old, groups comprising three or more individuals showed fewer aggressive interactions than cohorts of two birds.

Five chicks died during hand-rearing (see Health Monitoring) and the sex ratio of the remaining birds, established by DNA analysis, was 11.11, of which 10.10 were translocated to New Zealand. The two birds that remained were translocated to Bristol Zoo Gardens, UK, where hand-rearing continued until the birds were weaned and could join the Greater flamingo flock there.

FEEDING

Chicks were syringe fed 1–2 ml water at *c.* 8 and 12 hours post-hatch. The hand-rearing diet, a modification of the diet

developed by San Antonio Zoo, TX, USA, (Kunemann & Perry, 1990) (Table 1), was prepared daily by mixing ingredients thoroughly in a food blender and then freezing for use within 24 hours. Unused diet was discarded 12 hours post-thawing. Food was heated to *c.* 36.5°C and first offered to chicks at *c.* 18 hours post-hatch. Thereafter chicks received two to six feeds between 0630 and 2200 hours daily. Each chick's crop was externally palpated prior to each feed to ensure that food was moving through the digestive tract. The amount fed and number of feeds given was determined by appetite. Food consumption was recorded daily.

Chicks accepted the diet dribbled into their lower mandible from a 5 ml syringe at a rate determined by their ability to swallow. At age 7 days chicks were tube fed to save time and to minimize spillage and plumage soiling. Tube feeding involved inserting a soft 5 mm-diameter plastic tube 10–30 mm into the oesophagus. The tube was fitted to a syringe containing the food. Feeding equipment was washed in soapy water, disinfected with 10% Virkon S solution and rinsed with clean water after use.

At *c.* 16 days chicks were offered Clark and Butcher Flamingo Breeder pellets. If a chick was observed eating pellets, its next scheduled syringe feed was withheld to encourage self-feeding. Thereafter, these birds were given tube feeds only if their crop felt empty when palpated at a scheduled-feed time. To encourage self-feeding, unweaned chicks were housed with weaned chicks whenever possible.

The quantity of food given increased daily and was determined by appetite (Table 2). Daily food consumption increased from zero to 300 g per day between hatch and day 23. Thereafter food intake fluctuated around 300–500 g daily until the birds were fully weaned. Nineteen of the 20 chicks translocated to New Zealand were weaned successfully (17 weaned at Slimbridge and the remaining two at Auckland Zoo after

translocation). These were weaned at a mean 36 days of age (range 25–49 days, $n=19$). Mean mass at weaning was 853 g (range 461–941 g, $n=8$).

In preparation for travel each bird was tube fed 60 ml of Poly-Aid and Guardian Angel (Birdcare Company, Nailsworth, UK) solution 24 hours and again 12 hours prior to being put into the crates. A final 60 ml of these nutritional supplements was given immediately before the transport crates were sealed.

HEALTH MONITORING

During the hand-rearing process the chicks were observed closely in order to detect any leg-bone growth abnormalities. When the youngest chick was 30 days old, choanal and cloacal swabs were used to test the birds for avian influenza A viruses, paramyxoviruses and *Salmonella* spp, and all tests came back negative. Chicks that died were subject to full post-mortem examination and samples were submitted to The Veterinary Laboratories Agency, Weybridge, UK, for virus isolation.

Of the 27 eggs that hatched, five chicks died during rearing. One chick died aged 5 days as result of yolk-sac rupture and another at 9 days old as result of peritonitis caused by penetration of the small intestine wall by ingested eggshell. Three chicks died aged 4, 8 and 9 days as a result of clostridial enteritis. These deaths occurred on the same day and dietary krill was believed to be the source of infection. Following diagnosis, antibiotic was administered to nine chicks <15 days of age (clavulanate-potentiated amoxicillin at 100 mg/kg bird) for 3 days. The krill component of the diet was replaced by shrimp and no further deaths occurred.

Five chicks showed early mild signs of 'bent-leg syndrome' (a lateral deviation of the tarsometatarsus) when aged 4–14 days. In all cases the legs were loosely bound together with micropore tape and the leg straightened within 24–36 hours. Three chicks showed signs of

curled-toe syndrome at 3–10 days of age. The condition was corrected within 36 hours by attaching a cardboard template under the affected foot area using small strips of medical tape. Strips of tape were also applied over the webs between the toes to keep them apart. Two chicks showed bent bills from hatch. These corrected naturally within 6–10 days. Two chicks exhibited stereotypical behaviour and would push their heads into the corners of brooder boxes. This behaviour was corrected by temporarily rounding the corners of brooder boxes with curved cardboard.

TRANSLOCATION

In February 2001 five transport crates made from untreated 12 mm plywood and 10 mm × 10 mm galvanized weldmesh were constructed at Auckland Zoo, disassembled and shipped to Slimbridge. Assembled each crate measured 1.18 m × 0.88 m × 1.11 m high and comprised four compartments measuring c. 0.44 m × 0.42 m × 1.11 m high. The interior of each compartment was lined with hessian. The bases were lined with heavy-duty polythene, which was placed up the walls to a height of 0.15 m to prevent fluids leaking during transit, as required by the International Air Transport Association regulations (IATA, 1986). The floor of each compartment was covered with a woven-nylon mat. Almost half of the wall-panel area was weldmesh to allow air to flow through the compartments. Each compartment had an access door measuring 0.3 m × 0.15 m positioned 0.22 m from the top of the crate to allow hand-feeding.

Translocation began on 27 July 2001 when the 20 chicks were aged an average 55 days (range 33–71 days). Prior to departure, the crates and internal surfaces of two transport vehicles were disinfected with 10% Virkon S solution. Before being placed in a crate compartment, the veterinarian (N.F.) physically examined the birds for signs of infectious disease. Once

four birds had been placed in each crate, it was sealed using uniquely marked UK government seals. The crates were driven 590 km to Prestwick Airport, Scotland, where the veterinary inspector at the Airport checked the integrity of the seals prior to the export.

Examination of the birds at Prestwick Airport revealed that four had superficial wounds on the dorsal surface of their upper mandibles caused by rubbing against the hessian lining of the crate. To protect beaks against further abrasion, one to three layers of surgical tape were positioned along the length of the mandible of all birds. Tape was replaced three times during the journey.

On the aircraft the crates were positioned 0.15 m apart on two 2 m × 3 m pallets. Three times during the journey the flamingos were tube fed pre-mixed food, which was carried in a refrigerated container. Each bird was given Guardian Angel once every 24 hours and Poly-Aid at *c.* 8 hour intervals during the 51 hour-long journey. The temperature on the aircraft was 18–20°C.

QUARANTINE IN NEW ZEALAND

On arrival in New Zealand the chicks were transferred to a quarantine facility where they remained for a 30 day isolation period, during which they were screened for influenza A viruses, paramyxoviruses and *Salmonella* spp. The flamingos were held in three interconnected units, each measuring 5 m × 2.1 m × 1 m high. Each unit had a concrete floor and painted plywood walls. During the day two units were opened out into one and the 16 oldest chicks were given access to this area. However, at night the space was again divided into two, each housing eight birds. The four youngest chicks were confined to a single unit, which was reduced to an area of 2.1 m × 2 m at night. The units were maintained at an ambient temperature of 12–20°C. Each unit was fitted with a blow heater on the front wall. Temperature at the back of each unit was

cool owing to the position of the air-filtration system and a heat lamp was suspended over these areas.

For the first 2 weeks the floors were covered with thin, 3 mm-thick porous rubber matting to provide a non-slip surface. The matting was cleaned with 1% Virkon S solution daily. Two weeks after arrival, the floors were covered with synthetic-grass mats, which provided a softer non-slip surface. The grass mats were disinfected daily using 2% Trigen II solution. All chicks were handled daily after 2 weeks to administer protective treatment against bumblefoot (also known as pododermatitis, a common inflammatory and frequently infected foot lesion that causes lameness and will occasionally lead to death), including foot washing in water followed by dipping in Betadine antiseptic solution and application of Fusidic acid and betamethasone wound-healing gel (Fuciderm, LEO Laboratories, Denmark), Meloxicam oral drops (at 0.1 mg/kg; Metacam, Boehringer Ingelheim, New Zealand) to control pain and inflammation, clavulenate potentiated amoxicillin antibiotic injections (at 125 mg/kg twice a day; Clavamox, Pfizer, New Zealand) and itraconazole antifungal therapy (at 10 mg/kg twice a day for 5–7 days; Sporonox, Janssen, New Zealand).

All chicks had access to a water dish measuring 0.45 m × 0.6 m × 0.05 m deep and 3 kg of soaked Mazuri flamingo pellet in dishes measuring 0.6 m diameter and 0.05 m deep. Food was replaced three times daily for the first 2 weeks and twice daily thereafter. Younger chicks were given a mixture of whole and powdered pellet. Dry food was offered 3 weeks post arrival. Food dishes were cleaned between feeds and water dishes were cleaned once a day.

Two ♂ chicks died while in quarantine: one at 45 days old following aspiration of food during tube feeding and the other at 75 days old as the result of an *Aspergillus* sp infection.

DISCUSSION

The New Zealand Import Health Standard was designed to maintain biosecurity and it required flamingo chicks to be free from diseases, including salmonellosis. Although the Slimbridge donor flock had not been exposed to a disease outbreak caused by *Salmonella* spp in the previous 12 months, there was a possibility that some birds could carry the causative bacteria. As a precaution against the possible transmission of infection from carrier birds to chicks, all 26 Greater flamingos that had laid eggs in 2000 were screened for *Salmonella* spp. Sixteen of these ♀♀ went on to lay eggs but chicks from only ten of the ♀♀ were eventually translocated to New Zealand. The intention was to exclude eggs laid by infected birds. However, this screening, which was not stipulated by the IHS, restricted the total number of founder ♀♀ contributing to the group to be exported. Twelve unscreened ♀♀ also laid eggs and, to ensure that 20 chicks could be hand-reared for translocation to New Zealand, three of these eggs were taken to the PEIF for hatching. With hindsight, all ♀♀ should have been screened for *Salmonella* spp so that more could have become founders for the New Zealand cohort. Catching and handling the flock for screening 2 months before the onset of egg-laying did not affect overall egg-laying activity.

As parent-incubated flamingo eggs often become encrusted with mud shortly after oviposition and as the IHS required eggs from the donor flock to be disinfected, eggs were collected for artificial incubation shortly after they were laid and before they became soiled. Consequently no embryos were lost as a result of infection caused by eggshell contamination. By replacing fresh eggs with dummy eggs the incidence of egg loss resulting from breakage on the nest was also reduced. Around 25% of parent-incubated Greater flamingo eggs are lost at Slimbridge as a result of birds quarrelling over nest sites that had previously been occupied (Pick-

ering, 1992). In 2001 only two eggs (2.5% of the total laid) were lost. Removal of dummy eggs after 1–14 days incubation induced 81% of ♀♀ to re-lay. Two pairs laid three fertile eggs and one pair, aged at least 40 years, laid five fertile eggs, all of which were hatched and reared (three were hand-reared and two were reared by foster parents). Thus the repeated removal of eggs to induce re-laying is an effective technique to increase hatch rate.

The IHS stipulated that birds must be fitted with electronic transponders prior to the translocation. Although there are recommendations that transponders should be placed dorsally at the juncture of the neck and the body on the left side of a bird (CBSG, 1991), there has been 'migration' and failure of transponders implanted at this site in flamingos at Slimbridge. Transponders were therefore placed in the pectoral muscle, a site from which migration had not been recorded previously. All transponders were located successfully upon arrival in New Zealand.

When introduced to other chicks at *c.* 11 days old, larger chicks were observed pecking and stamping at smaller ones. This aggressive behaviour was seen less frequently in birds that had visual contact with conspecifics at <5 days of age, while still in the nest bowl. Leg and foot problems were all remedied successfully by treating deviations immediately.

The crates provided a safe environment in which to transport the Greater flamingos. However, a softer material covering the internal surfaces may have prevented some birds suffering slight damage to the dorsal surface of their upper mandibles. The operator was able to visit the flamingos to deliver food and water at *c.* 8 hour intervals during the 51 hour-long journey. The access doors to each crate could have been a bit larger to allow the operator to feed smaller birds more easily. However, the overall success of the translocation is probably the result of the operator being afforded regular access to the birds.

In New Zealand the Greater flamingos were quarantined in units with concrete floors, covered initially with 3 mm-thick rubber matting. After 2 weeks all birds showed early signs of bumblefoot so the rubber mats were replaced with artificial-grass mats. The birds were treated with antibiotic and antifungal drugs to control infection and heat lamps were used to increase the air temperature in the units (higher temperatures promote tissue repair in the bumblefoot lesions of other bird species; M. Batty, pers. obs). Two birds died in New Zealand: one after inhaling food during tube feeding, highlighting the importance of a skilled-operator technique when delivering food this way. The other flamingo died of acute *Aspergillosis* spp infection.

On 1 September 2001, 101 days after the first chick had hatched at Slimbridge, 18 (8.10, ♂.♀) fledged Greater flamingos were transferred from quarantine to Pridelands, Auckland Zoo's African savannah exhibit. It is hoped that these birds will become the founders of a self-sustaining Greater flamingo population in the Australasian region.

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PRODUCTS MENTIONED IN THE TEXT

Betadine: broad-spectrum topical antiseptic, manufactured by the Purdue Frederick Company, Norwalk, CT, USA.

Brinsea Superlume, Brinsea Hatchmaker, Brinsea Polyhatcher: incubation equipment, manufactured by Brinsea Products Ltd, Station Road, Sandford, Somerset BS25 5RA, UK.

Clark and Butcher Flamingo Breeder Pellet: flamingo diet, manufactured by Clark and Butcher Ltd, Fenland Waterfowl Feeds, Soham, Ely, Cambridgeshire CB7 5HY, UK.

Clavamox: clavulanate and amoxicillin broad-spectrum antibiotic injection, manufactured by Pfizer Animal Health (NZ), Level 3, Pfizer House, Normanby Road, Mt Eden, Auckland, New Zealand.

Fuciderm: for the topical treatment of dermatitis, manufactured by LEO Animal Health A/S, Mekuvej 9, 7171 Uldum, Denmark.

Guardian Angel: nutritional supplement for sick or stressed birds providing immune-system support, manufactured by the Birdcare Company, 21-22 Spring Mill Industrial Estate, Avening Road, Nailsworth, Gloucestershire GL6 0BS, UK.

Heinz Organic Oat Porridge: human baby cereal, manufactured by H. J. Heinz Company Ltd, South Building, Hayes Park, Hayes, Middlesex UB4 8AL, UK.

Mazuri Flamingo Complete: flamingo diet, manufactured by PMI Nutrition International, PO Box 66812, St Louis, MO 63166-6812, USA.

Metacam: for alleviation of pain and inflammation associated with acute or chronic musculo-skeletal disorders, manufactured by Boehringer Ingelheim (N.Z.) Limited, Ormiston Road, East Tamaki, Manukau City, Auckland, New Zealand.

Nolvasan: disinfectant, manufactured by Fort Dodge Animal Health, Fort Dodge, IA 50501, USA.

Nutrobal: calcium and D₃ supplement, manufactured by Vetark Professional, PO Box 60, Winchester SO23 9XN, UK.

Poly-Aid: nutritional supplement to prevent catabolism, manufactured by the Birdcare Company, 21-22 Spring Mill Industrial Estate, Avening Road, Nailsworth, Gloucestershire GL6 0BS, UK.

Sporanox: antifungal capsules (100 mg itraconazole), manufactured by Janssen-Cilag Pty Ltd, Melrose Street, Newmarket, Auckland, New Zealand.

Trigene II: disinfectant, manufactured by MediChem International Ltd, PO Box 237, Sevenoaks, Kent TN15 0ZJ, UK.

Vionate: vitamin/mineral supplement, manufactured by Gimborn, Inc., 4280 Northeast Expressway, Atlanta, GA, USA.

Virkon S: disinfectant, manufactured by Antec International, Chilton Industrial Estate, Sudbury, Suffolk CO10 2XD, UK.

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INGREDIENTS	AGE	
	1–30 days	> 30 days
Krill (or shrimp)	75 g	75 g
Herring (heads, tails, fins removed)	75 g	75 g
Hard-boiled egg yolk	75 g	75 g
Heinz Organic Oat Porridge	80 g in 400 ml water	80 g in 400 ml water
Nutrobal	2.5 g	2.5 g
Calcium carbonate	1.25 g	1.25 g
Vionate	5 g	5 g
Vitamin B ₁ (Thiamine)	125 mg	125 mg
Vitamin E (oil from capsule only)	100 IU	100 IU
Water	800 ml	500 ml
Clark and Butcher Flamingo Breeder Pellet		40 g (soaked)

Table 1. Ingredients of blended diet fed to Greater flamingo *Phoenicopterus ruber roseus* chicks during hand-rearing at a pre-export isolation facility.

AGE (days)	NO. FEEDS	AMOUNT PER FEED (ml)	AMOUNT PER DAY (ml)
1	0	0	0
2	5	4.0	20.0
3	6	6.1	36.6
4	6	8.2	49.2
5	6	10.8	64.8
6	6	12.1	72.6
7	6	15.0	90.0
8	6	18.3	109.8
9	6	21.2	127.2
10	6	23.5	141.0
11	6	26.3	157.8
12	6	29.3	175.8
13	6	32.2	193.2
14	6	35.5	213.0
15	5	38.7	193.5
16	5	41.6	208.0
17	5	44.3	221.5
18	5	46.3	231.5
19	5	49.4	247.0
20	5	52.2	261.0
21	5	54.3	271.5
22	5	57.4	287.0
23	5	60.2	301.0
24	5	63.0	315.0
25	5	65.3	326.5
26	4	66.8	267.2
27	4	68.4	273.6
28	4	70.0	280.0
29	4	86.0	344.0
30	4	90.5	362.0
31	4	92.2	368.8
32	4	95.0	380.0
33	4	97.0	388.0
34	4	103.0	412.0
35	4	105.0	420.0
36	4	105.0	420.0

Table 2. Average quantities of food given to 20 hand-reared Greater flamingo chicks aged 0–35 days (i.e. day before average age of weaning).