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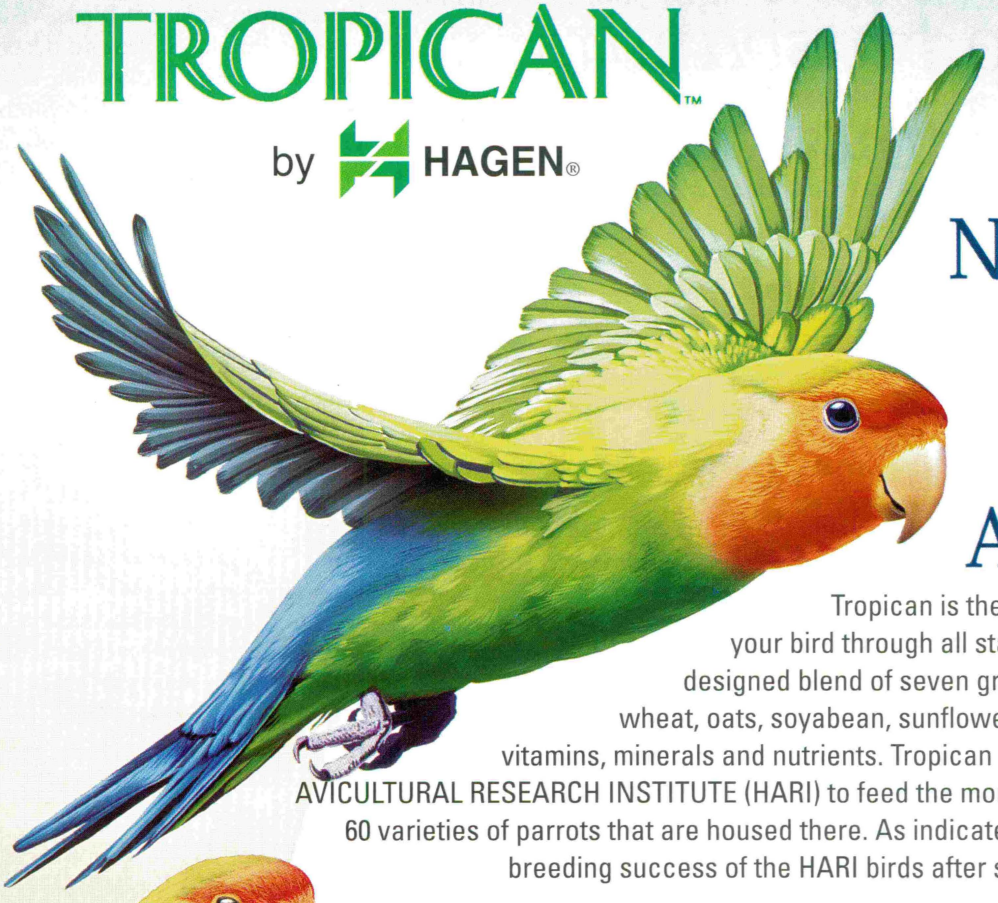

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Turaco Husbandry at the Houston Zoo

by Rochell Plasse
and William "Trey" Todd
Houston, Texas

[Editor's Note: The American Ornithologists' Union's Check-list of North American Birds *and* Distribution and Taxonomy of Birds of the World *by Charles G. Sibley and Burt L. Monroe, Jr. are both valid sources for the names of birds. The AFA prefers Sibley and Monroe but will always respect an author's personal preference. In this article, Plasse and Todd followed Sibley and Monroe using "Turaco." In his article, Milne used "Touraco" as found in the AOU's check-list.]*

The endemic African family Musophagidae (or order Musophagiformes) comprises the turacos, plantain-eaters and go-away birds, a homogeneous assemblage of some 20 species (with numerous distinct subspecies) traditionally accepted as related to the cuckoos (Cuculiformes). Separation of the three somewhat arbitrary categories is primarily by plumage color: turacos - green (genus *Tauraco*), plantain-eaters - blue (*Musophaga*, *Corythaeola*) and go-away birds - gray (*Corythaixoides*; *Criniferoides*, *Crinifer*). These common names are often, however, used interchangeably in ornithogical/avicultural literature. In this paper the name "turaco" will be used, unless otherwise noted, as a convenient collective for the entire family.

For nearly 20 years Houston Zoological Gardens has maintained a successful captive-breeding program for turacos: over 400 specimens of 14 forms (species and/or subspecies) have been raised. In 1981 the American Association of Zoological Parks and Aquaria awarded the zoo its significant achievement award for its turaco breeding program. In subsequent years we have increased our expertise and initiated several research endeavors. This paper presents a brief overview of management practices proven successful at the Houston Zoo, given our climate, facilities and staff; we do not intend them to be the last word in keeping these birds.

Housing

The oldest (1930s) breeding cages at Houston Zoo feature a wire-covered exhibit area, a roofed wooden shelter, and measure 7 ft x 15 ft with a height of 10 ft in the shelter and 7 ft in the outside enclosure. Newer cages (off-exhibit) consist of pre-fabricate weld wire or chain-link panels with an attached partial roof of corrugated fiberglass and shadecloth. These units measure 6 ft x 20 ft x 8 ft high. Dim night-time illumination is provided where possible to discourage rodent or predator disturbance. Infrared heat lamps are provided in shelters during winter. Off-exhibit cages are covered with fiber-reinforced polyethylene during winter and forced-air heat maintains temperatures above freezing. Birds may be housed side by side, but some visual or physical barriers may be necessary to discourage fighting through the wire.

Substrate is "filter sand," which is gravel approximately .5 to 2 mm in size, allowing rapid drainage and ease of cleaning by raking and sifting. Aviaries are planted as thickly as practical, given the need for public display and/or service. Vegetation provides shade and seclusion and offers escape opportunity should one of the birds attack another (a frequent occurrence with captive turacos; see Behavior). Juvenile birds are often housed for convenience off-exhibit in less stimulating, plant free, concrete-floored cages.

Turacos are arboreal nesters, but construct flimsy dove-like nests and are best provided with artifical platforms. Wooden produce flats filled with hay were originally used but were replaced by sturdier-built boxes lined with wire mesh to prevent rolling of eggs or leg problems in chicks if hay was displaced. The boxes are secured to the cage or shelter wall 7 to 8 ft above ground. Wicker baskets have occasionally been used and might be more acceptable to newly imported specimens. Some birds may carry token nesting material, but most soon accept artificial arrangements. To encourage shy pairs and to reduce disturbance from adjacent birds, visual barriers may be placed around nests situated high in aviaries. Following several successful nestings, nests can often be lowered to more accessible levels and barriers removed.

Turacos cool themselves by gular fluttering and are heat-tolerant if not unduly stressed: Houston summer temperatures often exceed 95°F with high relative humidity. During hot weather, keepers attempt to complete most cage maintenance by 10:00 a.m. In dry periods soaker hoses over cages provide some cooling.

Winter temperatures in Houston only occasionally plunge below freezing and rarely remain there longer than 24 hours. Provided with heat and shelter, turacos remain active and reasonably tolerant of these extremes. During an unusually severe cold snap (100 hours subfreezing) only one turaco in the zoo's collection suffered a frost-bitten toe.

Diet

Wild turacos are generally classed as frugivores and may be conveniently divided into two groups: the go-away birds and gray plantain-eaters, and the green turacos and blue plantain-eaters. The former inhabit more arid "acaia" and "savannah scrub" areas and have been reported eating the leaves, flowers, seed pods and buds of acacia, aloes and similar plants as well as termites.

Those species living in wetter areas, such as "gallery, lowland and mountain forests," eat fruits, leaves, some insects and occasionally algae or moss. Fruits such as Musanga (fig-like), oil palm, wild dates and podocarpus are reportedly consumed.

The complete diets (so far as known) of wild turacos have not been nutritionally analysed, and captive diets are therefore based to a large degree on trial and error. Often diets are chosen because they are easier to prepare, not because they are nutritionally correct. At Houston they have traditionally consisted of a protein source (e.g., cat chow, dog chow), a variety of fruits and vegetables, and greens (see Appendix). Recently these diets have been evaluated by an independent source and may be changed somewhat in the future to improve nutritional value and feeding efficiency. Those listed have, however, proven adequate for Houston's collection for

many years.

At first glance, protein levels of 35% (cat chow) and 22% (dog chow) may appear unnecessarily high, but soaking the chows first and adding mixed fruit and chopped greens reduces the protein level to 14.5%. There is some indication that higher protein levels may increase aggression among birds (and aggression between pairs is the main problem in captive maintenance of turacos), but proof of this theory awaits controlled experiements.

Although the sample size is small, it appears that the gray turacos benefit from a lower protein diet with an increased amount of leafy greenery (e.g., split heads of Romaine lettuce, steamed broccoli).

Behavior in Captivity

Turacos are active, vocal birds adapted to running along perches and moving between perches by conspicuous flapping flights and glides. They are territorial and advertise territorial ownership by crowing calls. Adjacent pairs often provide mutual stimulation to call, and in captivity bouts of calling may be induced by extraordinary stimuli (e.g., ambulance sirens). Threat displays involving calls, ruffled plumage, raised crests and spread wings are also typical of rival birds in visual contact.

Establishment of compatible pairs is, regrettably, no guarantee against aggression. The greatest single cause of death among turacos at Houston Zoo is violent aggression by a cage-mate, often by a long-term partner, most often (but not always) by the male. Keepers must remain alert for the first signs of impending discord, a growling call given by the dominant bird, the submissive bird low in the cage, displaced from a perch, pursued, hiding. Capture and a wing-clip may discourage the aggressor, but if not, death is inevitable if the aggressor is not removed. In most cases the bird may be reintroduced within days or weeks, but with some individuals re-pairing is the only solution. Substantial planting of aviaries offers cover to harried birds and may thus buy time to effect a rescue.

Nest-helping behavior has been reported in some species, at least in captivity. Juvenile Violaceous *Musophage violacea* and Grey *Corythaizoides concolor* remain within a territory and assist their parents with succeeding clutches. In general, it is safer to remove young birds when they are self-feeding as they are likely to suffer attack by renesting parents. Juveniles may be housed in groups until the onset of sexual maturity (approximately 1½ years old), although their social interaction should be monitored.

Turacos may be housed with other species of dissimilar birds (e.g., pheasants, curassows and smaller birds as well), but may occasionally attack cage-mates when breeding or interfere with nest platforms intended for other species.

Captive Reproduction

Only one species of Turaco is sexually dichromatic - the White-bellied Go-away Bird *Criniferoides leucogaster* (males have black beaks, females a gray-green). All others should be sexed by laparoscope or karyotype analysis. Once gender is determined, birds should be housed in adjacent cages for some days prior to a direct introduction. Any introduction should be closely monitored for compatibility. Courtship feeding or carrying nest material are excellent indicators. Low-level threats may initially accompany an introduction, but if they do not intensify or give way to ceaseless chasing, birds may safely remain together providing they are frequently checked. Although the sample size is small, at Houston Zoo introductions of the gray species have been peaceful compared to those of green and blue species.

Turacos are sexually mature in their second or third year (although some hens may lay eggs as early as 11 months) and may enjoy a long reproductive life. The oldest breeding specimen at Houston (a female Lady Ross' *Musophaga rossae*) was wild-caught over 24 years ago.

As mentioned above, turacos build flimsy nests which are best supplemented or replaced in captivity. Both sexes build and share incubation. The green and blue species lay two (very rarely three) off-white spherical eggs; the gray species often lay three pale blue-tinged eggs per clutch. Incubation usually begins with the first egg which therefore hatches a day or more before the next. The incubation period for green turacos is 20-23 days; for blue, 24-26; and for gray, 26-28. Time from initial pip to complete hatch may be as long as 48 hours. The eggshell and chicks' droppings are usually consumed by the parents.

Chicks hatch covered in thick black or gray down (White-bellied Go-away Birds have a light spot on the head and light bellies) and their eyes open soon after hatching. Many species have vestigial wing claws on the alula which disappear as chicks develop. Chicks gape readily and are fed by both parents by regurgitation. Chicks of one species resemble those of another closely enough that cross-fostering may be used to increase production of a rare species by use of another prolific species. We initially attempted to synchronize incubation periods closely, but soon discovered that pairs incubating for as short as a week would accept a hatching egg or even a dry chick with an empty eggshell. If the latter was eaten, we could feel secure that the chick was being cared for. In some cases, even those pairs which routinely broke eggs would accept and raise a chick if they could be kept incubating dummy eggs. Although cross-fostering is used as a management tool in raising other species of birds, it is unique in the softbill world.

The nest fidelity of turacos has allowed us over time to increase our interference in (and knowledge of) the incubation and rearing cycles: eggs and chicks are routinely weighed throughout the nesting period. In addition to establishing parameters of parent-raised eggs and chicks to compare with those artificially raised, frequent handling of chicks results in early detection of behavioral, developmental or medical problems.

At approximately two weeks old, chicks begin to clamber on branches adjacent to the nest (if present), and care should be taken to provide limbs from ground to nest along which fallen chicks may easily climb.

Handrearing, when necessary, is relatively straightforward if no medical problems develop (see Appendix).

Veterinary Care

When handling turacos, care should be taken to restrain birds securely as they, like doves, tend to shed feathers easily, including flight and tail. The handler may be left with only a handful of feathers while the de-plumed bird escapes. Most specimens also have very sharp claws which may slash hands trying to restrain them. Turacos which

Photo by Linda Weitzman

Guinea Turaco

have recently eaten may regurgitate when captured or restrained, increasing the danger of aspiration during medical procedures involving anesthesia.

In Houston Zoo's collection, turacos as a group have proven hardy; few significant medical problems have occurred. Other collections have reported high incidence of avian tuberculosis (only a newly imported group of Fischer's Turacos was euthanized for this disease in Houston). Salmonellosis has occasionally been diagnosed, and birds in other collections have succumbed to aspergillosis. Handraised birds may contract candidiasis.

Endoparasites found in Houston's collection include ascarids and dispharynx. (Dispharynx is difficult to diagnose with routine fecal analysis; its symptoms include weight loss with increased appetite, anemia/pale mucosa and hypothermia.) Ivermectin is an effective treatment. Coccidia has also been a recurrent finding, though rarely one that merits treatment.

As implied above, the greatest single cause of turaco deaths at Houston Zoo

Photo by Rae V. Anderson

White-bellied (or White-breasted) Turaco, also referred to as the White- bellied Go-away Bird.

Photo by Dale R. Thompson and George D. Dodge

Lady Ross's Turaco

Photo by Dale R. Thompson and George D. Dodge

White-cheeked Turaco

has been trauma caused by cage-mate aggression. The danger of this can not be over-stressed.

Turacos at Houston have extended breeding seasons, and many pairs raise chicks in succession throughout the year. Depletion of calcium reserves in egg-laying hens is a potential problem, and soft-shelled eggs or egg-binding occasionally occurs. Calcium/phosphorous supplement in the correct proportion usually corrects this problem. If necessary, pairs may also be separated to inhibit laying.

Other collections have reported turacos afflicted with iron-storage disease, but fortunately this has never been a problem in Houston's birds.

Splayed legs in nestlings may indicate a calcium deficiency, but more likely this is a result from inadqeuate nest substrate. A thick layer of hay is used routinely in nests; young chicks can easily grip the straws, and few problems with their legs are seen so long as they are prevented from sliding along a smooth floor. Lining nest platforms with hardware cloth prevents this from occurring. Handraised chicks are best kept closely confined in a cup or bowl on a substrate of twigs which

Photo by Linda Weitzman

Red-crested Turaco

Photo by Dale R. Thompson and George D. Dodge

White-cheeked Turaco chick

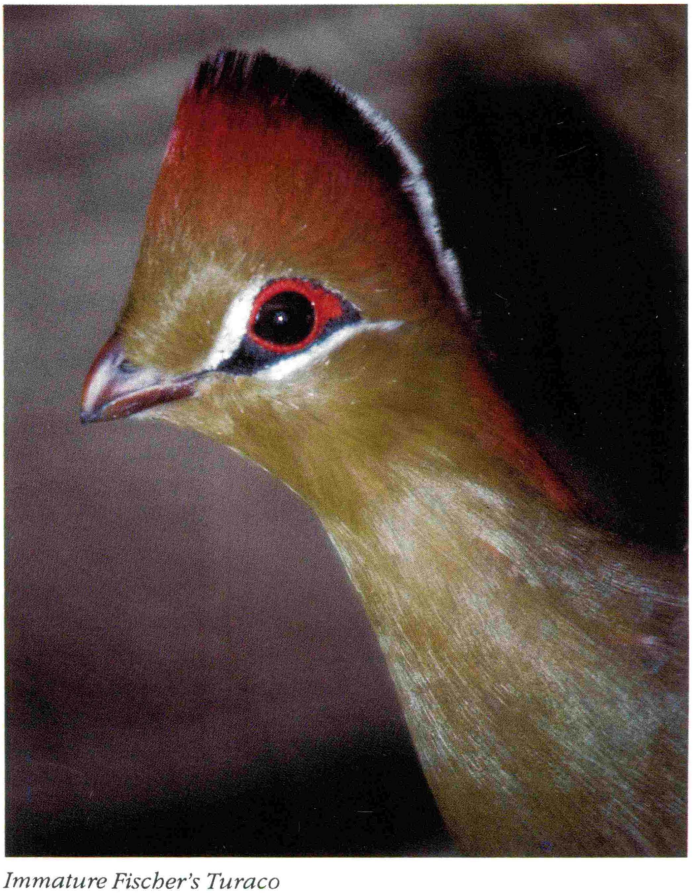

Photo by Dale R. Thompson and George D. Dodge

Immature Fischer's Turaco

can not slide or on an articificial fiber mat (e.g., Enkamat) which can be easily gripped.

Through our active "hands-on" involvement and by the large numbers of species kept, our veterinary staff has been able to establish a standard for blood values for turacos. This valuable data is being used in zoos and clinics throughout the U.S.

Availability

The past five years have seen importation of several uncommonly kept species of Turacos: Fischer's, *T. livingstonii*, Grey Plantain-eater, *Crinifer*, White-bellied Go-away Bird and Bare-faced Go-away Bird, *Coythaisoides personata*. The latter three species fared poorly during quarantine and subsequent shipping, and importers may be reluctant to obtain more *[Ed: Importation of CITES species banned in 1992]*. Fischer's and Livingstone's are being bred in small numbers, but we are aware of no other breeders than Houston of Violet-crested (where, for lack of specimens, two subspecies have been hybridized). Regrettably, no birds were imported to supply the severe need of new genetic material for White-crested, *T. leucolophus*, Hartlaub's, *T. hartlaubi*, Lady Ross' or Grey Go-away Bird, *Corythaixoides concolor*.

The lack of founder stock and the overall poor breeding success in the U.S. which was reported four years ago (Plasse, 1989) has not changed except for the following:

- Through the coooperation of two private individuals and two zoos, the situation for Lady Ross' has improved; more offspring are being produced, including some from a pair unrelated to other U.S. stock. Unfortunately, these successes have been offset by the deaths of several unrepresented founders.
- Houston Zoo has gathered all single adult White-bellied Go-away Birds to assemble four new pairs; only one pair (the original breeding pair), however, continues to reproduce.
- Several aviculturists have started turaco collections of more than two or three pairs, and are having some successes.
- The International Turaco Society has been formed in Great Britain.
- The status of turacos in the wild is perhaps becoming more serious:

Bannerman's *T. Bannermani* and Ruspoli's *T. ruspoli* are endangered and rare, respectively (Collar and Stuart).

Knysna *T. persa corythaix* and Violet-crested are listed on CITES Appendix II.

Great Blue, Yellow-billed *T. macrorhynchus*, Violaceous *M. violacea* and Western Grey *Crinifer piscator* are listed by Ghana on CITES Appendix III.

While the wild status of a number of species, particularly those with restricted ranges (e.g., Fischer's Angolan Red-crested *T. erythrolophus*) is uncertain, their status in captivity is known. With the overall decrease in bird imports and the resulting lack of new genetic material for those species presently in captivity, there is a pressing need for responsible aviculturists (both public and private) to cooperate in captive management programs, especially in the areas of record-keeping and specimen exchange. Stud-books are planned in the near future for some species and to petition for an American Zoo and Aquarium Association Taxon Advisory Group (TAG). The International Turaco Society is anxious to cooperate with U.S. breeders to exchange specimens. Both U.S. and European captive populations suffer from inbreeding, but populations are unrelated to each other and offer opportunity for enhanced viability.

It has been proven that turacos (at least most species) thrive in captivity. Given their attractiveness, the relative ease of their maintenance, and the numbers in captivity, it would be irresponsible if aviculturists fail to establish self-sustaining captive populations.

Acknowledgement

The continuing success of the Houston Zoo's turaco breeding program would not be possible without a dedicated and experienced keeper staff. The emphasis on turacos was begun by former curator Robert J. Berry and has been sustained by the attention of staff veterinarians Joseph Flanagan and Mark Peckham.

Introductory Bibliography of Turacos, Go-away Birds and Plantain-eaters

The following list is by no means complete. There is, regrettably, no modern monograph on the Musophagidae. The most thorough family treatments are in Fry, et al, and Moreau (1958), and these articles contain extensive bibliographies. *The Avicultural Magazine*, now nearing its centernary, contains numerous articles in addition to those listed below on their captive management.

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Houston Zoological Gardens Handraising Diet - Turacos: *Musophaga* and *Tauraco*

Diet #1

Ingredients:

2 parts Purina Cat Chow ..... 70 g
0.5 parts greens mix (chopped – endive, kale 1:1)..... 17.5 g
1 part applesauce ..... 35 g
1 part papaya (optional – similar fruit may be substituted), H_2O for blending ..... 35 g

Method:

Grind Cat Chow into dry crumbles. (May be jarred and stored in large amounts). Blend fruits, greens and dry Cat Chow with about 100 g of water to produce mixture with texture of toothpaste. Warm mixture before feeding.

Diet #2

Ingredients:

2 parts Zupreem Monkey Biscuit (approx. 13 biscuits) ..... 70 g
1 part chopped greens (endive, kale 1:1) ..... 35 g
1 part applesauce (unsweetened) ..... 35 g
1 part papaya (optional – similar fruit may be substituted), H_2O for blending ..... 35 g

Method:

Soak biscuits in enough water to cover them. Blend biscuits and other ingredients with about 50 g of water – enough to move blender blades and produce mixture a little looser than toothpaste. Warm mixture before feeding.

1. If artificially incubated, wait 24 hours before initial feed.
2. Day 1 - 6 approx. – feed blended mixtures only
3. Day 6 - 12 – in addition to blends, begin feeding small pieces of fruits and soaked chows with forceps. Decrease use of blended food so that by days 10 - 12 the bird is eating solid food exclusively. Chicks will begin picking up food by themselves by 3 to 4 weeks. Remember to add small bowl of water as chicks will begin drinking.
4. Brooder temperatures: start at approximately 95°F but adjust according to chick's response – panting if too warm, lethargic if too cold. Gradually decrease in relation to chick's growth to comfort levels – 85°F.
5. Turaco chicks gape when hungry and generally cease when full. The crop appears on the right side of the neck. Avoid completely filling the crop of small chicks as there is some danger of regurgitation and aspiration as neck is retracted. Chicks may also hold food in their mouths.
6. Turaco chicks easily develop splayed legs on moveable or ungraspable substrate. If this begins to occur, confine the chick closely (e.g., in a coffee cup with twigs).
7. Chicks often defecate while being handled (e.g., weighed before feeding). Failure to gape may indicate discomfort due to the need to defecate. Initially, young chicks may need additional stimulation (e.g., a moistened cotton swab) to induce defecation. Feces should be well formed and slightly encapsulated in mucous.

Fruit Mix Proportions:

1/4 chopped apple w/skin
1/4 chopped papaya w/o skin and seeds
1/4 chopped sweet potato, cooked
1/8 raisins, soaked
1/8 grapes, sliced w/skin and seeds

With each individual portion (i.e., 3/4 cup) there is always at least 5 g of banana.

Greens Mix:

1/2 endive
1/2 kale

Dog/Cat Chow, Soaked:

Breeding season ratio - 1:2
Non-breeding season ratio - 1:1 ●

Houston Zoo Turaco Diets

Turaco sp.: (All amounts in grams)	I *Musophaga*	II *Tauraco*	III *Coryth*	IV *Crinifer*
FOOD ITEMS:				
Fruit Mix	82.0	50.0	50.0	50.0
Banana	5.0	5.0	5.0	5.0
Plantain	R 5.0	R 5.0	5.0	5.0
Greens Mix	12.0	12.0	12.0	12.0
Romaine		180.0	180.0	
Dog / Cat Chow	33.0	24.0	11.0	24.0
Monkey Chow	R 10.0	R 10.0	10.0	15.0
Cheese	R 3.0	R 3.0	R 3.0	
Egg	R 5.0	R 5.0	R 5.0	R 5.0
Peas	R 1.0	R 1.0	R 1.0	R 1.0
Orange	R 8.0	R 8.0	R 8.0	17.0
Apple				112.0
Applesauce	R 23.0	R 23.0	23.0	23.0

"R" indicates a rotational food item and is not fed daily. Some pairs eat live food — keepers feed accordingly. Apple and pear are fed whole on a nail to *crinifers*.

Corythaixoides and *Crinifer* always have romaine lettuce available. *Musophaga* and *Tauraco* may be given it occasionally, or when there are chicks in the nest.

If fruit, greens or dog/cat chow is completely eaten by 2:00 p.m., additional amounts (less than a.m.) may be given.

Except for pairs with chicks, most pairs will eat less in the summer and increase intake during winter months — keepers make necessary adjustments. In addition, juveniles between 3 and 12 months eat more and are fed accordingly.

Crinifers and Bare-faced are rare in captivity. Their diet needs are obscure, but are suspected to be more folivorous than other species. We are still experimenting with their diets.