

TURACO TAG HUSBANDRY MANUAL

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I. Introduction

This paper provides a basic guide for keeping turacos in captivity. It does not contain the last word in avicultural husbandry for this group, and it is our hope to revise the text as additional information is available. Much of the data herein was obtained at the Houston Zoo, and much of it is anecdotal. Aviculturists are aware of how few scientific studies have been conducted on captive exotic birds and how often we must therefore rely on anecdote to formulate captive management decisions. Although not statistically significant, anecdotal information is nevertheless valuable, as even a single recorded occurrence assists in defining behavioral limits.

II. Taxonomic Overview

The turacos, plantain-eaters, and go-away-birds (Musophagidae) are a homogeneous endemic African family of medium-sized birds traditionally subordinated taxonomically to the order Cuculiformes (cuckoos). Recent DNA-DNA hybridization studies indicate however that this association is unwarranted (Sibley and Alquist 1990), and the family has been raised in recent treatments (e.g. Fry, et al. 1988, Sibley and Monroe 1990) to ordinal status (Musophagiformes).

Within the family most authors recognize four groups: the green turacos, genus *Tauraco*, the blue or violet turacos *Musophaga*, the grey turacos *Corythaixoides* and *Crinifer*, and the Great Blue Turaco *Corythaeola*. The common names turaco and

plantain-eater are used almost interchangeably (along with the South African "loerie" or "lourie"), though "go-away-bird" is usually applied only to the grey turacos of the genus *Corythaixoides*. Turaco (uncapitalized) or musophagid is a convenient collective term for the group.

A confusing variety of common names has been used for species and subspecies in literature, so in the interest of concision, scientific names are used throughout this paper; common names are listed in the Appendix.

Taxonomy within the family remains uncertain, especially in regard to the green turacos *Tauraco*. The most thorough modern treatment (Moreau 1958) recognized 18 species in five genera, with the species *Tauraco corythaix* containing no less than nine subspecies. Moreau nevertheless admitted there is little evidence of intergradation, and that his treatment was arbitrary. This general arrangement has been retained by Fry, et al. (1988), with *T. persa* containing seven subspecies. Other authors (e.g. Snow 1978) recognize five allopatric species of the *T. persa* complex. Recent vocal evidence (Dowsett-Lemaire and Dowsett 1988) indicates at least *T. livingstonii* and *T. schalowi* are full species, and Sibley and Monroe (1990) recognize six full species within the *T. persa* superspecies, and a family total of 23 species also in five genera.

Other taxonomic questions are the generic assignments of *porphyreolopha* and *johnstoni* (*Tauraco*, *Musophaga*, or *Ruwenzornis*?) and *leucogaster* (*Corythaixoides* or *Criniferoides*?), and the species/subspecies status of *T. leucotis donaldsoni* (no

intergrades are reported) and *Corythaixoides personata leopoldi* (a disjunct population of markedly different appearance). Interested readers are referred to the publications mentioned; suffice it to say that for avicultural concerns a conservative approach is recommended, in which all visually recognizable forms are treated as discrete breeding units (see Appendix 2).

III. Historical background

Although turaco ("touraco" or "touracou" in older references) chicks were occasionally taken from wild nests and handraised before the turn of the century (Finn 1905), it was not until 1904 that a turaco species was reported to have bred in captivity (Johnstone 1905): the *Tauraco macrorhynchus* chick survived four weeks. Any turaco nestling was at that time such a rarity that it elicited a scientific description, illustrations, and discussion of the family's taxonomic relationships (Pycraft 1905).

The first captive turacos to raise young to independence were in the aviaries of Jean Delacour at Villers-Bretonneux, France in 1915 (Delacour 1916). His success with *T. persa buffoni* continued, and he reported (1925) having bred it to the third generation. In his overview (1925), Delacour reported that two other species, *T. corythaix* and *T. erythrolophus* had attempted nesting in other aviaries, but had been unsuccessful.

The first reported breeding success of a turaco in the USA was *T. leucotis donaldsoni* in 1929 at the aviaries of A. H. Isenberg in Menlo Park, California (Seth-Smith 1930).

Though the 1930s might be described as the first "golden age" of aviculture, few turacos were reported bred, at least in Great Britain or the USA, the only mention being that of *T. persa* in 1932 (Stokes 1932). Few turacos in captivity in Europe survived the Second World War's severe dietary rationing imposed on captive animals, and it is not until the 1950s that imports are again mentioned. D. H. Risdon maintained *T. hartlaubi* at the Dudley Zoo in England and reported interesting observations about habits in captivity, but no breeding (1954).

The second 'golden age" of aviculture occurred from the late 1950s to the early 70s with improved access to formerly remote habitats, speedier, more frequent air transport, and minimal government regulation. The numbers and species of turacos in captivity increased accordingly, and as more birds found their way into the hands of professional aviculturists, instances of successful breeding increased as well. In 1962, a pair of *T. corythaix* raised one chick in the aviaries of C. M. Payne in Warwickshire, England (Payne 1963). This first success in the UK merited the Avicultural Society's medal the following year.

In 1965, Charles Everitt published an informative account of the rearing of seven offspring from four nests of a pair of *T. leucotis leucotis* in the Edward Marshall Boehme aviaries in Trenton, New Jersey. In 1971, *Musophaga rossae* was first bred in the UK (Steel 1973), and 1972, *M. porphyreolopha* in South Africa (Jarvis and Currie 1974).

The first zoo collection to concentrate breeding efforts on several species of turaco was Jersey Wildlife Preservation Trust, and its erstwhile Deputy Curator of Birds, Grenville Roles, published a spate of enlightening accounts of their breeding four species: *Corythaixoides concolor* (1970), *T. persa persa* (1971), *T. schalowi* (1973), and *T. erythrolophus* (1975), all of which were first successes in the UK. His account of *T. schalowi* contains a comparative chart of chick development of the first three species.

In the USA, the Houston Zoo has maintained turacos since the 1960's and has concentrated breeding efforts on this family since 1977 (Berry and Todd 1982). First breedings in the USA of seven taxa occurred here: *Tauraco persa persa*, *T. p. buffoni*, *T. leucolophus*, *Musophaga porphyreolopha porphyreolopha*, *M. rossae*, *Corythaixoides concolor*, and *Crinifer piscator*. Altogether over 400 specimens of 15 forms have been reared.

As more turacos have been raised in both zoos and private avicultural collections, interest in the group has increased accordingly, and an International Turaco Society has recently been formed (Brackenhurst, Grange Wood, Netherseal, Swadlingcote, Derbyshire DE12 8BE, UK). Some species have become so numerous that the formerly high price commanded has dropped by more than half, and some zoos have curtailed breeding certain species. On the other hand, some once common species have become rare or disappeared altogether from captivity. *T. leucotis_donaldsoni* was one of the most frequently imported prior to the mid 1960's; there are now no captive specimens in the USA. *T. schalowi* was so numerous in the mid-1980s that Houston

Zoo halted the breeding program for that species; the US population, having originated from a few successful breeding pairs, is now inbred and declining, with little likelihood of wild imports.

Though few species presently in captivity are threatened in the wild, it is likely that husbandry techniques developed with common forms will be applicable to endangered taxa of this homogeneous family should it become necessary. Import of many species, including all those of the genus *Tauraco*, is restricted by the Convention on International Trade in Endangered Species (CITES), largely due to similarity of appearance to *T. fischeri*, a species of restricted range impacted by avicultural trapping. Adequate numbers of several species are in captivity in North American and European collections to avert the need for further wild-caught imports, providing populations are managed responsibly. The formation of the American Zoo and Aquarium Association (AZA) Turaco Taxon Advisory Group (as well as its counterpart in the UK), and the production of this husbandry manual are steps toward their management.

IV. Housing

Turacos are best housed in monogamous pairs. Different species may be housed adjacently, but visual or physical barriers may be necessary to discourage fighting through the wire. This is especially true of species similar in color (e.g. *M. rossae* and *M. violacea*), and it is recommended where possible to place dissimilar species in adjacent cages.

Turacos may usually be safely housed with cursorial birds (e.g. pheasants) and, if the aviary is large enough, with non-related arboreal species as well, though care should be taken, especially when the turacos are breeding: some pairs have attacked and injured pheasants. Occasionally competition occurs between gallinaceous birds and turacos for elevated nest sites, and the former pose a danger to turaco chicks when they clamber from the nest but cannot fly (see Section VII). Kowalczyk (in litt.) has reported an instance of a White-eared Pheasant *Crossoptilon crossoptilon* destroying the nest and eating the eggs of *T. leucolophus*.

Consideration should be given when constructing aviaries to the materials appropriate to the situation and climate. Mesh size should be selected both to contain the birds (e.g. turacos have been known to squeeze between harp wires) and to exclude wild birds or rodents which may introduce disease, exploit food sources, or attack nestlings (e.g. 2.5 x 5cm - 1 x 2 in.- wire mesh contains turacos and excludes adult rats but allows House Sparrows and mice to enter cages).

Turacos have proven adaptable to a variety of housing situations, and the following notes (for the most part from the Houston Zoo) are intended as examples rather than precise requirements.

The smallest cages in which turacos have consistently bred at Houston measure 2.2 x 5 m (7 ft x 15 ft) with a height of 3 m (10 ft) in the shelter and 2.2 m (7 ft) in the outside enclosure, and are constructed of welded wire mesh (2.5 x 5 cm = 1 x 2in.) over pipe

support frames with a roofed wooden shelter covering one third of the cage. Other breeding cages of chain-link panel construction measure 1.7 x 6 x 2.5 m high (6 ft x 20 ft x 8 ft). Like other captive birds, turacos benefit from provision of a roof (and solid shelter sides if possible) covering at least one third of the cage for privacy and protection from predators, real or perceived.

Where possible, night illumination is provided by dim incandescent bulbs to minimize rodent or predator disturbance and to allow frightened birds to find perches. In winter infrared heat lamps are installed in shelters. Off-exhibit cages are covered with fiber-reinforced polyethylene, and forced-air heat maintains temperatures above freezing.

Substrate of most aviaries is soil covered by "filter sand" - gravel approximately .5 to 2mm in size - allowing rapid drainage and ease of cleaning by raking and sifting. When aviary space is limited, birds awaiting shipment are housed in bare, concrete floored pens, and although these are unplanted, occasional successful breeding has taken place in such cages.

Soil-floored aviaries are planted as thickly as practical given the need for public display and/or keeper service. Foliage provides shade and seclusion in addition to shelter structure and offers escape opportunity should one of the birds attack the other (a frequent occurrence among captive turacos - see Section VIII). Some species (e.g. go-away birds) are also folivorous.

Turacos are arboreal (though relatively weak fliers), and natural perches of diameters ranging from 2.5 to 4cm (1.0 to 1.5in) along which birds can run, and between which they can jump, are provided throughout aviaries. Several perches should be under shelter allowing both members of a pair to perch apart from each other (turacos do not maintain close bodily contact when at rest). Perches exposed to the elements provide opportunity to sun- and rain-bathe. Though most turacos will descend to the ground to feed, elevated feeding platforms are recommended for the birds' convenience and to restrict incursions of rodents, ants, or ground birds; these are best placed under shelter.

IV A. Artificial nests

Turaco nests tend to be flimsy, similar to those constructed by doves; but like doves, turacos readily accept artificial platforms. Produce flats, wood and wire frames, or wicker baskets may be used - dimensions should approximate 31 x 43 x 8cm high (12 x 17 x 3in). Care should be taken that smooth interior bottoms are covered with wire mesh or securely fastened twigs to prevent loosely rolling eggs or chicks' splayed legs if birds displace nest lining. Initially, artificial nests should be situated high in aviaries and under shelter if possible, or placed as closely as possible to a site the birds have chosen themselves. Some birds (particularly recent wild imports) may carry token natural nest material to the site, but most eventually accept artificial arrangements. To encourage shy pairs and to reduce disturbance from adjacent birds, visual screens (e.g. foliage) may be placed around nests situated high in aviaries. Following several successful nestings, platforms may be lowered to more accessible levels and barriers removed.

Roofed nestboxes are used in some collections, and these have occasionally proven helpful in inducing nesting by pairs in which one bird is prone to attack the other, as the roof offers some seclusion to the nest occupant.

IV B. Temperature tolerance

Turacos cool themselves by gular fluttering ("panting") and are heat-tolerant if not unduly stressed: they can withstand summer temperatures exceeding 35 degrees C (95 degrees F) with high relative humidity if allowed access to shade. In hot weather soaker hoses over cages provide some cooling. As turacos are avid rain-bathers (though occasionally taking advantage of a puddle or water bowl), the spray also provides opportunity for bathing.

Provided with semi-enclosed shelter and heat to maintain temperatures therein above freezing, turacos also remain active and reasonably tolerant of cold. Frostbitten toes have been reported following periods of prolonged sub-freezing weather (+ 100 hours at approx. -5 degrees C) when temperatures even under shelter could not be maintained above freezing.

V. Restraint and transport

When threatened or pursued, turacos which have recently eaten will quickly regurgitate. This may lead to aspiration, especially during veterinary procedures employing

anesthesia. Care should be taken when holding a bird that the beak is not restrained or the bird held on its back in a way that prevents expulsion of regurgitant.

Another defense mechanism of turacos is their ability to shed major feathers when handled: a clumsy captor is often left grasping a handful of wing and tail feathers as the would-be victim scampers away through the branches. Though turacos rarely if ever bite, their claws are very sharp and can lacerate tender skin when struggling to escape.

Turacos, like many smaller birds, are best caught with light-weight nets. When a bird is removed from the net, care should be taken to pin the wings, especially the "shoulders" (= carpal joints) against the body to prevent the bird's wriggling forward. The legs should be extended, pulled back, and held tightly against the base of the tail to prevent kicking. Two hands are best for restraining most turacos, especially large species (e.g. Ross's), but smaller species may be held with one hand encircling the wing-tips, tail base, and legs, while the bird's breast is pressed against the person's body to prevent forward movement.

Because of their ability to squirm out of tight holds, turacos are best carried over distance in ventilated transport containers. For temporary restraint or for procedures requiring multiple handling episodes, they may be confined in porous cloth bags within the containers, so that stress of recapture and the bird's likelihood of injuring itself inside the container is minimal.

Escaped turacos may often be recaptured by taking advantage of their pair bonding or their pugnacity. A decoy bird, either the mate of the escapee, if available, or a conspecific placed in a small cage within a trap or behind a mist net will often lure a lost bird to recapture.

VI. Diet

The Musophagidae are usually classed as frugivores, but may be conveniently divided into two groups: the green and blue turacos, which inhabit gallery, lowland, and mountain forest; and the grey turacos, which live in more arid acacia and savannah scrub. The former group reportedly eats fruits, leaves, some invertebrates, and occasionally algae or moss. Grey turacos are more dependent on acacias, and consume leaves, flowers, seed pods, and buds of those plants as well as invertebrates such as termites. The folivorous genera *Corythaixoides*, *Crinifer*, and *Corythaeola* (and possibly others) cast well-formed pellets of indigestible plant material.

Few surveys and nutritional assessments of wild turaco diets have been published (but see Sun and Moermond 1997), so captive diets are largely based on trial and error. All species, grey species included, relish fruit in captivity, given free choice, and may eat it to the exclusion of more nutritious items. No doubt poor diet limited historical breeding instances: it is surprising, for instance, that Delacour's successfully breeding turacos were fed on "...bananas, potatoes chopped in pieces and dry raisins. They have never eaten mealworms or bread and milk. I have never seen them hunt for insects, and I believe them to be purely frugivorous" (Delacour 1916).

Avicultural practices have changed little over the past century with the exception of veterinary care and our understanding of nutrition and consequent diet preparation. Though fresh fruit continues to be an important component of turaco diets, most successful breeders provide some form of blended nutritionally-balanced ration., (e.g. soaked cat chow, dog chow, parrot pellets), (see Appendix 1). Live food, usually mealworms *Tenebrio* are offered to those specimens which will eat them. At Houston, most grey species and some other individuals will consume them, and provision is based on selection trials. Some birds actively hunt invertebrates (e.g. insects, slugs) in planted aviaries, and Isenberg, in his report on the 1929 breeding of *T. leucotis donaldsoni* (Seth-Smith 1930) describes his birds hunting for worms on the lawn.

Diets for raising chicks of the grey species (to say nothing of *Corythaeola*) are not so well established as those for maintaining adults. Houston Zoo continues to experience problems rearing species of this group, either naturally or by hand: they are prone to gastrointestinal fungal or bacterial infection, and it is rare to raise one without resort to aggressive veterinary intervention. Those few raised without human interference have been in aviaries where parents had access to large amounts of small-leafed foliage, but results have not been consistent, and substitution of commercially available greenfood has proven less than successful.

VII. Behavior in captivity

Turacos are active, vocal birds adapted to running along branches and moving from perch to perch by somewhat labored flapping flights and glides in which contrasting wing patterns are conspicuous. They are strongly territorial and advertise possession

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 employing calls, fluffed plumage, raised crests and spread wings are also typical of rival birds in visual contact.

Segregation into apparently compatible pairs is no guarantee against aggression: the most frequent cause of death among adult turacos at the Houston Zoo has been violent aggression by a cage mate, often by a long-term partner, frequently (but not always) by the male. Keepers must remain alert for signs of an impending attack, often presaged by vocal threats (e.g. a growling call), the subordinate bird displaced, pursued and hiding, or a tuft of feathers on the cage floor. Clipping a wing or pulling the easily-removed primaries may inhibit an aggressor, but if this fails, the bird should be removed and re-introduced within a few days or weeks. Housing the birds in adjacent cages to become re-acquainted is sometimes helpful. For most individuals these techniques will eventually work, but for some, if repeated reintroductions fail, a new mate is a more likely solution. Substantial planting of an enclosure offers cover to harried birds and may buy time to effect a rescue. Anecdotal information indicates lower protein diets may decrease aggression, but no analytical studies have been conducted.

As might be suspected, hand-raised birds maintained in isolation (as opposed to being socialized at an early age) are more likely to become problem breeders, but there are exceptions to any generalization, and serious mate aggression occurs between parent-reared birds as well.

Nest-helping behavior has been reported in some species, at least in captivity: *M. violacea* (Bent and Corbett 1992), *Corythaixoides concolor* (Young 1976), *T. leucolophus* at Woodland Park (Kowalczyk in litt.), *T. erythrolophus* (Berry and Todd 1982) and *Crinifer piscator* at Houston. It is safer, however, to remove juvenile birds when they are self-feeding as they may suffer attack by re-nesting parents. Juveniles may be housed in groups until the onset of sexual maturity (approximately 1 1/2 years old), although their social interaction should be monitored. Extraordinary precocial aggression toward cage-mates by some juvenile *C. piscator* has been observed at Houston and other collections.

Most turacos may be safely housed with dissimilar birds (e.g. pheasants, curassows, some passerines), but may occasionally attack cage-mates or interfere with nest platforms intended for other species when breeding. (see section IV)

VIII. Captive reproduction

Only one species of turaco is sexually dichromatic: *Corythaixoides leucogaster* : males and juveniles (younger than six months) have black beaks, adult females grey-green. Behavior of the sexes is so similar that all other species should be reliably sexed by laparoscopy or karyotype (chromosome) analysis. After gender is determined, prospective mates should be housed in adjacent cages some days prior to direct introduction. Any introduction should be closely monitored for compatibility: courtship feeding or carrying nest material are promising indicators. An introduction may precipitate low-level threats, but if these do not intensify or give way to ceaseless pursuit, the birds may be left together if they are checked frequently.

Turacos are sexually mature in their second or third year (though a few hens may lay as early as eleven months) and their reproductive life may exceed 20 years. In captivity the annual breeding season may be prolonged, and turacos (at least in warmer climates or lower latitudes) have bred in all months. Formerly a peak of December through July was reported at Houston (Berry and Todd 1982), but presently most birds there breed from February through October. More northerly situated collections report shorter breeding seasons (e.g. Seattle: May through September).

As mentioned above, turacos build flimsy nests which are best reinforced or replaced with artificial platforms. Both sexes construct the nest and share incubation. The green and blue species routinely lay two (rarely three) off-white, spherical eggs; the grey species frequently lay three pale blue eggs per clutch. Eggs are laid every other day, and incubation usually commences with the first egg which therefore hatches a day or more before the next. Incubation period for green turacos is 20 - 23 days; for blue, 24 - 26; and for grey, 28. Time from initial pip to hatch may occasionally be as long as 48 hours. The eggshell and chicks' droppings are usually consumed by a parent.

Chicks hatch with eyes open and with bodies covered in thick black or grey down (some grey species exhibit light belly down and/or light spots on the head). Most species have a vestigial wing claw on the alula which disappears as the chick grows. Chicks gape readily and are fed by both parents by regurgitation. As early as two weeks, chicks begin to clamber on branches adjacent to the nest, and care should be taken to provide limbs from ground to nest along which fallen chicks can easily climb.

Chicks of one species resemble those of another closely enough that cross-fostering may be used to increase production of rare species by use of proven pairs of common species. Although breeding synchronization among such pairs is desirable, Houston Zoo staff discovered that some individuals incubating as briefly as one week would accept a hatching egg or even an older chick with an empty shell (provided as a stimulus as a parent usually consumes the eggshell). Some parents will also accept as many as three chicks of varying ages, although keepers must attend that all are being adequately fed.

Once pairs are well established in a nesting pattern, they will tolerate routine intervention (e.g. weighing of eggs and chicks), at times actively defending their nests (in some cases a sitting bird will attack the intruder, and care should be taken to shield chicks being handled to avoid their accidental injury by an irate parent).

IX. Artificial Incubation and Handrearing

Turaco eggs are artificially incubated at 100 degrees F (37.8 degrees C). Humidity should be adjusted to attain weight losses from date set to pip averaging 11% (range 8.1% - 15.4% in 17 successful incubator hatches of various species). Occasionally turaco chicks may make the initial pip below the aircell, but still hatch successfully, although the process may be protracted (in unusual cases 48 hours). Following

hatching, the umbilicus should be swabbed with tamed iodine (povidone iodine) solution and the chick's down allowed to dry.

The chick may be housed in a brooder with the initial temperature approaching 96 degrees F (35.5 degrees C). Turaco chicks pant and extend the neck if overheated or huddle and cease to eat if chilled. Behavior should be closely monitored to determine proper temperature, which should be gradually decreased as the chick grows until at approximately Day 18 it may be safely housed in a cage without supplementary heat in a draft-free room maintained at 75 - 80 degrees F.

It is recommended to withhold food for 12 to 24 hours from a newly hatched chick to encourage absorption of yolk. Electrolyte solution (e.g. Pedialyte) may be given occasionally to prevent dehydration. Feeding is straightforward using a gruel of fruit and a protein source (in approximate ratio of 1:1) with a narrowed spoon (i.e. with sides pressed inward) or a pipette. Food should be heated until warm to the touch (approximately 100 degrees F - 37.8 degrees C) and small amounts poured slowly into the chick's gape - allowing it time to swallow between sessions - until the expandable esophagus (located along the right side of the neck) is half-full (a full esophagus may result in aspiration as the bird settles). Beginning around Day 5, bits of solid food should be given with forceps, and the ratio of solid food to gruel should be increased until the chick is eating only solid food by Day 10. Initial feedings should be at intervals of approximately two hours from sunrise to sunset: it is not necessary to feed through the night. Although initial feeding of semi-liquid diet is based on observation of parents'

feeding behavior, some hand-rearers have successfully started chicks on small pieces of solid food.

Feces are not encapsulated (as in many passerines), but should be reasonably well formed, and are often initially accompanied by a mucus discharge. A moistened cotton swab may be used to stimulate defecation if it is delayed, but additional dietary fiber may also be needed, particularly with the grey species.

After Day 15, a food-tray and water-bowl should be offered to encourage the chick to begin eating and drinking on its own. Most chicks will self-feed by about Day 18. At approximately Day 20, roughly corresponding with chicks' climbing out of the nest, some chicks may become more selective about food items, and some weight fluctuation, as in bird fledglings of other species, may be observed. Usually weight will stabilize within three to five days. Initial flight occurs around Day 30.

During the first ten days of hand-rearing, an average daily weight gain of 14.5% (sample of three healthy handraised chicks) may be expected, with an average of 6.5% during the second ten days. So long as the behavior and defecation remain normal, occasional minimal weight gains should not cause alarm.

As noted above, proper nesting material is important for normal leg and foot development. Interwoven twigs, hay, or an artificial fiber matrix (e.g. Enkamat) should be arranged in the nest bowl in such manner that the chick cannot push it to the side as

it moves around the nest and thus slide across a smooth floor. Should legs begin to splay, corrective measures must be taken immediately: a chick may be hobbled (i.e. the legs tied in normal position under the body) or confined for several days in a narrow cup with immovable “graspable” flooring until growth re-aligns the legs. Chicks begin leaving the nest and clambering about adjoining branches around Day 20, so appropriate perching should be provided in the brooder.

If hand-reared turacos are housed together as soon as possible after they are self-feeding, sexual imprinting on humans rarely occurs and birds will breed normally, though they may remain tame. Their tameness, while initially appealing, may result in annoying aggression towards keepers as they mature.

X. Veterinary problems

This section is based on Brannion (1993) supplemented by material from Joseph Flanagan, DVM (pers. comm.). Although traumatic injuries and deaths attributable to conspecific aggression are the most frequently encountered veterinary problems, turacos are subject to a number of other maladies typical of captive birds.

Metabolic bone disease is encountered in turacos, especially juveniles reared on diets with a poor calcium/phosphorous ratio (e.g. with a large proportion of fruit). Iron storage disease has occasionally been reported in turacos, though never in the Houston Zoo collection, where no special dietary precautions (e.g. feeding low-iron pellets) are taken.

Avian tuberculosis has been reported to be a frequent cause of mortality in some collections, and it has been suggested that the family is especially susceptible to *Mycobacterium*. It is remarkable that despite large numbers of turacos in the Houston Zoo collection the disease has only been encountered there in newly imported specimens. Easily confused with tuberculosis, but lacking its contagious lethal effects is *Yersinia pseudotuberculosis*, and this organism may account for misdiagnoses of tuberculosis.

Mycotic diseases, such as aspergillosis and candidiasis are occasionally encountered, the latter especially in hand-reared chicks of grey species at Houston. Endoparasites reported include nematodes *Ascaridia*, *Capillaria*, *Tetrameres*, and *Dispharynx nasuta* as well as *Coccidia* and avian hematozoa.

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APPENDIX 1: Captive Diets

As mentioned above (Section VI) most recent captive diets consist of a protein source and a variety of fruits and/or vegetables. The following diets from representative institutions are offered as guidelines. In planning dietary regimen based on the

following information, it should be remembered that conditions may vary not only between avicultural collections, but between species, individual specimens, or even aviary situation within one collection.

Woodland Park Zoo, Seattle, Washington.

Chopped fruit mix: papaya, banana, apple, raisins, blueberries, grapes.

Dry dog food, soaked in water.

Buffalo Zoo, Buffalo, New York.

Reliable Protein low iron soft-billed bird diet. Crickets/mealworms (occasional).

Endive, kale, chopped.

Orange, banana, apple, grapes, papaya.

Toledo Zoo, Toledo, Ohio.

Avian Frugivore Gelatin Diet: Psittacine extruded diet (Marion Scenic Jungle Diet) mixed with

unsweetened dry gelatin powder, calcium carbonate, water, bananas, apples, and blueberries to

form a gel which may be cut into pieces for feeding.

Houston Zoo, Houston, Texas.

Chopped fruit mix (approx. 3/8 in - 1 cm dice): 25% apple, 25% papaya, 25% cooked sweet potato, 12 1/2% grapes, 12 1/2% soaked raisins. Chopped greens mix: 50% kale, 50% endive (chicory).

Parrot pellets: Mazuri Parrot Breeder Pellets (19.5% protein), soaked.

Formerly a 1:1 mix of soaked dog chow and cat chow provided the protein source.

It has been suggested that a turaco should consume 8 - 12% of its body weight in soaked parrot pellets daily, with the fruit and greens provided as enrichment rather than subsistence. To persuade the birds to eat primarily parrot pellets has proven difficult, however, and it is also not certain that a grain-based pelleted diet is in fact nutritionally sound for all species of frugivorous birds. Therefore the diets provided are a traditional presentation of fruit mix, greens, and parrot pellets in approximate ratio of 2 : 1 : 1. In an attempt to increase the proportion of protein consumed, ground dry parrot pellets have occasionally been mixed with the chopped fruit.

Amounts fed are roughly based on average species weights (grams) and the recommendation to provide approximately 12% body weight in soaked parrot pellets. Increases are made to compensate for parasitic sparrows which can freely enter most cages. Diets are usually split into a morning and afternoon feeding.

For convenience, species may be combined into two weight groups (average weight in grams): Group 1: *M. rossae* 358, *M. violacea* 317, *C. piscator* 311, *C. concolor* 308, *M. porphyreolopha* 298; Group 2: *T. hartlaubi* 256, *C. leucogaster* 245, *T. fischeri* 229, *T. livingstoni* 222, *T. schalowi* 207, *T. leucolophus* 194. For efficiency, diets are prepared visually, rather than by exact weight. Examples of diets for each group are as follows (amounts per bird):

Group 1

| | |
|-----------------|-----------------|
| fruit mix: | 2/3 cup - 116 g |
| greens: | 1/3 cup - 55 g |
| soaked pellets: | 1/3 cup - 48 g |

Group 2

| | |
|-----------------|----------------|
| fruit mix: | 1/2 cup - 94 g |
| greens: | 1/4 cup - 10 g |
| soaked pellets: | 1/4 cup - 35 g |

A nutritionist would doubtless criticize these diets, and we hope that they might in future be further analyzed, changed, or refined as needed. Nevertheless they have sufficed for a number of years, and most species continue to breed successfully.

APPENDIX 2: List of Turaco Species with some visually distinctive subspecies, based on Sibley and Monroe 1990. [] indicates superspecies. Where available a selection of common names encountered in literature is given; the first listed is our recommended common name for the species/subspecies.

Order **MUSOPHAGIFORMES**

Family **Musophagidae**

Subfamily Musophaginae (2 genera)

“green turacos”

Tauraco [persa] persa Guinea Turaco, Gold Coast Turaco, Green-crested Turaco
T. p. buffoni Sierra Leone Turaco, Buffon's Turaco

Tauraco [persa] schuettii Black-billed Turaco, Schütt's Turaco

Tauraco [persa] schalowi Schalow's Turaco, Long-crested Turaco

Tauraco [persa] livingstonii Livingston's Turaco

Tauraco [persa] fischeri Fischer's Turaco, Red-crested Turaco

Tauraco [persa] corythaix Knysna Turaco

Tauraco [erythrolophus] erythrolophus (Angolan) Red-crested Turaco, Pink-crested Turaco, Pauline Turaco

Tauraco [erythrolophus] bannermani Bannerman's Turaco **Vulnerable** (Collar, et. al. 1994)

Tauraco macrorhynchus Yellow-billed Turaco, Great-billed Turaco, Black-tipped Crested Turaco

T. m. verreauxi Verreaux's Turaco, Red-tipped Crested Turaco

Tauraco [hartlaub] hartlaubi Hartlaub's Turaco

Tauraco [hartlaub] leucotis White-cheeked Turaco

T. l. donaldsoni Donaldson's (White-cheeked) Turaco, Chercher White-cheeked Turaco

Tauraco [hartlaub] ruspolii (Prince) Ruspoli's Turaco **Endangered** (Collar, et. al. 1994)

Tauraco leucolophus White-crested Turaco

"violet" or "blue" turacos

Musophaga [porphyreolopha] porphyreolopha Purple-crested Turaco, Violet-crested Turaco, Pink-breasted Violet-crested Turaco, South African Purple-crested Turaco

M. p. chlorochlamys Olive-breasted (Purple-crested) Turaco, East African Purple-crested Turaco

Musophaga [porphyreolopha] johnstoni Ruwenzori Turaco

M. j. kivensis Kivu Turaco

Musophaga [violacea] violacea Violaceous Turaco, Violet Turaco

Musophaga [violacea] rossae (Lady) Ross's Turaco

Subfamily Criniferinae (2 genera)

go-away-birds and grey plantain-eaters

Corythaixoides [personatus] concolor (Grey) Go-away-bird

Corythaixoides [personatus] personatus Brown-faced Go-away-bird

C. p. leopoldi Bare-faced Go-away-bird, Black-faced Go-away-bird

Corythaixoides leucogaster White-bellied Go-away-bird

Crinifer [piscator] piscator Western Grey Plantain-eater

Crinifer [piscator] zonurus Eastern Grey Plantain-eater, Abyssinian Grey Plantain-eater

Subfamily Corythaeolinae (1 genus)

Corythaeola cristata Great Blue Plantain-eater

APPENDIX 3: Commercial Products mentioned in the text.

Enkamat: erosion control matting. Manufactured by Akzo Industrial Systems Company, PO Box 7249, Asheville, NC 28802.

Marion Scenic Jungle Diet: manufactured by Marion Zoological, 995 Witherspoon, Thousand Oaks, CA 91360.

Mazuri Parrot Breeder: manufactured by PMI Feeds, PO Box 66812, St. Louis, MO 63116-6812.

Pedialyte: oral electrolyte maintenance solution. Manufactured by Ross Laboratories, Columbus, OH 43216.

Reliable Protein Low-iron Soft-billed Fare: manufactured by Reliable Protein Products, 70-105 Frank Sinatra Dr., Rancho Mirage, CA 92270.

References and Supplementary Bibliography

The following list is by no means complete. There is, regrettably, no modern monograph on the Musophagidae, although we understand there to be no less than three in preparation. The most thorough family treatments thusfar are in Fry, et al. (1988) and Moreau (1958), and these articles contain extensive bibliographies. There are excellent family summaries in Snow (1978) and Turner (1997).

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