



EAZA BEST PRACTICE GUIDELINES
EAZA Toucan & Turaco TAG

RED-CRESTED TURACO
Tauraco erythrolophus



2nd Edition Compiled by

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2014

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Preamble

Right from the very beginning it has been the concern of EAZA and the EEPs to encourage and promote the highest possible standards for husbandry of zoo and aquarium animals. For this reason, quite early on, EAZA developed the "Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria". These standards lay down general principles of animal keeping, to which the members of EAZA feel themselves committed. Above and beyond this, some countries have defined regulatory minimum standards for the keeping of individual species regarding the size and furnishings of enclosures etc., which, according to the opinion of authors, should definitely be fulfilled before allowing such animals to be kept within the area of the jurisdiction of those countries. These minimum standards are intended to determine the borderline of acceptable animal welfare. It is not permitted to fall short of these standards. How difficult it is to determine the standards, however, can be seen in the fact that minimum standards vary from country to country.

Above and beyond this, specialists of the EEPs and TAGs have undertaken the considerable task of laying down guidelines for keeping individual animal species. Whilst some aspects of husbandry reported in the guidelines will define minimum standards, in general, these guidelines are not to be understood as minimum requirements; they represent best practice. As such the EAZA Best Practice Guidelines for keeping animals intend rather to describe the desirable design of enclosures and prerequisites for animal keeping that are, according to the present state of knowledge, considered as being optimal for each species. They intend above all to indicate how enclosures should be designed and what conditions should be fulfilled for the optimal care of individual species.

Citation

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EAZA Red-crested Best Practice Guidelines; L. Peat; Cotswold Wildlife Park; April 2014

Introduction

The information in this Best Practice Guideline has come from several sources; other literature, and personal experiences from both the author (EAZA sub-group leader for turaco species) and personal communication with other holders. In 2007 a husbandry survey was sent out to all holders, the results of which have been utilized in several aspects of this Guideline.

Some aspects of husbandry are still a working progress, there is little known about the wild diet of this species. There is on-going research into the captive nutrition of this species but as yet not enough is known to be able to put together an officially recommended diet.

Further research is on-going regarding genetics of the population, mate aggression and how best to manage the species in large mixed species exhibits.

This Guideline has been reviewed and approved by other Turaco TAG members.

Key husbandry points:

1. Most important aspect of husbandry starts with nutrition, not enough research has been done in this area yet to give decisive recommendations, but would advise a high fibre diet and limit amounts of sweet commercially grown fruits.
2. Have been cases of mate aggression leading to mortalities, not as common as it is in other turaco species but it does occur, generally when one specimen wants to breed and the other does not reciprocate.
3. Adults will chase juvenile offspring if they wish to breed a second time – monitor closely & remove juveniles when this behaviour persists – failure to do so could result in fatalities.
4. Suitable aviary design - very well planted & plenty of horizontal perching to enable natural locomotion. These are canopy dwelling species so areas of dense cover advised.

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SECTION 1. BIOLOGY AND FIELD DATA

A: BIOLOGY

1.1 Taxonomy

Order: Cuculiformes
Family: Musophagidae
Genus: Tauraco
Species: erythrolophus
Subspecies: None. Forms a superspecies with *Tauraco bannermani*
Common name: Red-crested Turaco

1.2 Morphology

Length: 40 - 43cms
Tail length: 17.5 – 19.4cms
Weight: 210 - 325g

Colouration: Crest and nape crimson; sides of neck and breast green; red wing feathers; mantle, lower back, wing-coverts golden-green.

Description: Differs from *T. bannermani* in that some of the crimson crest feathers are white-tipped, and more extended crimson on back of neck, chin and cheeks are white; bill smaller and all yellow; nostrils round not oval and covered in feathers.

Immature: Duller in colour.

Chicks: Black down.

Differences between sexes: None



1.3 Physiology

Blood analysis:

Clinical Pathology Records Report - ISIS/In-House Reference Values JERSEY ZOO - D.W.C.T

Scientific name: TAURACO ERYTHROLOPHUS

Common Name: Red-crested Turaco

		ISIS Values			In-House Values				
		Mean	S.D.	(N)	Mean	S.D.	Min.	Max.	(N)
WBC	*10 ⁹ /L	11.29	+ 4.618	(17)	5.071	+ 1.730	3.600	8.600	(7)
RBC	*10 ¹² /L	2.92	+ 0.64	(14)	2.973	+ 0.158	2.670	3.120	(7)
HGB	GM/L	145	+ 25.0	(12)	167	+ 9.90	156	179	(7)
HCT	%	45.6	+ 3.9	(19)	50.00	+ 3.11	45.00	53.00	(7)
MCH	*10 ⁹ /L	52.3	+ 5.3	(11)	56.33	+ 1.86	53.56	58.43	(7)
MCHC	gm/L	324	+ 50.0	(12)	335	+ 8.80	320	347	(7)
MCV	fL	164.4	+ 38.2	(14)	168.2	+ 5.7	159.3	176.5	(7)
HETEROPHILS	*10 ⁹ /L	4.290	+ 3.114	(17)	1.759	+ 0.575	1.080	2.842	(7)
LYMPHOCYTES	*10 ⁹ /L	5.461	+ 4.241	(17)	2.694	+ 0.715	2.072	4.128	(7)
MONOCYTES	*10 ⁹ /L	1.557	+ 1.262	(12)	0.274	+ 0.416	0.000	1.204	(7)
EOSINOPHILS	*10 ⁹ /L	0.502	+ 0.601	(8)	0.123	+ 0.325	0.000	0.860	(7)
BASOPHILS	*10 ⁹ /L	0.343	+ 0.206	(11)	0.134	+ 0.148	0.000	0.344	(7)
AZUROPHILS	*10 ⁹ /L				0.000	+ 0.000	0.000	0.000	(1)
NRBC	/100 WBC	0	+ 0	(1)					
PLATE. CNT.	*10 ¹² /L				20.0	+ 0.0	20.0	20.0	(1)
GLUCOSE	MMOL/L	16.2	+ 3.08	(11)	16.3	+ 1.75	14.7	18.8	(4)
BUN	MMOL/L	1.07	+ 0.357	(8)					
CREAT.	UMOL/L	17.7	+ 8.84	(5)	28.0	+ 20.2	15.0	58.0	(4)
URIC ACID	MMOL/L	0.431	+ 0.271	(9)	133	+ 323	0.256	972	(9)
CA	MMOL/L	2.33	+ 0.200	(11)	1.99	+ 0.218	1.67	2.28	(5)
PHOS	MMOL/L	1.23	+ 0.485	(4)	1.28	+ 0.310	1.02	1.62	(3)
NA	MMOL/L	153	+ 1	(2)					
K	MMOL/L	1.9	+ 0.3	(2)					
CL	MMOL/L	113	+ 0	(1)					
CHOL	MMOL/L	4.19	+ 0.494	(10)	4.47	+ 1.07	3.30	5.62	(4)
TRIG	MMOL/L	1.51	+ 0.352	(7)					
T.PROT. (C)	GM/L	37.0	+ 3.00	(11)	36.4	+ 3.65	31.0	42.0	(9)
ALBUMIN (C)	GM/L	16.0	+ 3.00	(4)	13.1	+ 1.14	12.0	15.1	(9)
GLOBULIN (C)	GM/L	20.0	+ 7.00	(4)	23.3	+ 3.54	18.3	30.0	(9)
AST (SGOT)	U/L	198	+ 32	(10)	201.5	+ 57.8	145.0	304.0	(6)
ALT (SGPT)	U/L	36	+ 12	(10)	24.00	+ 17.44	12.00	44.00	(3)
T. BILI.	UMOL/L	6.84	+ 3.42	(8)	8.00	+ 6.57	0.992	14.0	(3)
D. BILI.	UMOL/L	0.0	+ 0.0	(1)					
I. BILI.	UMOL/L	5.13	+ 0.0	(1)					
AMYLASE	U/L	1475	+ 0	(1)					
ALK.PHOS.	U/L	135	+ 42	(9)	114.3	+ 49.9	57.00	148.0	(3)
LDH	U/L	803	+ 731	(3)	171.0	+ 0.0	171.0	171.0	(1)
CPK	U/L	331	+ 39	(5)	370.8	+ 67.1	313.0	485.0	(5)
CO2	MMOL/L	23.0	+ 2.8	(2)					
FIBRINOGEN	G/L				1.30	+ 0.0	1.30	1.30	(2)
GGT	U/L	10	+ 9	(2)	16.00	+ 0.00	16.00	16.00	(1)
LPA	U/L	18	+ 0	(1)					
THROMBOCYTES	10 ⁹ /L				17.00	+ 3.10	13.00	22.00	(6)
TOTAL PHOS	MMOL/L				0.891	+ 0.0	0.891	0.891	(1)
UREA	MMOL/L				0.500	+ 0.000	0.500	0.500	(1)
GAMMA GLOB	GM/L	2.00	+ 0.0	(1)					

Printed on: 16.Jan.2007

Used by permission from ISIS and Jersey Zoo. Data from the ISIS CD: Reference Ranges for Physiological Values for Captive Wildlife, 2002 Edition.

1.4 Longevity

Wild: Unknown.

Captive: Oldest known male 27, oldest known female 21. (Taken from studbook data).

B: FIELD DATA

1.5 Zoogeography/Ecology

Distribution: Africa - West and Central Angola from lower Congo to Chingoroi area, and East to Malanje and upper Cuanza.

Habitat: Evergreen and riverine forests.

Population: The global population size has not been quantified, but the species is reported to be locally common (del Hoyo et al. 1997).

Conservation status: CITES II. Status – Least Concern. Population trend – Decreasing (IUCN Red List of Threatened Species).
Reportedly common in forest at Gabela and N’dalatando district.
Endemic to war-torn Angola where clearance of forests presents a possible threat to numbers. The population is suspected to be in decline owing to ongoing habitat destruction. Currently four year PhD project being conducted studying the effects of deforestation and forest degradation in the endemic birds of the Central Angolan Scarp.

1.6 Diet and Feeding Behaviour

Very little information known on wild diet. Primarily thought to take fruit and berries.

1.7 Reproduction

Sexual maturity: Both sexes have reproduced from 1 year in captivity, but there are cases from studbook data of both sexes producing young at 8 months of age. The average age at first reproduction in captivity is 3 years 4 months. Oldest breeding dam 18 years, oldest breeding sire 24 years.
No wild data available.

Seasonality: In captivity the majority of births occur between April and October, but are recorded throughout the year.
No wild data available.

Eggs & clutch size: Usually 2 white eggs, laid on a flimsy platform of twigs, 1.5 – 10 meters off the ground. Eggs laid every other day.

Incubation: Incubation by both sexes, after first egg laid. Incubation period is 24 days.

Hatching: Chicks hatch with a thick coat of black down, eyes generally on the point of opening. Chick fed by parents regurgitating food into beak.

Development: Become very active from two to three weeks and will attempt to leave the nest before they can fly. Generally able to fly from four to five weeks, but will remain dependent on parents for several months after leaving the nest. Green and red pigments generally visible between 25-30 days of age, with the red crest becoming prominent from 40-50 days. By four months of age they have full adult plumage.

1.8 Behaviour

- Activity:** Mainly arboreal, this species will generally only descend to the ground to drink or bathe. A large part of the day is spent feeding, broken up by short rest intervals spent preening or basking in the sun. At dusk they will return to their favourite roost.
- Locomotion:** Generally poor fliers, tending to move from tree to tree by gliding or with a few fast wing beats. Move short distances with a series of short hops, or by running along tree branches.
- Social behaviour:** They are territorial, and will generally stay in pairs throughout the year. This species has several vocalisations; the loud drawn out calls most often heard dawn and dusk and are generally territorial calls which will be responded to by neighbouring birds, and the quieter shorter vocals, possible used as contact calls and when showing excitement or aggression.
- Sexual behaviour:** Courtship behaviour usually begins with calling and chasing from tree to tree, followed by mutual feeding, gentle beak clapping and head bobbing. If receptive the female will lower her body allowing the male to tread her.

SECTION 2. MANAGEMENT IN CAPTIVITY

2.1 ENCLOSURE

Historically generally held in single species aviaries or mixed with one or two different avian species. More recent trend towards larger emersion exhibits, tropical houses or public walkthrough exhibits mixed with multiple species. Reproductively tend to do better in the more traditional aviaries but breeding success is being achieved in the larger exhibits.

2.1.1 Boundary

Maximum gauge of mesh to be used on aviary should be 2.5cm x 2.5cm. Although in order to prevent access to wild birds and mammals smaller gauge would be recommended. Under floor wiring will also help prevent any potential rodent problems.

Ensure that any adjoining aviaries have double mesh between them to prevent possible aggression from or towards neighbouring species.

Walls of the house should be constructed from an easy to clean material.

Roof can be either netted or meshed – ensure there are some covered areas where birds can shelter/nest from inclement weather.

An enclosure access safety area should also be incorporated into the design of the aviary to prevent escapes.

2.1.2 Substrate

Bark, grass, gravel and sand are all suitable substrates for the outside aviary. A concrete/tiled floor inside the house will allow for easier cleaning.

Sand or wood shavings are ideal for using as a substrate inside the house, although ensure that there is adequate ventilation if they produce too much dust. Dust free bedding materials are also available but are generally more expensive.

2.1.3 Furnishing and Maintenance

Naturally planted aviaries offer the best environment for this species. A well-planted aviary provides cover against the elements and can also provide perching and nesting options.

By adding well thought out perching to the aviary in the form of ropes or branches you can encourage natural locomotion and activity. Turaco species tend to hop from branch to branch, or have short flights between perches and also run along branches. Perches open to the elements will allow the birds the opportunity to sun and rain bathe.

Annual re-branching is recommended for environmental stimulation and enrichment.

Being frugivores turaco species are very messy and enclosures benefit from being cleaned regularly. Daily cleaning around feeding stations is recommended, weekly or twice weekly cleaning of outside & inside aviary should be sufficient.

2.1.4 Environment

Can withstand temperatures as low as 10 degrees centigrade comfortably; to maintain activity levels through the winter access to heated areas recommended when temperature drops below 10C. Deny access to the outside in extremes of cold weather - birds will roost outside through poor weather conditions if you do not shut them in.

Can withstand temperatures as high as 36 degrees centigrade - ensure adequate shade areas during the hottest months.

2.1.5 Dimensions

The majority of institutions hold this species in aviaries over 2 metres squared with the vast majority being in access of 6 metres squared, (usually maintained in mixed species exhibits).

Being a predominantly arboreal species there is no limit to maximum height requirements, but 2 metres should be the minimum height.

House size should be large enough to incorporate a feeding and roosting area, with enough room for easy servicing.

2.2 FEEDING

Very little is known regarding the wild feeding habits of this species, as such it is difficult to recommend a specific nutritionally balanced captive diet. On-going research, faecal analysis of captive birds, may well help draw some useful conclusions in the future.

2.2.1 Basic Diet

Many presentation variations are used throughout institutions but the vast majority use the same types of ingredients. 22 institutions responded to a survey sent out in January 2007, the information below has been compiled from those answers.

Diet ingredients used by Red-crested Turaco holders (some diets used for mixed aviary species)	
Fruits	Apple, pear, grape, banana, Paw paw, tomato, pomegranate, kiwi, strawberry, blueberry, melon, mango, apricot, plum, nectarine, seasonal fruits & berries.
Vegetables	Cucumber, cauliflower, broccoli, carrot.
Greens	Lettuce, watercress, cabbage.
Commercial Diets	Mynah pellets, Nutribird pellets, Aves fruitmix, soaked dog pellets, Aves meat mix, Insectivorous diet, Witte Molen Insectivore mix, Witte Molen softfruit mix, soaked Mazuri Diet A.
Misc	Dried figs, canned peaches, sultanas, boiled eggs, brown bread, boiled vegetables.
Meat, insects	Mincemeat, mealworms, dried insects, crickets, wax moth, flour beetle.
Supplements	Nutrobal muti vit/min Produced by Vet Ark. Calcivit. SA37. Breedmax. Korvimin ZVT.
Enclosure vegetation	Leaves and berries taken from Elder tree in enclosure. Leaves taken from various plants/trees in tropical house (banana, mango, papaya growing in exhibits, fruits, leaves and possibly flowers), actively feed on fruiting <i>Hamelia patens</i> (Rubiaceae)

Diet supplements are used by 76% of the 22 institutions.

Live food is offered by 64% of the 22 institutions, 75% of these offered mainly mealworms. Two institutions stated that they have offered live food in the past but it was never taken, and one institution only offers live food when the birds are rearing young.

86% of the 22 institutions keep their turacos in mixed species aviaries with access to other bird species diets; understandably it is difficult to monitor both intake amount and ingredients chosen.

General

When creating a diet for this species always remember that commercially grown fruits rarely represent the nutritional value of wild grown fruits. Feeding a largely fruit based diet is not recommended – consider a combination of a third fruit & berries to a third of vegetables & greens and a third of a commercial diet. This should provide all the nutrients required for a healthy balanced diet. Keep a close eye on faeces consistency of your birds, by feeding a diet higher in fibre there are marked differences in faecal consistency.



Red-crested fed on standard fruit based diet



Red-crested fed on increased fibre diet

2.2.2 Special Dietary Requirements

Many institutions offer seasonal fruits & berries.

Two institutions increase the protein levels of the diet during the breeding season.

2.2.3 Method of Feeding

The diet should be chopped into fairly small pieces, even though turaco will attempt to swallow large items it can be quite a struggle and an uncomfortable experience. By feeding smaller items all components of the diet can be mixed together which helps to avoid individuals from picking favoured items and ensuring a more nutritionally balanced intake.

Intake amount will vary significantly through the year, monitoring the amount of diet left uneaten each day and adjusting the diet amount offered accordingly will help reduce food wastage. Turaco species have a very short digestive system being without food for a long period of time is not recommended; ensure the diet is available early in the morning, especially if the birds are raising chicks.

The diet should be fed off the ground, out of reach of wild rodents. The feeding area should be either inside or undercover out of direct sunlight and rain. The cover will also prevent wild birds or aviary inhabitants from defecating on the food. The feeding area should be built from materials that are easy to keep clean.

In hot weather fruit will begin to spoil quickly, to ensure the diet is kept as fresh as possible I would recommend offering a second feed during the warmer months.

Diet enrichment - whole fruits spiked on branches.

2.2.4 Water

Turacos will drink several times a day; as such access to clean water is essential. They bathe regularly for which a shallow pond is ideal. Avoid placing any ponds or bowls under perches to prevent contamination from faeces.

2.3 SOCIAL STRUCTURE

2.3.1 Basic Social Structure

Generally kept in pairs.

Recently a few collections have begun maintaining bachelor groups – over the next few years we should have a better understanding of how feasible keeping single sex groups can be utilized as a management tool for this population; socialising immature birds, changing dynamics of a group as individuals reach maturity, how practical it is to mix new birds into an establish group etc.

2.3.2 Changing Group Structure

Introducing birds is never predictable, as a general rule introduction on neutral territory is usually advisable; however, this is not always practical due to a shortage of aviary space.

Introduction of what potentially would be the most aggressive of the pair (in most cases the male) into the established territory of the least potential aggressor (generally the female) would be the next most viable option. Always ensure there is a suitable amount of cover to allow any bird being pursued to hide, and closely monitor that neither individual is being prevented access to housing or food by the other and that neither individual is becoming unduly stressed.

Of the 22 institutions that replied to the 2007 survey 30% have introduced birds on neutral territory, of those aggression was observed during 3 separate introductions but all were considered successful introductions.

44% of institutions introduced males to an established female territory with 2 instances of aggression being observed. One introduction was a hand reared male, the female still has to be removed from the aviary from time to time due to her aggressive behaviour; this is the only mentioned case of an introduction being considered as unsuccessful.

26% of institutions have introduced females to an established male territory; no instances of aggression were mentioned.

Historically in the 1980's there were two cases of females being killed by their mates, with one death occurring during the initial introduction. This information indicates that no introduction should be considered predictable, every introduction should be planned and behaviours closely monitored.

In the event of a particularly difficult pair a softer approach can be attempted by allowing the birds to see each other from adjacent aviaries or by partitioning off part of the enclosure placing one bird either side. Once positive behaviour is observed gradual access can be allowed.

Wing clipping has also been used in the past with more aggressive turaco species; by “slowing down” the aggressor this enables more time for the subordinate to retreat. (This technique is not recorded as being used on Red-crested Turacos).

2.3.3 Sharing Enclosure with Other Species

Many species have been mixed with Red-crested turaco without problems. Many of these mixes are in large aviaries and in the case of one institute they are mixed with 25-30 other bird species (not listed in the table below) in a large walk-through exhibit.

Whenever mixing species for the first time always look at aviary size; is it large enough to allow species to establish their own territories? Is there adequate cover to allow specimens to get away from each other? Are there sufficient feeding stations to prevent any territorial disputes that may stop species from feeding?

During the breeding season it is essential to continually monitor for any signs of aggression; turaco species can become aggressive when nesting, as can other species. Turaco chicks tend to leave the nest before they can fly and at this time they are very clumsy and vulnerable to attack.

Aggression has been recorded from pheasant species with chicks, becoming increasingly protective and eventually attacking a Turaco species that had co-habited happily in an aviary for years without any previous sign of aggression.

Common Name	Taxonomic name	Problems associated with mix
Puna Ibis	<i>Plegadis ridgwayi</i>	
Madagascar Teal	<i>Anas bernieri</i>	
African Pygmy Geese	<i>Nettapus auritus</i>	
Pheasants & Quails spp	Phasianidae	Aggression from Red-crested during breeding season
Peacock Pheasant spp	<i>Polyplectron spp</i>	
Rothschild's Peacock Pheasant	<i>Polyplectron inopinatum</i>	
Palawan Peacock Pheasant	<i>Polyplectron emphanum</i>	
Tragopan species	<i>Tragopan spp</i>	
Temminck's Tragopan	<i>Tragopan temminckii</i>	
Green Peafowl	<i>Pavo muticus</i>	
Congo peafowl	<i>Afropavo congensis</i>	Red-crested Turaco 20-day-old specimen attacked and killed. (Recently fledged).
Lady Amherst Pheasant	<i>Chrysolophus amherstiae</i>	
Giant wood Rail	<i>Aramides ypecaha</i>	
Stone Curlew	<i>Burhinus oedicnemus</i>	
Dove spp	Columbidae	
Socorro Dove	<i>Zenaida macroura graysoni</i>	
Mountain Witch Doves	<i>Geotrygon versicolor</i>	
Sheepmaker's Crowned Pigeon	<i>Goura scheepmakeri</i>	
Green Imperial Pigeon	<i>Ducula aenea</i>	Red-crested stopped pigeons from breeding
Crested Pigeons	<i>Ocyphaps lophotes</i>	
Pink Pigeon	<i>Columba mayeri</i>	
King Parrots	<i>Alisterus amboinensis</i>	
Moluccan Lorries	<i>Eos bornea</i>	
Grey-headed Parrot	<i>Paradoxornis gularis</i>	
White-cheeked Turaco	<i>Tauraco leucotis</i>	
Rollers spp	Coraciidae	
Blue-bellied Roller	<i>Coracias cyanogaster</i>	Red-crested observed chasing nesting adults and fledgling rollers – Turacos moved from aviary.
White-fronted Bee Eaters	<i>Ockoides bullockoides</i>	
Speckled Mousebird	<i>Colius striatus</i>	
Regal Starlings	<i>Cosmopsarus regius</i>	
Superb Glossy Starling	<i>Spreo superbus</i>	
African Pied Starlings	<i>Spreo bicolor</i>	
Bali Mynahs	<i>Leucopsar rothschildi</i>	Aggression from Red-crested during breeding season
Golden breasted Mynah	<i>Mino anais</i>	
Yellow-bellied Laughing Thrush	<i>Garrulax galbanus</i>	
White-throated Laughing Thrush	<i>Garrulax albogularis</i>	
Black-throated Laughing Thrush	<i>Garrulax chinensis</i>	
Red and Yellow Barbets	<i>Trachyphonus erythrocephalus</i>	
Bearded Barbet	<i>Lybius dubius</i>	
White crowned Robin Chats	<i>Cossypha albicapilla</i>	
Shamas	<i>Copsychus</i>	
Weaver spp	Ploceidae	
Cape weaverbirds	<i>Ploceus capensis</i>	
Pekin Robin	<i>Leiothrix lutea</i>	
Bat spp		

2.4 BREEDING

Inexperienced pairs may need several attempts before they successfully rear chicks. It is vital that holders give inexperienced pairs the opportunity to learn; avoid intervention where possible for the first 2-3 clutches. If pairs continue to fail, conditions may not be fully conducive - consider and adapt husbandry, even subtle changes can influence the outcome. Once turaco have bred successfully, they generally tend to have repeated success.

2.4.1 Mating

It is important to ensure there is at least one sturdy perch in the aviary that is long enough to enable both birds to perch adjacent to each other as the male will mount the female from this position, after a series of chasing, feeding, calling and mutual head bobbing and beak clapping.

2.4.2 Egg Laying and Incubation

Turacos build very flimsy nests, providing them with an appropriate nest choice is important for success. Basket, wood or wire frames with approximate nest dimensions of 33cm x 20cm x 7.5cm. A substrate on the floor of the nest will prevent eggs from rolling or the chicks' legs from splaying; astro-turf, carpet or similar work well, but be sure to clean or replace between clutches. For added security artificial or natural foliage can be placed around the nest, take care to ensure the birds have a direct route to and from the nest.

Turaco will play at nest building and may add twigs to the nest, by providing them with nesting material you are allowing them to carry out natural behaviours.

Nest placement must be considered carefully. Too high and you will be unable to monitor the nest, too low and the turaco will not feel secure. It must be in a sheltered position from the weather and away from any keeper access doors in a position that allows the birds to view a large part of the aviary to ensure the birds have a sense of security. Once a site has been successfully used by a pair they will continue to use it for subsequent clutches, at this point it is worthwhile making it part of the routine to check the nest once daily. Turaco quickly become conditioned to this routine and over time you may be able to get close enough to slightly raise incubating birds to gain a look at the eggs or chicks, or to offer supplementary feeds if there are problems. The turaco will defend the nest by hissing and attacking with their beak, so be aware that eggs or chicks may get between your hand and the attacking beak! Do not attempt this unless you know your birds well, it takes time to build up this type of relationship, and any mistake could result in trampled eggs or chicks.

It is good practice to remove all nests at the end of the season; this can discourage some species from extended breeding during winter months, and will give the birds the opportunity to regain condition. Introducing nests at the start of the breeding season can actively stimulate breeding behaviour.

The following data has been taken from the data collected in the studbook.

Hatch seasonality (clutches)		
Month	Number	Percent
January	1	0%
February	0	0%
March	2	1%
April	13	6%
May	33	14%
June	41	18%
July	56	24%
August	39	17%
September	23	10%
October	19	8%
November	3	1%
December	1	0%

Clutch Size		
Eggs per clutch	Number of clutches	Percent
1	137	59%
2	80	35%
3	11	5%
4	3	1%
Out of a total of 231 clutches, mean clutch size is 1.5		

If your pair of Red-crested are particularly bad at incubating or rearing and you have another steady reliable pair of turaco (*Tauraco spp*), adding eggs or chicks is feasible for foster incubation/rearing.

2.4.3 Hatching

Both adults will take part in incubating, brooding and feeding (feed via regurgitation). Adults generally consume eggshell once the chicks have hatched. Adults are very protective of nests and will generally remain sitting eggs/chicks whilst attacking any threat.

Newly hatched chicks are covered in dense black down, with visible small wing-claws. Eyes are either open or on the point of opening. Parents will consume the chicks' faeces as soon as it is expelled.

Generally for the first week to 10 days after hatching adults will rarely be observed off the nest for any length of time, any extended time away from the nest could indicate a problem. Watch for signs of mate aggression on the point of fledging chicks - oversexed young males may be in a rush to breed again, they can turn on both fledglings and or the female.

2.4.4 Development and Care of Young

The chicks grow rapidly and by two weeks they may start to explore their surroundings. At this age turaco chicks cannot fly and may fall to the floor; it is important to prepare for fledged youngsters in advance of nesting. When putting up nests, always ensure there is a network of branches from the floor up to the nest.

Chicks will come and go from the nest at this age - providing a natural ladder for chicks to return to the nest if they drop to the floor can save lives, especially in bad weather. Keep a close eye on the enclosure on the point of fledge - ensure there are no deep water bodies for clumsy chicks to fall into. Monitor any other bird species in the enclosure that may pose a threat to awkward and clumsy chicks. Even pheasant species will out of curiosity cause harm to stranded turaco chicks.

Generally the chicks are able to fly from four to five weeks, but will remain dependent on parents for several months after leaving the nest.

As a general rule adults do not tend to be tolerant of young from previous clutches, pairs will harass, pursue and even attack juveniles, especially when adults are ready to nest again. If offspring are not removed in a timely fashion injury or death may occur. It is vital that both adult and juvenile behaviour are monitored closely at this time, subtle clues will allow you to make the correct decision at the right time, warning signs are; increased distance between juvenile & adults, less positive interaction, increasing levels of chasing or harassing (best to remove juveniles at this point), eventually escalating into physical aggression. Beware that if you remove juveniles too soon they may not be fully independent, in this situation closely monitor food intake.

Good quality aftercare for juvenile turaco is as essential as all other stages of the breeding process, these juveniles will be the next generation of breeders, it is vital that birds are given the right quality of care at this stage. Avoid (where possible) isolating individuals in small holding aviaries where they cannot build up flight muscles, nor interact with other birds. Avoid (where possible) transferring juvenile birds to other collections for pairing before they are mature - or at the very least before they are six-eight months of age.

After removal of juvenile turaco from parents, they can be mixed with juveniles from previous clutches or other turaco species to form a crèche, this will keep juveniles stimulated and socialised, giving them time to mature before being transferred for pairing.

Utilize any large mixed species exhibits as potential playgrounds for juvenile turaco - these types of aviaries are becoming increasingly popular, and are ideal to build up flight muscles - resulting in fitter individuals. Young turaco bouncing around a large aviary will make an impressive display for visitors.

2.4.5 Foster rearing

If the option is available, foster rearing is a preferable alternative to hand rearing, and can be utilized as a tool to maximise offspring from genetically important pairs; it is more keeper time efficient than hand-rearing, and produces physically and psychologically healthier individuals.

The key to any successful foster rearing attempt is in knowing the fostering individuals. Any turaco species pair which has a proven track record is an ideal candidate for use as foster parents. If possible spend some time conditioning pairs to the presence of keepers in the proximity of nests. Ideally nests need to be easily accessible to facilitate any exchange of eggs or chicks, whilst causing minimal stress to the adults.

Once broody, reliable foster rearers will accept substitutions at any stages; eggs not too far into incubation can be replaced for eggs which are closer to hatching, pipping, or with newly hatched chicks. Alternatively, (provided they are due around the same time) you can add eggs to an existing clutch, or chicks to an existing brood.

When swapping eggs or chicks, extreme care must be taken; brooding turaco will puff themselves up, hiss and beak strike at any object which comes too close. Always fully protect any egg or chick

with your hand, divert the adults attention with your free hand whilst gently removing or adding the egg/chick. Work calmly and with slow movements, if the bird panics, it may result in damage to other eggs/chicks that are already in the nest. Step back and observe from a safe distance to ensure the bird has settled and accepted any substitution.

Turaco can be conditioned over time to tolerate nest inspection by keeping staff, allowing keepers to slightly raise brooding birds enabling inspection of eggs or chicks. Any individual chicks that do not appear to be thriving could be offered supplementary feeds.

2.4.6 Hand-Rearing

With the right husbandry techniques the majority of turaco species are not difficult to breed. Artificial rearing should only be considered as a last resort - parent or foster rearing will result in physically and psychologically healthier individuals.

Turaco species will easily imprint on humans when hand-reared and although hand-reared turaco can go on to parent rear successfully, there can be behavioural problems. Hand reared birds can prove more difficult to pair and may result in increased mate aggression. In a breeding situation hand-reared birds lose their fear of humans and can attack keepers. If the birds are housed in a public walkthrough enclosure this aggression could be taken out on passing visitors. The attack is usually focused towards the head and face, so could result in injury.

If a decision is made to hand rear every effort should be made to minimise imprinting - if possible rear at least two birds together, and minimise human contact. Socialise/crèche juveniles as early as possible with other juvenile turaco.

Artificial incubation – eggs should be placed in an incubator set at 37.5 degrees centigrade. Humidity should be adjusted to insure appropriate weight loss at 15%.

There are many different turaco hand-rearing diets several examples can be accessed via the Avian Rearing resource <http://www.avianrearingresource.co.uk/>

The following protocol has been used successfully for Red-crested turaco.

Ingredients of Rearing Powder

- 200g Shredded Wheat
- 100g Avi Plus Mynah Pellets (Rob Harvey)
- 33g Nectar Mix (Haiths)
- 7.4g Nutrobal

Take all components and grind together until a very fine powder.

Basic diet:

First 24 hours – Wait for at least 6 hours after hatching. Then offer 5ml of distilled water with a pinch of Avipro chick starter, give this every 2 hours. All feeding is carried out between 7.00am and 10.00pm.

Day 2 Diet ratio - 5% Rearing Powder, 20% Banana, 75% Distilled water, 1 pinch of paediatric. 7 feeds per day, every 2 hours.

Day 3 to 9 Diet ratio – 10% Rearing Powder, 40% Banana, 50% Distilled water. Continue feeding every 2 hours.

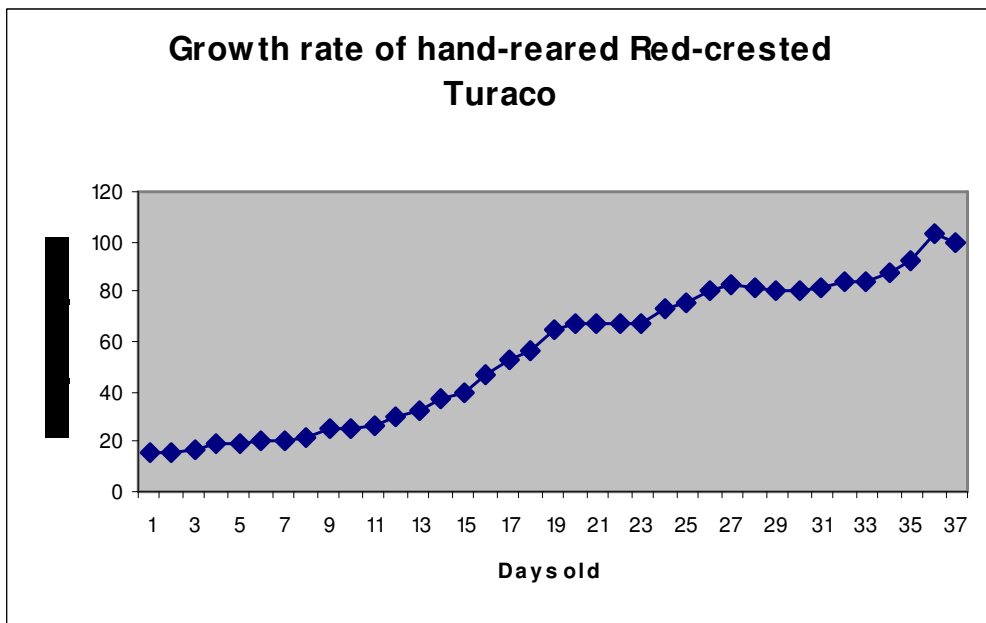
Day 9 onwards – Gradually reduce mixture and increase fruit.

Day 6 onwards – Start to introduce in small amounts different types of soft fruit and greens; this is in preparation for the change in diet from day 9/10 onwards.

When making the mix, pass Banana through syringe before drawing up full mixture.

Diet is fed via syringe a little at a time; take care the chick does not aspirate. Warm diet through slightly before feeding. Feed no more than 10% of the chick's bodyweight per feed.

Defecation can be stimulated, by gentle palpation of cloaca.



2.5 POPULATION MANAGEMENT

2.5.1 Population Status

As of 31/12/13 there are 52 institutions holding 145 specimens in the European region. Overall the population is growing, with more holders and breeding success.

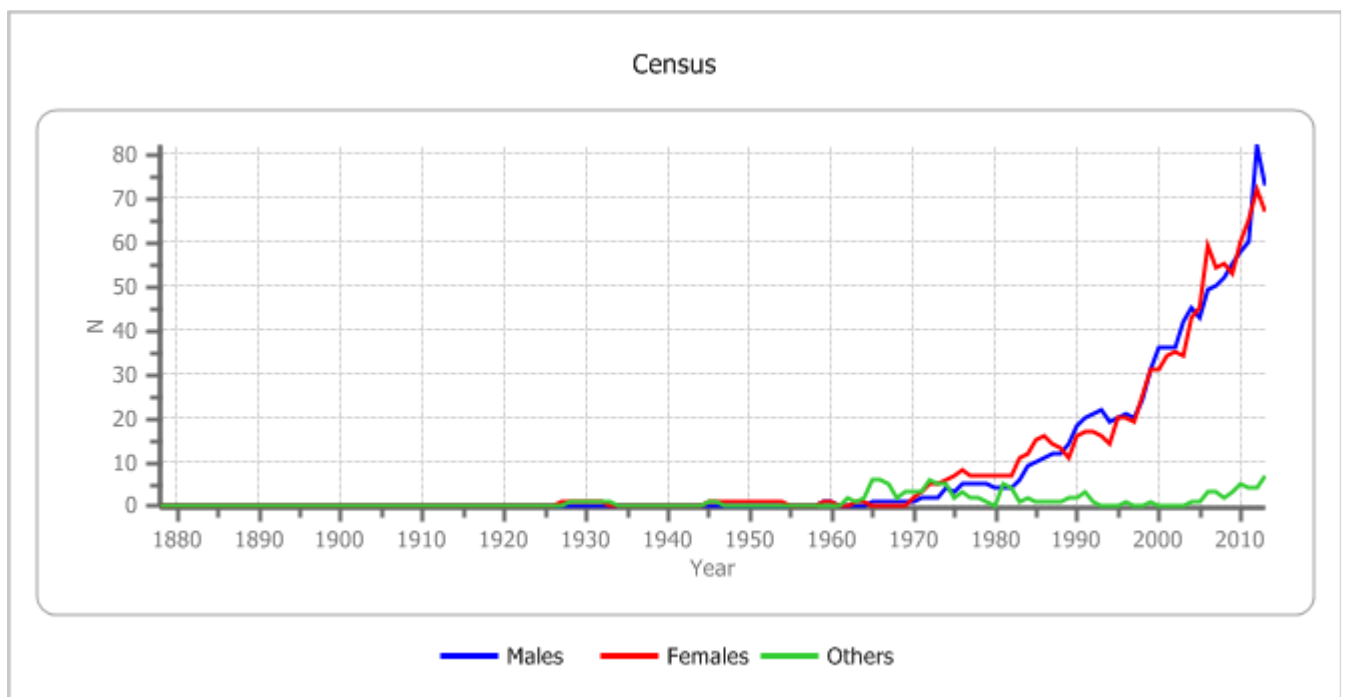
Proper analysis of this population is difficult due to the low number of known founders and only 36% known origins. There is a potential of a genetic study on this population by Oxford Brookes, this will give a much more informed view of origins and how the population is functioning overall.

The first traceable Red-crested turaco held in captivity dates back to 1878. Several more arrived during the 1960's and early 70's. The first breeding was in 1974 by the then named Jersey Zoo.

Due to the conflict/war in Angola, after the early 1970's only two more wild caught birds entered the captive population in Europe.

This species is very popular in private aviculture and many individuals have been exchanged between zoos and private individuals, there is no doubt as large a population of Red-crested turaco in the private sector in Europe as there are in zoological collections. All investigation into the origins of birds in the private sector leads to an assumption that they share origins with the ESB population. Several private individuals are keen to take part in the proposed genetic study, helping to determine if assumptions are correct or if we can add further genetic diversity into the ESB population via private individuals.

Census of Red-crested population in ESB



2.5.2 Individual Identification and Sexing

This species is not sexually dimorphic; the only ways positively to sex this species are via non-invasive DNA sexing, either through toenail clippings or from feathers (the option frequently used), or through surgical sexing.

Identifiers used are microchips inserted under the skin in the breast area, and/or leg rings. Closed rings can be placed on the chicks at approximately 3 weeks of age (Ring size S). Alternatively split plastic or metal rings can be used and fitted at any age. Different coloured rings can allow identification of individuals from a distance

2.6 HANDLING

2.6.1 General Handling

As with all bird species care must be taken whenever handling a turaco. A firm grip with two hands is recommended; they will struggle but take care not to hold too tightly.



As pictured, hold the wings firmly to the body of the turaco. When stressed turaco will regurgitate food, do not obstruct the beak or hold the bird on its back, if the bird is not able to expel the food material there is a risk of asphyxia.

Many thanks to Tori a visually impaired turaco who kindly modelled this procedure.

2.6.2 Catching/Restraining

Catching turaco in a small enclosure is best done using soft catching nets, as turaco are quite clumsy fliers they are relatively easy to predict and catch mid-flight. This is less stressful/traumatic than attempting to catch against a wall of an enclosure.

In a large mixed exhibit a catching cage can be used. By placing food inside a cage close to the normal feeding station, birds can be encouraged to enter, using a pulley system the door can be closed from a distance by a patiently waiting keeper. This can take time to achieve, but if the cage is a permanent fixture the birds will become conditioned to entering the cage, making the process more routine and quicker.

Anaesthetic protocol – Same as for other bird species. Careful manual restraint of the bird, using a mask and membrane attachment to the anaesthetic circuit. 2 litres/min oxygen flow with either isoflurane (4-5%) or sevoflurane (8%) induction. After induction, if the procedure is likely to be more than a few minutes, routine endotracheal intubation is carried out. Maintenance of anaesthesia is isoflurane (1-3%). On recovery, volatile anaesthetic agent is switched off and pure oxygen maintained until recovery.

A short interval of fasting is recommended before any anaesthetic, this will reduce the risk of inhalation of regurgitated food, a 4 hour fasting period should be sufficient.

2.6.3 Transportation

For short journeys (in-house moves from aviary to aviary) a sky kennel or cardboard box can be used. Cover the container to keep the bird in the dark, but ensure there is still adequate ventilation (especially important in hot weather). Do not place the container in any draughts. Always crate individuals separately as stressed birds can become aggressive.

For longer car journeys follow the above routines but also place a perch in the crate. Foam attached to the roof of the crate will prevent any damage to the head if the bird panics and newspaper can be used as a substrate for the floor of the crate. If travelling in hot weather make sure that the vehicle is air conditioned. Food and water must be provided if the journey time exceeds 12 hours.

For journeys by air the IATA Live Animal Regulations must be adhered to. In the 31st edition container 11E (pages 176-183) is required.

2.6.4 Safety

As with all bird species there are risks of zoonotic diseases, to date I have no information of an instance of this relating to Red-crested turaco, and with good working practices and protocols any risks can be dramatically reduced. Good hygiene regimes should be practised in enclosures along with thorough personal hygiene routines. Routine faecal screening of birds can pre-empt any health issues.

Hand reared birds when placed back into an aviary situation and paired can become quite aggressive towards keepers, flying at and brushing against keeper's faces. Take extra care when working around these birds and protect your eyes.

Enclosure escape – in the event of an escaped individual, provided the individual is not being harassed and they can see and hear other turaco species, escapees do not tend to venture too far out of the area. One documented case of an individual being at liberty for two weeks, feeding from local fruiting trees, constantly came back and sat on top of the enclosure calling to its mate. Food was placed in a live trap on top of the aviary daily and eventually when the fruiting trees had lost their appeal the individual was safely re-captured.

2.7 HEALTH & WELFARE

Parasites

Red-crested Turaco do not appear to have many problems with internal parasites. As it is difficult regularly to examine individuals especially in large mixed aviaries, twice annual precautionary deworming treatments are advised and should be carried out in conjunction with faecal parasitology screening; this way you can reduce the occurrence of any potential problems. Recommended that treatments are given before and after the main breeding season.

Yersiniosis or *Yersinia pseudotuberculosis* is a gram-negative bacterium that can cause tuberculosis-like symptoms and has virulence factors, allowing the bacterium to live as a parasite in the host. It is spread through the faeces of rodents and wild birds - both of which can

contaminate food and water. It can infect humans zoonotically so personal hygiene precautions must be taken.

Symptoms include dehydration, lethargy, diarrhoea, laboured breathing, weight loss, resulting in death which can occur quite rapidly giving little chance for treatment to be administered or enough time for them to work. If symptoms are noticed early enough treatment with antibiotics can be effective, however prevention through good husbandry practice is the best course of action. Always ensure that food and water dishes are under cover and off of the floor out of reach of rodents. Wherever possible when building new aviaries, design them to keep out wild birds and rodents.

Egg binding has been the cause of several deaths with this species. The difficulty is identifying the problem especially in large mixed species aviaries as you may not always be aware of where birds are nesting.

There are multiple causes of egg binding; a malformed or large egg, if the bird is in poor physical condition caused by illness, stress, calcium deficiency, or over-weight. To treat the bird place in a dark, quiet, warm and humid area, if the egg has not been passed after a few hours seek veterinary help, they may be able to remove the egg by gentle massage and lubrication.

Metabolic bone disease/splayed legs.

An umbrella term for many disorders (e.g. rickets, osteoporosis, hypocalcaemia etc.) that results in severe crippling or death when not identified early. It can be caused by calcium deficiency, excess or a poor calcium/phosphorus ratio. This issue can affect turaco chicks during development. MBD can occur in both parent reared and artificially reared turaco. In the past it was much more prevalent in hand-reared birds, but since the demise of the paw-paw / pinkie hand-rearing diet it is less widespread. Pinkies are low in calcium and high in protein, resulting in rapid growth of chicks without the adequate levels of calcium needed for proper bone development.

There are still occasional problems with leg splaying in turaco chicks, and if not identified early can result in fatalities. This is preventable in most cases by ensuring that the correct substrates are used to line the nests, both with parent and artificially reared chicks. Avoid items which can potentially trap their legs and excessively slippery surfaces on which they cannot gain a purchase. For parent-reared chicks pieces of carpet can be used to line the nests, this should be discarded after each clutch and the nest re-lined with fresh material. Astro-turf has recently been used for hand-reared chicks with great success. This is an easy material to keep clean and offers the chick much better purchase.

Another difficulty is over-feeding when hand-rearing chicks; turaco do not have a crop so visually it is difficult to judge the correct amounts to feed, it is always wise to weigh feeds out to avoid over-feeding and growth spurts.

Obviously in the case of parent-reared chicks we have much less control over what happens to them. Having said that, leg deformities with parent-reared turaco are infrequent. It is difficult to monitor what the chicks are being fed and even more so in a mixed aviary situation where multiple food items are available. Whether this is as a result of inexperienced birds or weak chick's remains to be seen.

Microphthalmia

In 2010 there were two pairs of birds which produced chicks with varying degrees of microphthalmia (small eyes), after investigation it was suspected that recessive alleles were responsible.

The two pairs were stopped from any further breeding and since then no new cases have been reported. Research is still on-going, with the potential in the near future to identify the genetic basis of this phenotype, with a view to removing all individuals carrying disease alleles from the current captive breeding population.

Ill Health: behavioural indicators	
Lethargy	Birds are very good in masking a disease, usually when a bird is lethargic and staff can easily approach him – this is an end stage of a disease. Lethargy can be a symptom of CNS injury eg. after hitting the window.
Fluffed up	Hypothermia, non-specific. Occurs when bird is undergoing an infection or infestation – birds can't have fever and when fighting a disease will "shift" energy by saving body heat. If that is not environmental (too low temperatures in enclosure) provide an additional heat source eg. reptile heating lamp.
Wasting	Loss of weight may indicate Aspergilosis, fungal diseases or a GI tract, parasites, chronic bacterial diseases (including TB and Yersiniosis), liver insufficiency, metabolic diseases etc.
Sneezing	Infections (bacterial, fungal) of upper respiratory tract, sinus infections, gapeworm infection
Rapid breathing	Stress, fungal and bacterial diseases of respiratory tract, shock, also when peritonitis occurs (egg bounding), gapeworm

2.8 CONTACT ADDRESSES

DNA Feather Sexing

AVIAN BIOTECH website www.avitronics.co.uk
PO Box 107, Truro, Cornwall, TR1 2YR England
Tel: (44) 01872 262737, Fax: (44) 01872 262737
info@avianbiotech.co.uk

IATA Live Animals Regulations.

Available from Freight Merchandising Services, website www.fmslondon.co.uk
Unit 19, Shield Road,
Ashford Industrial Estate,
Ashford, Middlesex. TW15 1AU
England
Tel: 01784 240840 Fax: 01784 248615

International Turaco Society

Website www.turacos.org
Chairman David Jones
E-mail: david@turacos.org

2.9 RECOMMENDED RESEARCH

Nutrition	More research required into nutritional requirements of turaco to help improve health, longevity and production. Current research underway to analyse captive faeces.
Mate aggression	What factors trigger mate aggression? Individual health, a lack of socialising, feather colour and or condition, environmental stresses, age/maturity differences, hormonal?
Juvenile care	Does the way we manage young birds influence their future? Are there ways to improve management of juveniles that will improve productivity as an adult? What effect does crèche management have on individuals?
Genetic study	Oxford Brookes are proposing a genetic study on the Red-crested turaco population – this will have the potential to give us a more definitive understanding of the genetic diversity of this population and enabling a more informed management strategy for this species.

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