

# EAZA Best Practice Guidelines

## Straw-headed Bulbul *Pycnonotus zeylanicus*



Photo credits: Steward Muir, Newquay zoo

**Edition 1, August 2019**

**Author:** T.Manoj Kumar

Jurong Bird Park, Singapore

**Passeriformes TAG:** David Jeggo



## **EAZA Best Practice Guidelines disclaimer**

Copyright (August 2019) by EAZA Executive Office, Amsterdam. All rights reserved. No part of this publication may be reproduced in hard copy, machine-readable or other forms without advance written permission from the European Association of Zoos and Aquaria (EAZA). Members of the European Association of Zoos and Aquaria (EAZA) may copy this information for their own use as needed. The information contained in these EAZA Best Practice Guidelines has been obtained from numerous sources believed to be reliable. EAZA and the EAZA Passerine TAG make a diligent effort to provide a complete and accurate representation of the data in its reports, publications, and services. However, EAZA does not guarantee the accuracy, adequacy, or completeness of any information. EAZA disclaims all liability for errors or omissions that may exist and shall not be liable for any incidental, consequential, or other damages (whether resulting from negligence or otherwise) including, without limitation, exemplary damages or lost profits arising out of or in connection with the use of this publication. Because the technical information provided in the EAZA Best Practice Guidelines can easily be misread or misinterpreted unless properly analysed, EAZA strongly recommends that users of this information consult with the editors in all matters related to data analysis and interpretation.

## **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**

Kumar, Manoj T. 2019, EAZA Best Practice Guidelines for the Straw-headed Bulbul *Pycnonotus zeylanicus*. Edition 1

## Summary

This is the first edition of the EAZA Best Practice Guidelines of the Straw-headed bulbul (*Pycnonotus zeylanicus*). These guidelines aim to give basic information on the captive care requirements of the species to zoo professionals that is interested in working with it. Jurong Bird Park, Singapore (JBP) has been successful in consistently breeding this species and these guidelines are mostly based on the data collected at JBP. It is noteworthy to point out that Singapore is a range country for the species and as such the data collected reflects the needs under its native tropical climate. These guidelines will be reviewed and adjusted in the future, when more research studies are done and along with more experience.

The taxonomy used in this document follows: del Hoyo, J. & Collar, N.J. (2016) HBW and BirdLife International Illustrated Checklist of the Birds of the World. Volume 2: Passerines. Lynx Editions, Barcelona.

## Acknowledgements

The author is immensely grateful to the following individuals for their kind contributions and advice to the first edition of these guidelines.

Dr Luis Carlos Neves, Anais Caroline Tritto, David Tan, Dr Neo Pei Ci, Mohd Razali Bin Habdin and Gerard Wan.

**All images to be credited to T.Manoj Kumar, unless otherwise stated.**

## Content

<b>Section 1: Biology and Field Data.....</b>	<b>5</b>
A. Biology.....	5
1.1. Taxonomy.....	5
1.2. Morphology.....	6
1.3. Physiology.....	12
1.4. Longevity.....	12
B. Field Data.....	12
1.5. Conservation status/ Zoogeography/ Ecology.....	12
1.6. Diet and Feeding Behaviour.....	12
1.7. Reproduction.....	13
<b>Section 2: Management in Zoos and Aquariums.....</b>	<b>14</b>
2.1. Enclosure.....	14
2.2. Feeding.....	16
2.3. Social Structure.....	21
2.4. Breeding.....	22
2.5. Behavioural Enrichment.....	34
2.6. Handling.....	35
2.7. Veterinary: Considerations for Health and Welfare.....	30
2.8. Specific Problems.....	43
2.9. Recommended Research.....	44
<b>Section 3: References.....</b>	<b>45</b>

## Section 1: Biology and Field Data

### A. Biology

#### 1.1 Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Aves

Order: Passeriformes

Family: Pycnonotidae

Genus: *Pycnonotus*

Species: *zeylanicus*

Subspecies: This species is monotypic

Common name(s): Straw-headed Bulbul, Straw-crowned Bulbul, Cucak-rawa (Bahasa Indonesia)

The Straw-headed Bulbul is a monomorphic medium-sized Passeriforme that is endemic to Brunei Darussalam, Malaysia, Singapore, Myanmar & Indonesia. It is known for its rich, melodious and powerful call, often sang in duets, which has ironically contributed to the species demise through its natural range due to unsustainable harvest.



Plate 1 : Straw-headed Bulbul (*Pycnonotus zeylanicus*) © David Tan, Wildlife Reserves Singapore

## 1.2. Morphology

### Morphometric

Sex	Beak (Tip to nostril) (Length)	Skull (Width)	Tail (Length)	Wing (Length)
Male	22.2mm (+/- 2.7mm)	25.7mm (+/- 4.93mm)	122mm (+/- 2.3mm)	122mm right, (+/- 1mm) 122mm left, (+/- 0.6)
Female	23.1mm (+/- 1.7mm)	19.8mm (+/- 0.51mm)	112mm (+/- 8.8mm)	116mm right, (+/- 2.5 mm) 117mm left, (+/- 3 mm)

Plate 2: A table that lists the average morphological details of 3 males and 3 females.

### Weight

Recorded weight of birds in the wild is 80-93g. (Fishpool. et al, 2018).

A study was done using 4 individuals in JBP, and the average weight for a male was 73g and the average weight for a female was 70.5g

### General Description

The Straw-headed Bulbul is one of the largest species in the family, and a robust, well-built bird. The bill is relatively heavy for a bulbul but proportional to the size of the bird.

The general coloration is as below:

<b>Forehead, crown, lores and infra-orbital area above submoustachial black stripe</b>	Golden-yellow (giving the species its vernacular name). There is also a black line that starts from the beak (near nostril) and runs across the eye level and extends a bit beyond
<b>Nape, mantle, upper back</b>	Greyish-brown, with narrow off-white to greying central stripes
<b>Chine, throat and upper breast</b>	Off-white
<b>Ventral body</b>	The chest is pale greyish-brown, with central off-white to greyish stripes; this coloration and patten continue to the abdomen though paler and less boldly patterned.
<b>Upper body</b>	Wings and tail brownish olive-green, with green tinge more evident in the outer webs
<b>Legs</b>	Black, with black claws
<b>Eyes</b>	The coloration of the iris changes gradually over time for juveniles. Juveniles lack the narrow blackish stripe at the start of the nostrils and their chin, throat and breast are of greyish colour.

There is no clear morphological difference for both sexes. Juveniles also lack the olive-green feathers and their plumage is more towards brownish. The juveniles attain the adult plumage when they are a year old.



Plate 3 : 15 day old Straw-headed Bulbul juvenile at Jurong Bird Park



Plate 4: Underwings of an adult Straw-headed Bulbul, at Jurong Bird Park



Plate 5: Dorsal face of the wing of an adult Straw-headed bulbul at Jurong Bird Park





Plate 6: The dorsal view of an adult Straw-headed Bulbul at Jurong Bird Park

The iris coloration of juveniles is black and this colour is prominent for a period of 6 months before it starts changing to a dull greyish colour. The dull greyish colour changes to a much brighter chestnut-reddish colour after a year and a half and this co-relates with them being an adult. Sub-adults have dull brownish iris coloration. Studies done at JBP have confirmed that the iris coloration of juveniles, changes as they grow older and could possibly be a way to tell when they have attained sexual maturity. A study is currently in progress at JBP, to find the correlation between the colour of the iris and the sexual maturity.



**Plate 7:** A 15-day old juvenile Straw-headed Bulbul with black iris coloration at Jurong Bird Park



**Plate 8:** Grey iris coloration of a captive-bred, hand-reared subadult male at Jurong Bird Park (7 months old)



Plate 9: Dull reddish coloured iris of a captive-bred, hand-reared sub adult female at Jurong Bird Park (1 year, 6 months old)



Plate 8: Chestnut-reddish coloured iris of a confiscated female at Jurong Bird Park

## Vocalisation

Straw-headed bulbul is a very vocal species and it is easily heard all year round. Its' main call consists of descending regular notes "trr-trr-trr" and this is presumed to be the contact call due to the behaviour that is associated with it. The call lasts from 1 second to 2 seconds and this is the longest one that was recorded. However, this could be repeated several times. Their roosting calls consist of ascending regular notes "hu-tiu-tiu-tiu". Antiphonal duets are often heard in pairs and this is a sign of good bonding. Research was done using 1 breeding pair and a new pair that was housed together for 7 months and the antiphonal duet was only heard in the breeding pair. The other pair of Straw-headed bulbul often sang separately.

### 1.3. Physiology

No physiology data is available for this species at the time of writing.

### 1.4. Longevity

The average life span for this species in captivity is unknown due to the low numbers of individuals present plus considering the fact that most of them were acquired at an adult stage. Currently, JBP holds 4.4.2 of this species of which the founders were either donated by the public or confiscated and they have been in captivity for a period of 2 years and 4 months at the time of writing this document.

## B. Field Data

### 1.5 Conservation status / Zoogeography / Ecology

The Straw-headed bulbul is usually found in broadleaf evergreen forests and more exclusively along banks of rivers and marshes. This species has a very specific habitat type and it prefer altitudes from 240m to 1500m. (Birdlife International, 2016)

Due to its popularity as a songbird, rising value in the markets and the lack of sufficient legal protection in parts of its range, this species is being pushed towards extinction in the wild. (Chris R. et al, 2003). Intensive trapping to supply the cage bird trade has led to its rapid decline through most of its range and this was further confirmed by surveys. (Birdlife International, 2016). This species was formerly native to southern Myanmar and southern Thailand, Peninsular Malaysia and Singapore, the island of Borneo (except the southern part of Kalimantan), and the islands of Java and Sumatra. Although this species was considered to be widespread and common across much of its range as recently as two decades ago, it is

now believed to be extinct in Thailand and more surveys need to be done to assess its status in Myanmar and Brunei. It was extirpated from Java by the middle of the twentieth century and it is now quite possibly extirpated from Sumatra too. Remaining populations in Malaysia are facing severe threat from poaching for the cage bird trade and are thought to be in serious decline. The loss of habitat, especially the destruction of lowland forests along rivers has further contributed to the decline of this species. (Chris R. et al, 2003)

Recent surveys conducted in Singapore found that the country might now be harbouring more Straw-headed Bulbuls than anywhere across its range. Findings revealed that at least 200 individuals are thriving in Singapore and it is considered to be one of the few remaining strongholds. The Straw-headed Bulbul is currently listed as Critically Endangered (CR) by the IUCN Red List (Birdlife International, 2018), after it was up-listed to Endangered (EN) in 2016. Population trends is still decreasing.

Straw- headed bulbul is a protected species in Thailand and is also listed in Appendix II in CITES.

## **1.6. Diet and Feeding Behaviour**

The Straw-headed Bulbul is a fruit-based omnivore. In addition to berries, figs and other fruits, they also feed on small invertebrates such as small river-dwelling snails, spiders, beetles and cockroaches. In contrast to other bulbul species, the Straw-headed bulbul regularly feeds on the ground and are usually found foraging in family groups consisting of 3-6 individuals. There is no evidence of this species joining mixed-species flocks to forage. (Fishpool, L., et al 2018).

## **1.7. Reproduction**

There is very minimal information available from wild populations, with no information pertaining incubation and fledging periods. Straw-headed bulbuls breed from January to September in Singapore and build a cup-shaped nest comprising of thin twigs, rootlets, grass, and plant fibres and lays clutches of 2 eggs. (Fishpool, L., et al 2018) Several anecdotal data indicate that this species is a cooperative breeder although further detailed research should be done to clarify the breeding system.

## Section 2: Management in Zoos and Aquariums

### 2.1. Enclosure

#### 2.1.1. Boundary

Stainless steel wire mesh which has a grid that measures 1x1cm should be able to prevent rodents and other predators from accessing the aviary. In order to prevent rodents from burrowing underground and entering the aviary, a wire mesh or brick wall of minimum of 50 cm deep should be dug underground and then bend horizontally outwards at about 30cm. This should deter rodents from burrowing into the aviary. Straw-headed bulbuls are easily prone to stress and visual barriers can be used to increase sense of security and facilitate acclimatisation and also mitigate stress. Black shade netting can be used to seclude the cage without impairing air circulation for off-display exhibits. The shade netting should be placed on the outer mesh of the aviary so as to prevent the birds from getting their digits trapped and injuring themselves. Good planting of the enclosure is important for the birds' welfare and to improve sense of security and this is even more relevant in visitor-facing enclosures where human traffic is higher. It is not advisable to house two pairs of Straw-headed Bulbul in close proximity of each other and they should be housed a few aviaries apart, with ample visual barrier offered to avoid any form of territorial actions and with non-related species in between.

#### 2.1.2. Substrate

Natural substrate is highly recommended as this greatly enhances their welfare under human care by allowing the expression of the natural behaviour of foraging for food. Substrates such as grass, sand, soil and leaf litter also help trees grow. This said, the substrate has to be regularly raked, to avoid the accumulation of droppings. Regular replacement of the substrate needs to take place in order to avoid parasite build-up. In countries with harsh weather conditions, there is a need for indoor enclosures. For such cases, the substrate for the indoor enclosures should be concrete with a layer of sand. This allows easy cleaning of the floor by simple raking.

#### 2.1.3. Furnishings and Maintenance

While the species benefits from a well-planted aviary, enough flight space should be given, as there is evidence of propensity to become overweight in captivity due to lack of exercise. Perches of various adequate sizes should be placed throughout the aviary, including sheltered areas. The minimum diameter of a perch should be 5 cm and the maximum diameter should be 10cm. Lower and leaning perches should be added in case new fledglings are present in the aviary. 'Y' shaped perches are recommended since this species

has a liking towards holding onto vertical perches. Perches should never be placed above or near the food and water trays so as to prevent contamination of faeces. In tropical countries, plants such as Neanthe bella palm, *Chamaedorea elegans*, palm trees, *Arecaceae spp*, camwood *Baphia spp*, golden eye-grass *Curculigo spp* and Cogon grass *Imperata cylindrical* can be used in the aviaries. In temperate countries, trees such as the European beech *Fagus sylvatica*, Mexican white pine *Pinus ayacahuite*, *Pinus wallichiana*, Large-tooth aspen *Populus grandidentata*, Montezuma bald cypress *Taxodium mucronatum* would probably be as used.



**Plate 8:** Off-exhibit aviary housing Straw-headed Bulbuls at Jurong Bird Park

The food and water dishes should be made of a resistant easy-to-clean material and disinfected daily. It is recommended that perches and substrate be changed once every year and this could be scheduled to coincide with whatever operations require the birds to be caught such as physical checks or transfers. This is to prevent causing distress to the birds by removal of existing perches and coming in with new ones while the birds are inside. This should be done before the breeding season as the breeding season is a sensitive period for the birds.

The aviary should be regularly checked for the presence of pests and vermin (rats, snakes, snails) that could be disease carriers, injure the birds or disturb their breeding. Aviculturists should always keep a look out for signs of pests such as rat droppings, snake sheds and snails.

### 2.1.4. Environment

It is not necessary to have indoor aviaries when housing the species in countries in the tropics. It is advisable to provide the birds with adequate shelter from the rain and retreating places to hide from human view.

While there is very little reference to keeping the species in temperate climates with a harsher it is likely necessary to have an indoor area with additional heat source.

### 2.1.5. Dimensions

A pair of Straw-headed Bulbul should be housed in a well planted aviary with a minimum of 3m length by 3m wide. A minimum height of 2.5m is recommended as it allows the bird to perch high and feel secure. In countries with harsh weather conditions, an indoor accommodation should be provided so the birds can retreat from cold wind and temperature. It is recommended that the indoor aviary has to be a minimum of 2m length by 2 m wide by 2 m height, with ample perches and maintained at a temperature of 25 degrees Celsius. The indoor aviary should be furnished with enough vegetation for the birds to feel secure.

## 2.2. Feeding

### 2.2.1. Basic Diet

At Jurong Bird Park the diet for a pair of birds is as below:

<u>Maintenance diet</u>	<u>Breeding diet</u>
<ul style="list-style-type: none"> <li>• 30g of papaya</li> <li>• 10g of apple</li> <li>• 10g of pear</li> <li>• 12g of Mazuri® Softbill Pellet</li> <li>• 2 x mealworms (<i>Tenebrio molitor</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• 5 x Giant mealworms (<i>Tenebrio molitor</i>)</li> <li>• 10g of Orlux® Unipatee</li> <li>• 15g of Papaya</li> <li>• 5g of Apple</li> <li>• 5g of Pear</li> <li>• 15g of Mazuri® Softbill Pellet</li> <li>• 5g of crickets (twice a week)</li> </ul>

The diet above is offered to the birds, twice a day with the first feeding at 0630H and the second feeding at 1200H. The fruits are chopped diced and then later mixed and offered on a stainless steel plate, on the feeding platform.



### **2.2.2. Special Dietary Requirements**

The breeding diet is offered to the birds 1 month, prior to the breeding season. Different insects such as live crickets, live grasshoppers and dead cockroaches are also offered. Offering of live food should be decreased when the first egg has been laid and this is to prevent the male from displaying mating aggression towards the female. The amount of live food should be increased again, one day before the estimated hatch date. During chick rearing, extra care should be taken to ensure only small insects that are edible by the chicks should be offered in order to prevent any form of suffocation or choking. Different food such as ant eggs or moulted mealworms (white) should be provided for the chicks. Mature, rough-skinned mealworms are preferentially avoided because of the difficulty for the chicks to digest the exoskeleton and consequently cause impaction. Small sized crickets can be offered as food for the nestlings when they have passed 5 days of age. The crickets should be placed in a tray with smooth walls to prevent the crickets from escaping. A perch could be placed inside the tray which would aid the birds from landing on the perch to catch the crickets. Straw-headed bulbuls prefer live insects and have been observed to ignore dead crickets or mealworms. Food should be offered several times a day when there are chicks present in the nest, with the first feeding starting as early as 0630H and the last feeding being at 1800H. A minimum of 8 live food provisions is recommended per day and this can be decreased as the chick ages. Vitamin supplements such as Nekton-MSA<sup>®</sup> are also given once every two days and furthermore, all the live food that is offered is gut-loaded 2 hours prior to being offered to the birds. It is advised to sprinkle Nekton-MSA<sup>®</sup> on the live food prior to offering the birds for all 8 feedings.

At Khao Khew Open Zoo, Thailand, the diet for Straw-headed Bulbul comprises of seasonal fruits such as papaya, banana, guava and mealworms. The Straw-headed Bulbuls are housed in a mixed-species exhibit in Khao Khew Open Zoo.

### **2.2.3. Method of Feeding**

A feeding platform that can be serviced from outside in one of the ends of the aviary is ideal as it allows the animal care staff easily to feed the birds without having to enter the aviary. This prevents any stress caused to the birds whenever humans enter the aviary. The feeding platform should be at a minimum height of 1m and should be vermin- proof. Animal care staff should further ensure that wild birds have no access to the feeders neither a way to perch right on top of it to avoid faecal contamination. This could be avoided by placing a roof over of the feeding platform. The feeding platform should be scrubbed and washed, once a day using disinfectants such as F10.



Plate 9: Sliding feeding gate of the Straw-headed bulbul aviary at Jurong Bird Park



Plate 10: Feeding platform at Jurong Bird Park



**Plate 11:** A roof over the feeding platform to prevent wild birds from perching above the feeders, at Jurong Bird Park

#### **2.2.4. Water**

Fresh, clean water should be available at all times. At JBP, drinking water is offered in the feeding platform, in a relatively small stainless steel bowl. The birds also have access to shallow water trays made of stainless steel, of a depth of 5cm for bathing. Small pebbles are placed inside the water dish to give the birds an elevation while bathing. The bath tray is advised to be removed when new fledglings are present in the aviary to avoid any cases of drowning. The bathing trays are also removed in case of need to administer medication in the drinking water, to ensure the birds consume it. The water tray should not be placed directly under perches and trees to prevent contamination of faeces.

If streams are present in naturalistic aviaries, it is recommended to stop the stream and to drain it out prior to the chick fledging or at least drop the water level if possible, to minimize the chance of drowning.



Plate 12: A shallow water bowl, made from stainless steel, allows the birds to drink water and enables medications to be administered.



Plate 13: Tray with water and pebbles for the birds to shower

## 2.3. Social Structure

The Straw-headed Bulbul is a social bird and is rarely seen alone. They are usually seen foraging in pairs or in groups. There is no evidence or observation of the bird joining mixed-species flocks to forage. There have been no trials done till this date to determine whether this species could be housed as single-sex groups or single-sex pairs, thus this is not a recommended action.

### Pair formation

New pairs should be formed as early as possible prior to the breeding season. In South East Asia, the Straw-headed Bulbuls usually commence nesting in January. It is highly recommended that a new pair is formed and established in their breeding aviary by December. As a rule of thumb, care should always be taken when forming new pairs.

Ideally, new pairs should be introduced to each other by being housed in adjacent aviaries. The aviaries have to be fitted with adjacent perches which then allow the birds to roost right next to each other, with just the mesh in-between. There should not be any form of visual barrier between the birds and this would allow them to properly familiarize with each other. They should be housed next to each other for a minimum period of 30 days. Observing an antiphonal duet between a newly introduced pair is always a good sign of bonding. After the introduction period of 30 days, the pair can be then introduced in a neutral aviary. If a neutral aviary is not possible, it is advised to allow the female to become established in a breeding aviary, before introducing the male. Close observation should be made of the birds for several days, after introducing them together. If any form of aggressive behaviours is observed, the birds should be immediately separated. Prior to setting up a new pair in a neutral aviary, extra care should be taken to ensure the disturbance is kept to a minimum and black shade netting is placed around the aviary to allow the birds to feel secure and undisturbed and a CCTV can be used for strong monitoring. In zoos, it is better to house a newly formed pair in off-exhibit aviaries rather than walk-in exhibits. A bonded pair will often engage in duets, perch close to each other, engage in mutual allopreening, wing-shivering (courtship display), and token feeding.

### Interactions between different pairs

Distance between pairs of Straw-headed Bulbul is a very important factor when it comes to breeding. They should never be housed in adjacent aviaries as they are likely to spend time bickering instead of breeding. If more than one pair is being kept, this should be spaced out, as far as possible, not having visual sight of each other and most importantly, at a distance far enough to avoid any vocal distress between the pairs.

## **Parent/Sibling tolerance**

As the Straw-headed bulbul flocks together in family groups, the juveniles are not removed from the parents immediately and will be allowed to flock together till the progenies are 8 months old. They would be then removed for DNA sexing and ringing.

### **2.3.1 Changing Group Structure**

No information is available at the time of writing.

### **2.3.2 Sharing Enclosure with Other Species**

At Jurong Bird Park single juvenile Straw-headed Bulbuls have been housed with birds of other species. This includes Columbiformes, Galliformes and some Passeriformes such as the Asian Fairy Bluebird *Irena puella*, Green Broadbill *Calyptomena viridis*.

It is however not advisable to house mature pairs of Straw-headed Bulbuls with other smaller or equally-sized arboreal species as this may result in aggression. The Straw-headed Bulbul is known to be aggressive during breeding season and they would only tolerate ground dwelling species such as Galliformes. A breeding pair was successfully housed with a pair of Malayan Peacock-pheasant *Polyplectron malacense* and the Straw-headed bulbuls successfully bred without any form of aggression displayed towards the pheasants.

## **2.4. Breeding**

The Straw-headed Bulbul was bred successfully for the first time in over a decade at Jurong Bird Park in March 2017.

Although there are anecdotal reports that suggests private aviculturists having consistent success breeding this species, it has proven to be not an easy species to breed and such allegations of captive breeding require validation. The species has shown to be rather nervous during nesting, with pairs abandoning the eggs at an early stage of incubation, often with minimal disturbance. As early attempts to parent rear in 2017 were unsuccessful, hand-rearing was necessary for this species for the subsequent clutches of that year. The first parent-reared chicks were successfully fledged the following season, on July 2018.

### **Seasonality of breeding in captivity**

In South-east Asia, the breeding season for the Straw-headed Bulbul is from January to September. This coincides with the start of the rainy season and abundance of insects found in the wild and the temperature of the breeding season ranges from 26-30 ° Celsius. Most

nest building activity takes place from January to February with a peak in nesting at the months of March, April, June and July.

### **Nest building**

Plenty of nesting material should be made available for successful nest building. Both sexes participate in this process, with the female playing a greater role. During the nest building period, the pair becomes very quiet and secretive only engaging in duets in the early hours and during sunset. This often poses as a problem for observations of nest building as their aviary has to be heavily planted and their chosen nest sites are always secluded within the vegetation. Installing a CCTV in the aviary can provide valuable footage of the nest construction process and for this the cameras should be installed at a minimum distance of 5m away from the nest and facing it from above to allow close monitoring of the chicks at all times.

During the nesting period all forms of disturbance should be kept to a minimum; this includes procedures like entering the aviary, raking of fallen leaves and maintenance works. Any form of disturbance can stress the birds out and result in abandoning nests and/or eggs. Nests are usually built in natural vegetation, either in a small tree or hanging plant pots. They are commonly built at a height of 1.8m-3metres above ground level. Unlike other Passeriformes, this species does not use dead leaves to build its nest. We found that the Dragon-scale Fern, *Drymoglossum piloselloides*, seems to be a favourite species of plant for nest building. Other nesting materials utilized by the Straw-headed Bulbul consist of Coconut, *Cocos nucifera*, fibre and Banana Tree, *Musa acuminata*, fibre. Pieces of Dragon-scale Fern of various lengths (min 20 cm length) should be scattered around the aviary, along the branches and perches in the aviary. From our observations at JBP, the birds showed more interest in nesting when the nesting materials were scattered along the branches but paid less attention to the materials when they were placed on the ground. Nest construction is usually completed in 3-5 days when sufficient nesting materials were supplied to them. The exterior of the nest is built solely using the Dragon Scale fern and the nest cup is lined with finer materials such as Coconut fibre and Banana tree fibre. They usually like to nest in the fork of trees and use the ferns to tie the exterior of the nest to the trees and secure it. An artificial nest basket measuring about 15cm in diameter and 10cm deep was always offered but the birds never once showed any interest. However, it is always advisable to offer them artificial nest baskets as this might encourage them to start nesting. Hanging fern pots can also be offered to the birds as an alternative. Coconut fibre can be placed in the middle of the pot and be 'molded' to a cup shape. This can pique the interest of the birds and can possibly encourage them to start nesting in the hanging fern pot. In an outdoor aviary, an acrylic piece should be placed on the roof of the aviary to prevent the nest from getting wet in cases of harsh weather conditions.



Plate 14: The nests built by the Straw-headed Bulbul at Jurong Bird Park



Plate 15: Nest built in a hanging fern pot by the Straw-headed Bulbul at Jurong Bird Park



### **2.4.1 Mating**

Copulation in bulbuls has rarely been observed. Keepers in JBP reported that the female presents to the male by fluttering her wings and while facing the male and this took place for about 3-5 seconds. The male will then fly over and mated with her. The copulation takes about 2 seconds and the male usually lands by the female's side. This is followed with a duet by both the birds.

### **2.4.2 Egg laying and incubation**

The first egg is laid 3 days after the copulation and the 2<sup>nd</sup> egg is laid 24hours after. Incubation usually begins after the laying of the second egg. The incubation period is 14 days and is carried out solely by the female. The male usually hangs out around the nest and always stay close to the female. The female is relatively quiet during this period and only leaves the nest to feed, bathe and defecate. The male was never observed, bringing food back for the incubating female.

#### **Egg description**

The eggs are cream coloured, dotted with purplish scrawls and the normal clutch size is two.

### **2.4.3 Hatching**

Both eggs hatch after the incubation period of 14 days. The parents were observed consuming the fragments of the eggs. The Straw-headed bulbul were observe to feed their nestlings only 2 hours after both the eggs hatched. This was assumed to be due to the presence of yolk in the chicks.

#### **Number of clutches**

The Straw-headed Bulbul can produce multiple clutches and will lay a replacement clutch if their earlier clutch failed. Re-clutching was observed to be very rapid in this species with the new clutch being laid 9 days after the failed clutch.

A pair of Straw-headed bulbul was observed to lay 5 clutches in a single breeding season in JBP. Out of the 5 clutches, 1 was pulled out for artificial incubation, 3 were destroyed by the birds and the final clutch was successfully parent-reared.

#### **Nest inspection**

Straw-headed bulbul is a high strung species and their nest inspection should be avoided. In the event that nest monitoring using close-circuit camera is not viable, only experienced animal care staff should check the nests and this should only be done when the brooding female leaves the nest. This should be done quickly and quietly and as little often as possible, as they are known to abandon the nest at the slightest form of disturbance.

To avoid such mishaps, installing a CCTV system to record nesting behaviour and the developments of chicks is highly recommended. This has been used with great success at JBP and valuable footage has been gathered that helped in the compilation of this manuscript.

#### **2.4.4. Development and Care of Chicks**

Like all Passeriformes the chicks are altricial. Both parents take turns to feed the chicks and they always stand on the edge of the nest while feeding. Faecal sacs were always consumed by the parents, after the chicks were being fed. CCTV footage revealed that only the female was observed to taking part in brooding duties and the male always stayed nearby the nest. Pin feathers were observed to appear on day 3 and the eyes were opened on day 7. The feathers were almost fully grown by day 10 and at this stage the chicks start to get more active. By day 11 the chicks are able to perch at the edge of the nest.

#### **Fledging**

Based on the experience at JBP, the chicks fledged on day 12, with 1 chick fledging about 30 minutes after the first one. The fledglings were observed to be sitting at the edge of the nest before flying out and were observed to be perching very close to the nest. They were observed to be taking short flights around the aviary and stayed close to their parents. The fledglings become independent 2 weeks after fledging and started vocalising about 4 weeks after fledging. Good observation and monitoring should be in place to remove the juveniles if chasing or aggression is observed. Leaning perches towards the nest should be offered to facilitate easy access to the nest, for the parents to climb in to feed or to aid the chicks when they fledge.

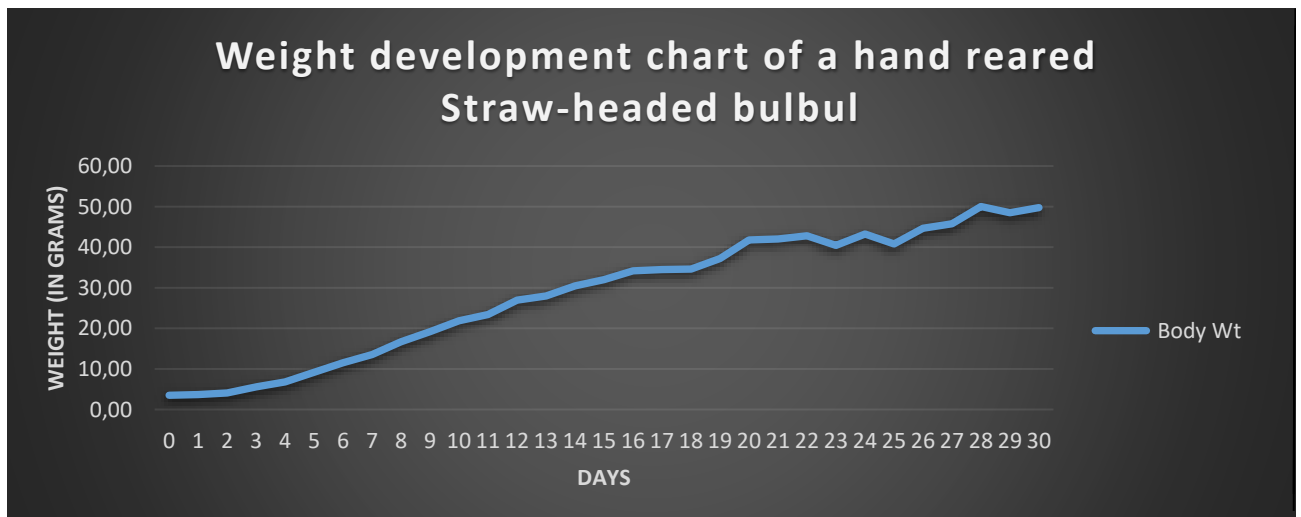


**Plate 16:** 15 day old Straw-headed Bulbul fledgling at Jurong Bird Park

### 2.4.5. Hand Rearing

Whenever possible, this species should be parent reared to produce stronger off springs that will be develop faster than their hand-reared counterparts. Experiences from JBP, showed prominent success in hand rearing the Straw-headed bulbul from day 0.

Diet consisted of a mix of papaya and pinkie from day 2 – day 5 and they were fed 7 times a day with the first feeding starting at 6am and the last feeding at 6pm. After the age of day 6, soaked Mazuri<sup>®</sup> Softbill pellets, ant eggs, cricket abdomen (insides) and white mealworms were added to the diet. Several supplements such as Caco3, probiotics, multivitamin were administered to the chicks. They were fed with tweezers and the diet was indirectly warmed by placing over or in hot water at a temperature of 37.5°C for a 2-4 minutes. Chicks of the same species are kept together in the same brooder and the doors' of brooders were always covered with paper, to decrease the risk of having a tame bird.



**Plate 17:** Weight chart for a hand-reared Straw-headed bulbul in Jurong Bird Park, Singapore



**Plate 18:** 5-day old chick with pins developing under the skin, head, back, wings and flanks.

© Madelyn Leow,  
Wildlife Reserves  
Singapore



Plate 19: 9-day old chick with eye slits starting to appear. Black and brown feathers starting to grow on both wings.

© Madelyn Leow,  
Wildlife Reserves  
Singapore



Day	Brooder/ Temp (°C)	Freq.	Diet (by weight)	Intake	Misc.	HRP Notes
0	37°C Decrease temp. ~1°C/day Nest cup w/ paper towel/tissue & spongy mat. w/ water cup for humidity. Humidity to maintain high at ~75% throughout	Every 2 hrs (7x) 0600 to 1800 hrs	<b>DO NOT FEED for 24hrs</b>  Saline 0.02mls given at every feeding, No solids fed. Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls once a day, but not on the 1 <sup>st</sup> day.		Betadine seal 2x/day for 2 days Number of feedings dependant on hatching time and yolk absorption.	Hydration is most important. Chick should be passing out faecal sac after each feeding. To alert vet if chick fails to do so after more than 2 feedings.
1			60% Pinkie (small pieces) No limbs & tail 40% Papaya  Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.	70% of body weight/day		

EAZA Best Practice Guidelines – Straw-headed Bulbul (*Pycnonotus zeylanicus*)

2			Same as Day 1			
3	34°C		Same as Day 1		Begin CaCO <sup>3</sup>	
4	33°C		55% Pinkie (small pieces) No limbs & tail 35% Papaya 10% Crickets Abdomen  Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.			Reduce the frequency of feeding based on appetite and weight gain.
5			Same as Day 4			
6			Same as Day 4			
7	30°C		50% Pinkie (small pieces) No limbs & tail 30% Papaya			Chick will start to hop around and perch.

EAZA Best Practice Guidelines – Straw-headed Bulbul (*Pycnonotus zeylanicus*)

			<p>20% Crickets Abdomen</p> <p>Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.</p>			
8			Same as Day 7			
9			Same as Day 7			
10			<p>45% Pinkie 20% Papaya 30% Crickets Abdomen 5% Soaked Mazuri Pellets<sup>®</sup></p> <p>Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.</p>		Offer diet & water dish	Should expect chick to start pecking on food.
11			Same as Day 10			
12			Same as Day 10			
13			<p>40% Pinkie 20% Papaya 25% Crickets Abdomen</p>			Expected nestling period

EAZA Best Practice Guidelines – Straw-headed Bulbul (*Pycnonotus zeylanicus*)

			<p>10% Soaked Mazuri Pellets® 5% Ant Eggs</p> <p>Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.</p>			
14			Same as Day 13			
15			Same as Day 13			
16		Every 2.5hrs (6x) 0600 to 1800 hrs	<p>30% Pinkie (small pieces) No limbs &amp; tail 20% Papaya 15% Cricket Abdomen 20% Soaked Mazuri Pellets® 15% Ant Eggs</p> <p>Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.</p>	75% of body weight/day		
17			Same as Day 16	Ad lib		
18			Same as Day 16			



19			20% Pinkie (small pieces) No limbs & tail 20% Papaya 20% Cricket Abdomen 20% Soaked Mazuri Pellets® 20% Ant Eggs  Saline 0.02mls given every feeding Probiotics 0.02mls given twice a day. Multi vitamin 0.1mls given once a day.			
20						
21						
22						Expected post-fledging dependence

Plate 21: Hand-rearing protocols used at Jurong Bird Park, Singapore for the Straw-headed Bulbul (*Pycnonotus zeylanicus*)

### 2.4.6. Population Management

In the 1980s-1990s, 3 institutions in Europe were holding this species but unfortunately the population was not sustainable and the species has since disappeared from European zoos. As of date, only 4 zoological institutions hold this species and all of them are in South East Asia. None of the other institutions has reported any hatchings in the last 2 years and JBP has been the only institution that has been consistently breeding this species since 2017. To date, the total number of Straw-headed bulbuls in zoological institutions is 4.4.26 (34).

<b>Institution</b>	<b>Male</b>	<b>Female</b>	<b>Other</b>	<b>Birth (Last 12 months)</b>	<b>Total</b>
<b>Hong Kong/ Hong Kong Zoological Park</b>	0	0	6	0	6
<b>Jurong / Jurong Bird Park, Singapore</b>	4	4	2	3	10
<b>Khaokheow / Khao Kheow Open Zoo</b>	0	0	5	0	5
<b>Songkhla / Songkhla Zoo</b>	0	0	13	0	13

Plate 22: A list of the zoological institutions that are currently holding this species.

The birds at Khao Kheow Open Zoo and Songkhla Zoo are being managed as a group. They could not confirm the numbers currently available and whether the birds were breeding.

### 2.5. Behavioural Enrichment

Straw-headed Bulbul likes to forage amidst leaves in search for small arthropods. Providing a small tray, filled with dry leaves and insects would be a simple but efficient behavioural enrichment activity. Scattering crickets around the aviary would also encourage the birds to exercise more, which is important as the species tends to become overweight in captivity. Tying fruits such as apple or pear onto the branches of the trees, would also serve as an enrichment activity.



Plate 23: Enrichment activity for the Straw-headed bulbul

## 2.6. Handling

### 2.6.1 Individual Identification and Sexing

The Straw-headed Bulbul is a monomorphic species, and after DNA sexing different colour rings are given for the male and female along with an identification ring with an individual ring number for management purposes. The rings utilized for this species have an inside diameter of 4mm. The juveniles are ringed once they are removed from the parents. The best time to determine the gender of chicks is when they are being removed from the parents, which also aids in preventing nest abandonment through disturbance of the nest.

### 2.6.2. General Handling

Manual restraint for the species follows the same model as for other mid-sized passerines. Having birds' neck in between the middle and index finger aids in having a good and safe control of the bird. Animal Care staff can use the other hand to hold down the birds' leg and this allows a good checking position while also preventing the bird from moving much and possibly getting injured. This handling posture is recommended to administer medications, checking of the wings and to also ring the bird.



Plate 24: Animal Care Staff handling a Straw-headed Bulbul for a medical check-up at Jurong Bird Park

### 2.6.3. Catching

At JBP a hand-held net that measures 25cm in diameter is usually used to capture passerines. The hand net should be well padded to significantly decrease the probability of the bird, getting injured by the net. The capture of birds should always be only carried out by experienced staff. Weather conditions and timings have to be taken in mind prior to catching birds to avoid accidents that can lead to fatalities. The capturing should be carried out as quick as possible to ensure the bird does not spend too much of time flying around the aviary, getting exhausted or injuring itself.

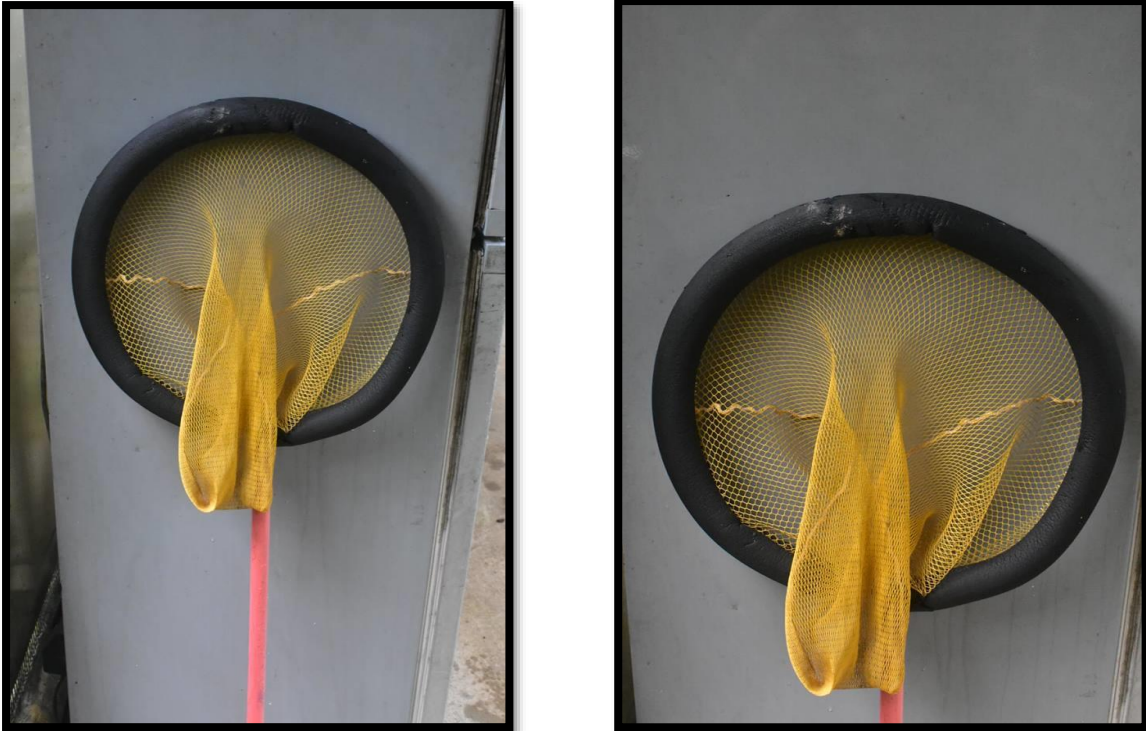


Plate 25: A well-padded net, used to capture passerines at Jurong Bird Park

## 2.6.4. Transportation

### A. Internal transportations

As a general rule, each bird is always transported individually, no matter the time or distance of transportation. If the bird is being transported over a long distance/long period of time, a wooden transport box is recommended to be used. The dimensions should ensure that the bird should not be able to move too much inside the box and possibly injure itself. A commercially available transport box of 53(L) x 38 (W) x 40 (H) is ideal for a medium sized passerine like the Straw-headed Bulbul. Ventilation holes of 1cm diameter must be done along the side of the box. The transport box should be fitted with a stable perch of suitable diameter.





Plate 26: Transport boxes used for internal transportations, in Jurong Bird Park, Singapore.

## **B. Inter-institution transportation**

A bird will spend a prolonged period of time in transport when it is being transported to a different institution thus it is advisable to carefully plan for its' welfare and safety.

As a general rule of thumb, the birds should be crated individually to prevent any form of distress or injuries. The best time to move birds would be earlier in the day, when it is cooler and potentially less lit; this is to minimize stress. The species is quite nervous and the transport box should be placed in a quiet and secure environment.

Transportation in an air-conditioned vehicle is recommended if the temperature exceeds 25°C. For transportation by airplanes, the company must adhere to the IATA Live Animal Regulations where the crate and transport routine must follow strong requirement for the safety and welfare of the animal.

### **Transport box**

If a commercially available transport box (pet carrier) of suitable size is not available, a transport box made of plywood can be used. The front part should be made of wire mesh of suitable size (e.g. ½ inch). This allows the bird to be checked whenever necessary. It is beneficial if the wire mesh is covered with a clean cloth to keep the bird in semi-darkness, preventing it from checking out the surroundings. The roof of the box should be padded with 2cm foam, to prevent the bird from injuring itself.

Each compartment of the box should house only one bird and the dimension should allow the bird to perch and stand without touching the compartment walls or ceiling. Appropriate size for a Straw-headed Bulbul is 53(L) x 38 (W) x 40 (H). A 2cm diameter perch at a height of 4cm and 15 cm from the back of the box allows the bird to comfortably perch during transport. The transport box should have ventilation holes of 1cm diameter for every 5cm along both sides of the box at the height of 15cm from the bottom of the box. 1.5cm wooden spacer-bars fitted on the sides of the box allows good ventilation when several boxes are placed next to each other. The back of the box should be made of a sliding door (10cm wide, 18cm high) which would be securely closed with screws on the top.

Food and water bowls are placed at the front of the box for an easy check and fill. They should be made of stainless steel or plastic with a size of 8cm long, 5cm wide and 4cm deep.

All boxes must be labelled appropriately with the name of the species, contact of the shipper and be fitted with “Live Animal” and “This Way Up” tags. Feeding and watering instructions as long as the medical records for the individual should accompany the box.

### **Feeding**

As a general rule, the birds should be well fed and given fluids before any translocations. For transfers that do not exceed 1 hour, it is not necessary to provide food if the bird can be kept in a cool environment. If translocations exceed 1 hour, water-rich items such as papaya should be given in the transport boxes. It is not recommended to start a new diet during transportations. Favourite items such as insects should be included in the diet to encourage the bird to eat, during this stressful period. The food and water bowls for the crate should be made out of plastic and have a minimum diameter of 7cm.

### **2.7. Veterinary: Considerations for Health and Welfare**

Similar to every other bird species, good indicators of health would be food consumption and the individuals’ activity. When catching the bird for a routine medical check-up, it is good to then assess the general condition of the bird in more detail.

It is vital to record morphological details of the bird that will help to determine the condition of the bird, when it is being caught. The pectoral muscle score and the subcutaneous fat score are good parameters and should not be dissociated as they will both represent the general condition of the bird. Recording these scores with consistency between check-ups and different assessors is very important.

Historically, this species has shown to be prone to becoming fat. Extra care should be meted out to ensure they are not over-fed and housed adequately.

### **Hygiene**

This is vital for prevention of disease transmission. All the feeding trays, water bowls and cleaning equipment should be stored in a cool environment and disinfected daily using F10® or an equivalent product.

## 2.7.1. Body condition

### Pectoral muscle score

The pectoral muscle score is a good indicator of the physical condition of the bird. The pectoral muscle score ranges from 1 to 5. Though a high body score in mammals reflects an obese animal, a pectoral muscle score of 4 or 5 for a bird represents a healthy bird which has well-developed flight muscle

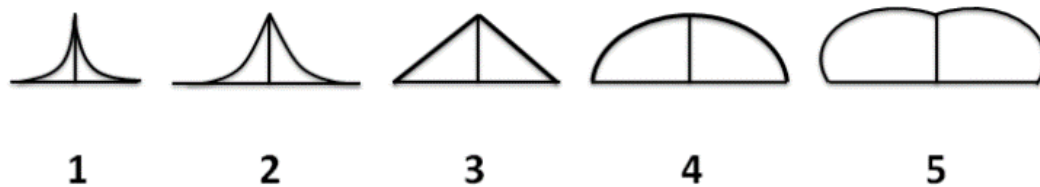


Plate 27: A pectoral muscle score chart. A healthy bird should ideally have the pectoral muscle score of 3-4.

### Subcutaneous fat score

The subcutaneous fat score is a scale indicating the presence of visible fat and the potential obesity of the bird. The subcutaneous fat score records the amount of fat present in the inter-clavicular cavity (around the wishbone) and below the sternum. The subcutaneous fat score ranges from 0 to 4, 0 indicating an absence of fat and 4 being the presence of a big lump of fat in the inter-clavicular cavity and lumps of fat below the sternum. A bird is considered fat when the subcutaneous fat score reaches 3 and obese when it reaches 4.



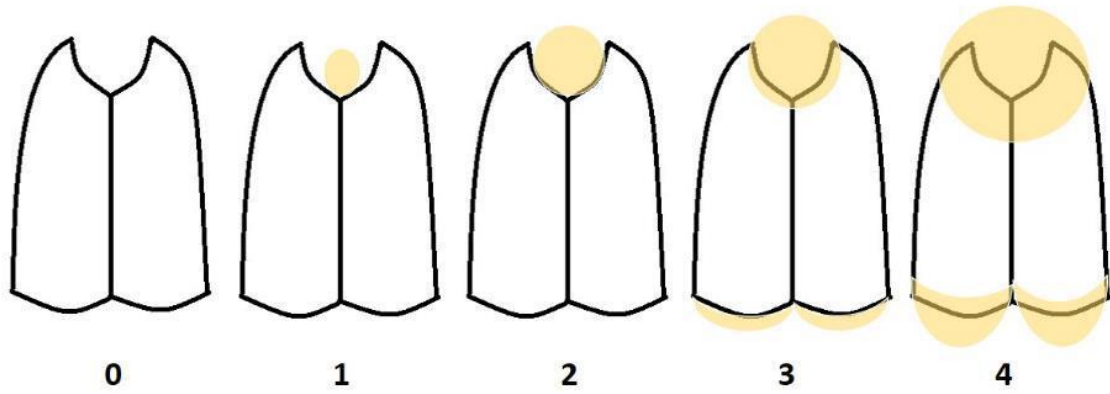


Plate 28: Image showing the subcutaneous fat score. A bird with good body condition will have a pectoral muscle score of 3-4 and a subcutaneous fat score of 1.



Plate 29: A Straw-headed Bulbul with a pectoral muscle score of 5 and a fat score of 0 at Jurong Bird Park



Plate 30: A Straw-headed Bulbul with a pectoral muscle score of 4 and a fat score of 0 at Jurong Bird Park

### 2.7.2. Routine health monitoring

Like any passerine, regular health checks are beneficial to assess the overall condition of the bird and also detect any potential problems early on. Routine checks should include faecal screening for parasites.

Opportunistic tests that can be done *ad hoc*, in case the birds are being caught include body score and fat score (as described above), blood work (basic haematology and biochemistry, serology) and bacteriology (cloacal swabs).

When a bird dies it should undergo a complete necropsy. All un-hatched eggs should also undergo necropsy to determine cause of failure to hatch. In affected flocks, preventive treatment for *Atoxoplasma* is recommended.

### 2.7.3. Recorded Causes of Death in Captivity

The captive population of the Straw-headed Bulbul is small and historical data on cause of death was not found. It is extremely important that any casualties undergo a complete necropsy by a qualified veterinary pathologist to determine the cause of death.

## 2.8. Specific Problems

As this species is known to be very sensitive, any form of disturbance caused to the aviary, would result in issues in breeding. If the birds are disturbed while nesting, they would

abandon their nest site and destroy the nest. They will also throw the eggs out and egg shells can be found, right below the nest site.

Like most passerines the Straw-headed Bulbul is susceptible to Coccidia, including *Atoxoplasma*, and *Capillaria* thus regular faecal checks and good hygiene of the aviary is key, to keep this species healthy.

## 2.9. Recommended Research

The Straw-headed Bulbul is uncommon in captivity and has a rapidly decreasing population in the wild. While the recovery of the species will have to rely on a one-plan approach, where in-situ work, community engagement, reinforcement of law and legislation and ex-situ work take part, at this point it is very important to increase our knowledge on how to best care for the species in captivity and to perfect captive breeding. As with many species, valuable data collected from captive birds may play a vital role in better understanding their wild counterparts and in determining the best way to help the species in its habitat.

This manuscript aims to be the first edition of living document that will continue to evolve as we deepen our knowledge on the species and its needs. As the small population under human care continues to grow, and additional holders are needed for the species, we hope that more data is made available and that eventually the species will attain a level of sustainability in captivity that will strengthen the role of ex-situ conservation breeding in saving it.

While all areas of research benefit from new data, some that could be highlighted include:

- Moulting period and frequency
- Iris coloration for birds exceeding 1 years old and the reason of difference between black, brownish and red iris and whether it correlates with sexual maturity
- Vocalisation study to determine whether there are variations between both males and females
- Breeding system (There are some anecdotal data that suggests cooperative breeding in this species)
- Life expectancy in the wild and captivity

Ultimately, research in remaining wild populations would allow a better understanding of the species situation and ecology.

## Section 3: References

BirdLife International. 2016. *Pycnonotus zeylanicus*. The IUCN Red List of Threatened Species 2016: e.T22712603A94338033. .

BirdLifeInternational (2016a) *Speciesfactsheet: Pycnonotus zeylanicus*. <http://datazone.birdlife.org/species/factsheet/22712603>. Accessed on 14 December 2016.

Chris R. Shepherd, Loretta Ann Sherpeherd & Kaitylyn-Elizabeth Foley (2016) Straw-headed Bulbul *Pycnonotus zeylanicus*: legal protection and enforcement action in Malaysia.

Daniel Bergin, Serene C. L. Chng, James A. Eaton and Chris R. Shepherd (2017) The final straw? An overview of Straw-headed Bulbul *Pycnonotus zeylanicus* trade in Indonesia. Bird Conservation International, page 1 of 7. © BirdLife International, 2017 doi:10.1017/S0959270917000302

Fishpool, L., Tobias, J. & Sharpe, C.J. (2018). Straw-headed Bulbul (*Pycnonotus zeylanicus*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Editions, Barcelona. (retrieved from <https://www.hbw.com/node/57920> on 13 September 2018).

### Products mentioned in the text

F10® SC Veterinary Disinfectant <https://www.f10products.co.uk/>

Super – Q (406) Concentrated Disinfectant <http://www.supersteam.com.sg/products/cleaning-chemicals/super-q-406#undefined1>

Mazuri® ZuLife Soft-Bill Diets

[https://www.mazuri.com/mazuri/ccrz\\_ProductDetails?viewState=DetailView&cartID=&sku=AG-10025&isCSRFlow=true&portalUser=&store=&cclcl=en\\_US](https://www.mazuri.com/mazuri/ccrz_ProductDetails?viewState=DetailView&cartID=&sku=AG-10025&isCSRFlow=true&portalUser=&store=&cclcl=en_US)

NEKTON®-MSA

<https://www.nekton.de/en/product-reader/nekton-msa-155.html>