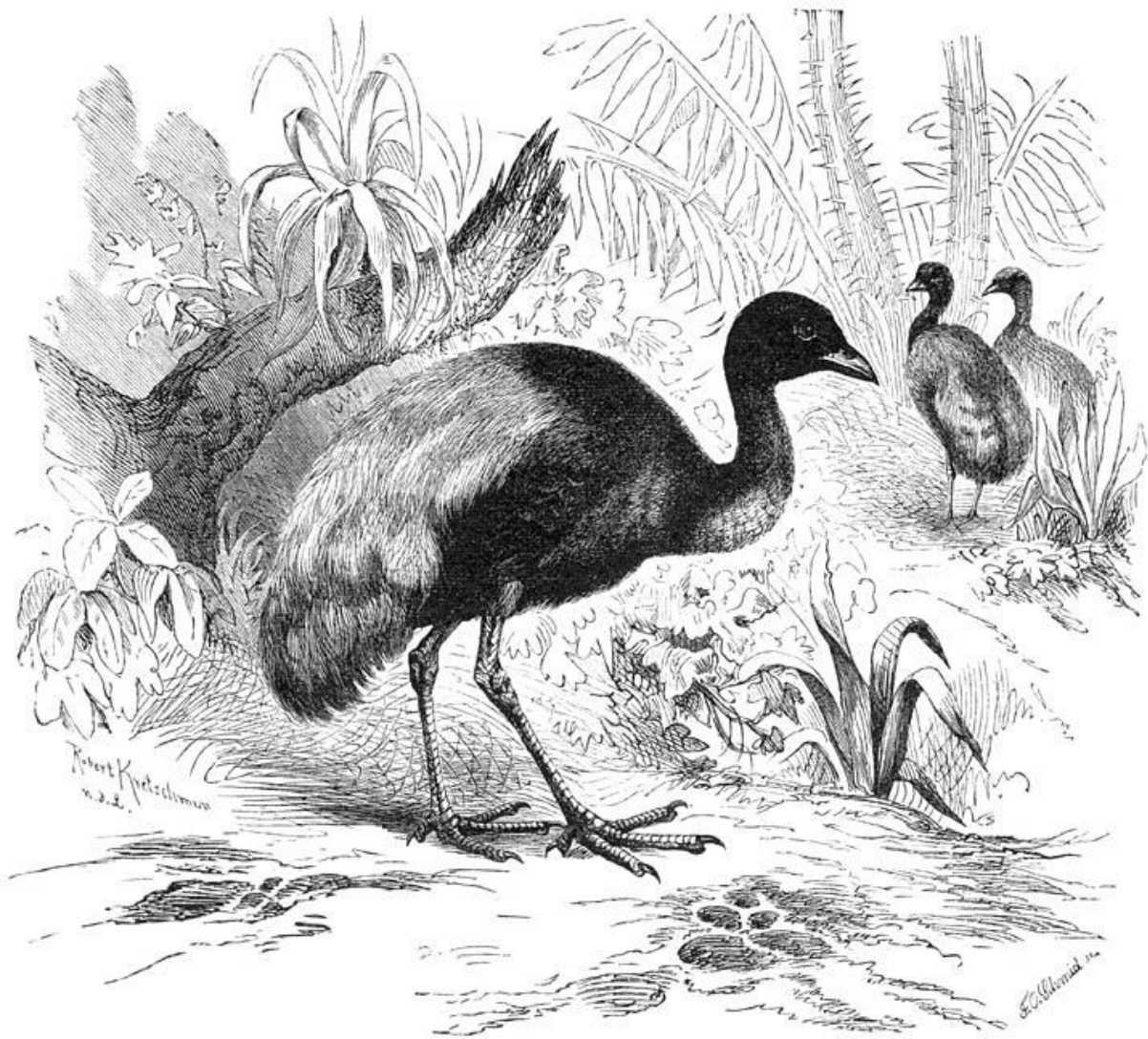


# Concept Best Practice Guidelines for the Trumpeters (*Psophiidae*)





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## **Preface**

This study is carried out as a final thesis at the University of Applied Science Van Hall Larenstein, Leeuwarden, The Netherlands, from May 2014 till November 2014. During this period we were supervised by Okka Bangma, Hans Bezuijen and Tine Griede of Van Hall Larenstein Leeuwarden. Our initiator was Tjerk ter Meulen, the curator from GaiaZOO, Kerkrade, The Netherlands. We would like to thank them all for their help and support and feedback on our thesis project.

The participants of our questionnaire shared their knowledge and experience with us. Without them it would have been impossible to complete these concept Best Practice Guidelines for the trumpeters. We would like to thank Jan Dams, Kim Willems, Peter Smallbones, Peggy Rüegg, Simon Brusland, Pierre de Wit, Maïke Franzen, Aude Bourgeois, Marleen Giesen, Tjerk ter Meulen, Elodie Trunet, Marleen Huyghe, Timm Sprekte, Adriane Prah, Warren Spencer and Frank Verstappen for helping us, by completing the questionnaires. At last we would like to thank Joost van Dijk (English teacher) for checking our report for English grammar and our families and friends for their support and interest in our thesis during the past months.

We had a good time during this project and we hope that this concept best practice guidelines will form eventually the first editions of the Best Practice Guidelines for the trumpeters and that it is not only helpful for EAZA zoos, but also for zoos in other regions.

Tara Koops and Bridget Maste,

Leeuwarden, November 2014



## Summary

The trumpeter belongs to the order *Gruiformes* (cranes) and the family *Psophiidae* (trumpeters). The family trumpeter covers three domestic chicken sized bird species that are native to northern South America. The three species are the grey winged trumpeter (*Psophia crepitans*), the pale winged trumpeter (*Psophia leucoptera*) and the dark winged trumpeter (*Psophia viridis*). The trumpeter have a long neck, uniform black plumage, a dark green to olive-brown hind-wing patch, purple iridescence on the lower throat, the outer wing-coverts tipped in iridescent purple and a green to olive bill and feet. Subspecies differ in coloration, especially the hind-wing patch. The conservation status of the trumpeter species varies from least concern to critically endangered according to the IUCN since 2014. The conservation statuses are based on future deforestation in the Amazon basin and on the fact that the species is vulnerable to being hunted. It is concluded that the populations will decline very rapidly over the next three generations. The trumpeter species that is kept in captivity is the grey-winged trumpeter. The captive trumpeters are monitored in Europe by EAZA. Trumpeters are difficult to keep and breed in captivity, therefore there is a strong need for Best Practice Guidelines (BPG) to assist zoos in creating optimal conditions for these species. The goal of this research is to have an overview of trumpeter holder opinions on best practice in housing and husbandry, as well as biology and conservation status/field data written in the framework of the EAZA Best Practice Guidelines.

The first section, the in-situ situation of the trumpeters is described in the chapters biology and field data. These data were collected with literature study. The second section describes the recommendations for management in captivity divided into chapters according to the EAZA framework for BPGs. The data for these chapters were collected with literature study and by interviewing 22 zoos, two private holders and one veterinarian, specialized in birds, with a questionnaire. The questionnaire for the holders consisted out of 78 questions, asking for the best practice on many subjects. For the bird veterinarian there was a different questionnaire made, specialised on veterinary aspects about the trumpeter. The participants were selected by the curator of GaiaZOO and the person who monitors the trumpeters for EAZA. Sixteen participants responded to the questionnaire. Four of the sixteen participants completed the whole survey.

Overall the results of the questionnaires give a good overview on best practice of trumpeter husbandry. The participants agree on most of the topics and only the topics feeding, breeding and chick rearing and social structure raise some discussion.

The concept BPG at this point covers all the topics of the standard contents of Best Practice Guidelines of EAZA and gives indication for the best practice on the trumpeter in zoos. The topics specific problems and recommended research are left out because it did not come forward from the survey. The gathered information is incorporated in the concept BPG. To go from the concept to the final Best Practice Guidelines, the Gruiformes TAG committee has to remove the information they decide to be not best practice for trumpeters.





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## Introduction

According to ZIMS (2014) at least 56 zoos worldwide, of which 35 in Europe, keep trumpeter birds (*Psophiidae*), mostly in couples of two (one male and one female). Of those 35 zoos, 32 are member of the European Association of Zoos and Aquaria (EAZA) (EAZA, 2011a; ZIMS, 2014).

The 345 member institutes of EAZA work together. They keep and present animals with the purpose of educating the public, delivering a contribution to scientific research and conserving biodiversity worldwide with professional quality (EAZA, 2011b). EAZA institutes aim to keep self-sustaining animal populations, without the need to obtain specimens from the in-situ population (Leus, et al., 2011). This requires optimal housing, husbandry and controlled breeding results. Information on housing and husbandry is among other exchanged between EAZA institutes by Best Practice Guidelines based on best practice experience and scientific literature. At this moment there are no Best Practice Guidelines available for the trumpeters (EAZA, 2011c; EAZA, 2011d).

The family trumpeter (*Psophiidae*) covers three domestic chicken sized bird species that are native to northern South America. They have a long neck, uniform black plumage, a dark green to olive-brown hind-wing patch, purple iridescence on the lower throat, the outer wing-coverts tipped in iridescent purple and a green to olive bill and feet. Subspecies differ in coloration, especially the hind-wing patch (Sherman, 1996). The birds have a loud, distinctive alarm call and are used as guard birds by native South Americans. The genus *Psophiidae* primarily lives in the deep forest where it forages on fruits and invertebrates. The species are polyandrous cooperative breeders; the females will mate with two or more males who all help to raise a single brood (Sherman, 1996; Potter, 2011). The family consists of three species: grey winged trumpeter (*Psophia crepitans*) (see figure 1.), pale winged trumpeter (*Psophia leucoptera*) and dark winged trumpeter (*Psophia viridis*). These are divided into seven subspecies (Sherman, 1996).



Figure 1. Grey winged trumpeter (*Psophia crepitans*) (Anonymous, n.d)

The trumpeter is difficult to keep and breed in captivity (Horning, et al., 1988; Sherman, 2000). Therefore there is a strong need for Best Practice Guidelines to assist zoos in creating optimal conditions for these species.

EAZA uses a structured way to write Best Practice Guidelines. Best Practice Guidelines hold detailed information of species regarding issues such as biology, field data, enclosure, nutrition and feeding, social structure, behavioural enrichment, breeding, population management, handling and veterinary issues. Production of these Best Practice Guidelines is one of the tasks of the Taxon Advisory Groups (TAGs) (EAZA, 2011d). The Trumpeter (*Psophiidae*) falls under the Gruiformes TAG (EAZA, 2011c).

Information on best practice in housing and husbandry of these species is available through several trumpeter holders. However, it needs to be collected and structured in the standardized format of EAZA to become available as Best Practice Guidelines. Since the participants do not agree on all

aspects of housing and husbandry, the TAG has to decide which opinion is reflected in these Best Practice Guidelines. Therefore the TAG needs an overview of trumpeter holder opinions of the best practice in housing and husbandry of *Psophiidae* and a literature research on biology and field data, structured in the EAZA format for Best Practice Guidelines.

### **Goal**

The goal of this research is to have an overview of trumpeter holder opinions on best practice in housing and husbandry, as well as biology and conservation status/field data written in the framework of the EAZA Best Practice Guidelines.

### **Research questions**

- I. What is the biology of the trumpeters?
- II. What field data is available for the trumpeter species?
- III. What is the best practice of housing and husbandry of the genus *Psophiidae* in captivity?
  - a. What is the best practice regarding enclosures?
  - b. What is the best practice regarding nutrition and feeding?
  - c. What is the best practice regarding social structure?
  - d. What is the best practice regarding breeding?
  - e. What is the best practice regarding populations management?
  - f. What is the best practice regarding handling?
  - g. What is the best practice regarding Veterinary issues?
  - h. What are species specific problems with keeping trumpeters?
  - i. What kind of additional research is needed to improve the husbandry of trumpeters, according to the EAZA members?

## Methodology

### Type of research and design

This research is a descriptive, non-experimental survey research. The research data are presented in an overview (Baarda & Goede, 2001). The research questions are answered with literature study and information gathered by a questionnaire, which is completed by selected trumpeter holders and a veterinarian specialist in birds.

### Research population

The total research population exists of 35 European zoos, two private trumpeter holders, who have or had trumpeter birds, and a veterinarian. Out of those 35 zoos, the sample size consists of 22 zoos that have been selected by Michael Merkel, who is monitoring the trumpeters for EAZA, and Tjerk ter Meulen, who is curator of GaiaZOO. The two private holders have been approached by using the network of one of the authors of the concept Best Practice Guidelines (hereafter referred to as concept BPG). Of those 22 contacted zoos and two private keepers, 16 participants have contributed to the research, 14 zoos: one private keeper and a veterinarian who is specialized in birds. F. Verstappen is currently the veterinarian of two zoos (Avifauna and Artis) in The Netherlands and has experience with trumpeters, see box 1 for all participants.

#### Box 1. The participants who filled in the questionnaire

All participants opinions are labelled 1-11:

1: Jan Dams		(Weltvogelpark Walsrode)
2: Kim Willems	private holder	(Phuru-Wasi,)
3: Peter Smallbones		(Paignton Zoo)
4: Peggy Rüegg		(Papiliorama Foundation)
5: Simon Bruslund		(Zoo Heidelberg)
6: Pierre de Wit		(Dierenpark Emmen)
7: Maike Franzen		(Zoo Frankfurt)
8: Aude Bourgeois		(Menagerie du Jardin des Plantes)
9: Marleen Giesen		(Burgers' Zoo)
10: Tjerk ter Meulen		(GaiaZOO)
11: Elodie Trunet		(Zoo de Montpellier)
12: Marleen Huyghe		(Zoo Antwerp)
13: Timm Sprekte		(Zoo Halle)
14: Adriane Prah		(Zoo Hagenbeck)
15: Warren Spencer		(Artis Zoo)
16: Frank Verstappen	bird veterinarian	(Artis Zoo & Avifauna, veterinary clinic Hoofdstraat)

## **Data collection**

### **Biology and field data**

The first section of the concept BPG, information on the biology and field data, is gathered with literature study, including scientific books and articles. Sources are found by searching online, using Google, Google scholar and Scopus, with search terms and/or combinations shown in table 1. The information that is found during the literature study is selected in relevancy and in reliability, by the following conditions:

- Information should be about trumpeters (*Psophiidae*);
- Information should cover one of the tropics of the standardized format of EAZA BPG;
- Information should come from a reliable source (with reliable it is meant information from organisations like IUCN, EAZA, Zoos that keeps trumpeters and (scientific) universities. Also known experts and articles published in scientific magazines and scientific websites.)
- In Google hits are used up to and including page 5, then the searching term is changed. Every page contains 10 hits, which amounts to a search through a maximum of 50 hits per term or combination.
- In Google scholar, only the first page with the same specific terms is used. Again 10 hits per page with a maximum of 10 hits per term.
- In Scopus, mainly the scientific names are used with a maximum result of 20 hits.

The bibliography of the articles that were found with the aforementioned sources were also used for searching more information about the trumpeters. These articles are looked up in Google scholar and Google with the same hits as mentioned before.

Books are found in the SAM-HAO catalogue with the searching terms, shown in table 1, and collected at the library of Van Hall Larenstein in Leeuwarden, The Netherlands. Recent research is preferred over older articles.

**Table 1. Search terms for literature study in the period of May – November 2014 to collect the data about the biology and field data on trumpeters.**

<b>Source</b>		<b>Searching terms</b>	<b>Combinations used</b>
<b>Book</b>	SAM-HAO catalogue	Birds of the world; Zoos	
<b>Internet</b>	Google Google Scholar Scopus	<i>Psophiidae</i> ; <i>Psophia crepitans</i> ; <i>Psophia leucoptera</i> ; <i>Psophia viridis</i> Taxonomy; Morphology; Behaviour; Vocal; Nutrition; Diet; Distribution; Habitat; Reproduction; Breeding; Conservation status; Physiology; Longevity; Captivity; Grey- winged trumpeter; Pale- winged trumpeter; Dark- winged trumpeter;	<i>Psophiidae</i> Taxonomy; <i>Psophiidae</i> Morphology; <i>Psophiidae</i> Behaviour; <i>Psophiidae</i> Vocal; <i>Psophiidae</i> Nutrition; <i>Psophiidae</i> Diet; <i>Psophiidae</i> Distribution; <i>Psophia crepitans</i> Distribution; <i>Psophia viridis</i> Distribution; <i>Psophiidae</i> Habitat; <i>Psophiidae</i> Reproduction; <i>Psophiidae</i> Breeding; <i>Psophiidae</i> Conservation status; <i>Psophia crepitans</i> Conservation status; <i>Psophia viridis</i> Conservation status; <i>Psophiidae</i> Longevity; Grey- winged trumpeter Captivity; pale- winged trumpeter Captivity; dark- winged trumpeter Captivity;

### Management in captivity

For the second section of the concept BPG, management in captivity, the opinions of participants are collected, next to a literature study. A selected group of trumpeter holders have been asked to fill in a questionnaire, existing of 78 questions on different subjects. To collect the holders opinions the questionnaire has been made in Microsoft Word. The Microsoft Word document is secured in such a way that the participants can only fill in the answers. The questionnaire has been send per e-mail by T. ter Meulen, with an introduction and explanation of the purpose of this research, to all selected zoos. The private keepers and veterinarian received the e-mail directly from the authors of the concept BPG. Three, six and nine weeks after sending the questionnaires, a reminder has been sent by the authors of this concept BPG. For additional information on veterinarian issues an interview took place with F. Verstappen, questions in this interview were not asked in the regular questionnaire.

The structure and questions of the questionnaire are based on literature, the standard contents of Best Practice Guidelines of EAZA (see appendix II) and previous used questionnaire for other concept Best Practice Guidelines (de Boer & Buijtenhek, 2011). All topics of the standard contents of BPG of EAZA have been included. Every topic has several questions. For this research closed questions are chosen to use, so answers of different participants are easily compared and it is less time consuming to fill out the questionnaire (University of Utrecht, n.d.). The option “Other” is given with each question, to give participants the opportunity to give an extra comment or other answer if they don’t agree with the given answer categories.

### Data editing

All data collected with literature study is summarized in the chapters “biology and field data” of the concept BPG. Participant’s opinions are shown in the chapter “management in zoos”. The contents of this chapter consists mainly out responses on the questionnaire, see example 1.

Every participant has a label (see box 1):

- |                  |                          |
|------------------|--------------------------|
| 1: J. Dams       | (Weltvogelpark Walsrode) |
| 2: K. Willems    | (Phuru-Wasi)             |
| 3: P. Smallbones | (Paignton Zoo)           |

Example 1: “Trumpeters have an inside enclosure <sup>(1,2,3)</sup> and an outside enclosure <sup>(1,3)</sup>.”

J. Dams is referred to as number 1, his label is <sup>(1)</sup>, K. Willems = <sup>(2)</sup> and P. Smallbones= <sup>(3)</sup>.

The label behind an answer shows the participant that share that opinion. The example above shows that J. Dams, K. Willems and P. Smallbones agree that trumpeters have an inside enclosure, but only J. Dams and P. Smallbones share the opinion that trumpeters have an outside enclosure too.

The gathered information is incorporated in the concept BPG. To go from the concept to the final Best Practice Guidelines, the Gruiformes TAG committee has to remove the information they decide to be not best practice. This results in a document with the most up to date information about the best practice for captive trumpeters: the Best Practice Guidelines.

# Results

## Section 1: Biology and field data

### 1. Biology

#### 1.1. The trumpeters (*Psophiidae*)

Trumpeters are ground-dwelling birds that eat lots of fruit. They are the size of domestic chickens, have a long curved neck, long legs and a hump-backed profile. They resemble some of the larger gallinaceous birds more than they resemble other Gruiformes (Sherman, 1996; Potter, 2011). Trumpeters are native to northern South America and live deep in the forest. (Ribas, et al., 2011). Three species of the trumpeter are known: the grey-winged trumpeter *Psophia crepitans*, the pale-winged trumpeter *Psophia leucoptera* and the dark-winged trumpeter *Psophia viridis* (hereafter referred to as *P. crepitans*, *P. leucoptera* and *P. viridis*). Trumpeters are certainly not shy birds and are often kept as pets by native South Americans, who sometimes keep trumpeters with their chickens to act as watch birds (Potter, 2011).

#### 1.2. Taxonomy

This paragraph gives an overview of the taxonomy of the genus *Psophiidae*.

Table 2. Classification of the trumpeters (Sherman, 1996; Oppenheimer & Silveiral, 2009).

Science classification			
Kingdom	Animalia		
Phylum	Chordata		
Class	Aves		
Order	Gruiformes		
Family	<i>Psophiidae</i>		
Genus	<i>Psophia</i>		
Species	<i>P. crepitans</i>	<i>P. leucoptera</i>	<i>P. viridis</i>
Subspecies	<i>P.c. crepitans</i>	<i>P.l. leucoptera</i>	<i>P.v. viridis</i>
	<i>P.c. napensis</i>	<i>P.l. ochroptera</i>	<i>P.v. obscura</i>
<i>P.v. dextralis</i> or <i>P.v. interjecta</i>			

The genus *Psophia* is based on the Greek word *psophos*, meaning an “inarticulate sound”, referring to the belief that trumpeters produce their loud call with their anus while breaking wind (Sherman, 1996).

##### 1.2.1. Subspecies

The grey winged trumpeter (*P. crepitans*) has two subspecies; the *Psophia crepitans crepitans* (*P.c. crepitans*) and *Psophia crepitans napensis* (*P.c. napensis*) (Oppenheimer & Silveiral, 2009; Pegan & Hruska, 2013).



The pale winged trumpeter (*P. leucoptera*) has two subspecies; *Psophia leucoptera leucoptera* (*P.l. leucoptera*) and *Psophia leucoptera ochroptera* (*P.l. ochroptera*) (Oppenheimer & Silveiral, 2009; Pegan & Hruska, 2013).

The dark winged trumpeter (*P. viridis*) has three subspecies; *Psophia viridis viridis* (*P.v. viridis*), *Psophia viridis obscura* (*P.v. obscura*) and *Psophia viridis dextralis* (*P.v. dextralis*) that is also known as the *Psophia viridis interjecta* (*P.v. interjecta*) (Oppenheimer & Silveiral, 2009; Pegan & Hruska, 2013).

### 1.3. Morphology

The trumpeter is a medium sized bird with a long neck and long legs (see figure 2). It has a short stout bill, a hump-backed appearance and weighs around 1,5 kg (new born chicks weigh around 35 grams) (Sherman, 1996; Sherman, 2000). Morphometric data did not point out significant differences between the subspecies, also showing no sexual dimorphism among them (Sherman, 1996). They are predominately distinguished by the colour of their hind-wing patch (or mantle), which is why they are called grey winged, pale winged and dark winged trumpeters (Oppenheimer & Silveiral, 2009; Pegan & Hruska, 2013).

Table 3. The dimensions of the skull of the trumpeter in millimetre (Anonymous, n.d)

Skull size	
Length	82 mm
Length cranium	44 mm
Width cranium	31 mm
Height cranium	38 mm
Length bill	38 mm



Figure 2. The skeleton of the trumpeter (Meyer, 1879-1897)

#### 1.3.1. Colouring

All trumpeter species have an overall dark colour and vary mostly in their hind-wing colour. The grey winged trumpeter (*P. crepitans*) has a grey hind-wing patch with a chestnut brown band. The pale winged trumpeter (*P. leucoptera*) is distinguished by its very light/white hind-wing patch, while the dark (or green) winged trumpeter (*P. viridis*) has a dark green hind-wing patch and an overall green sheen (see figure 3). The hind-wing patch appears to have a purpose in maintaining visual contact among individuals in groups that are travelling or

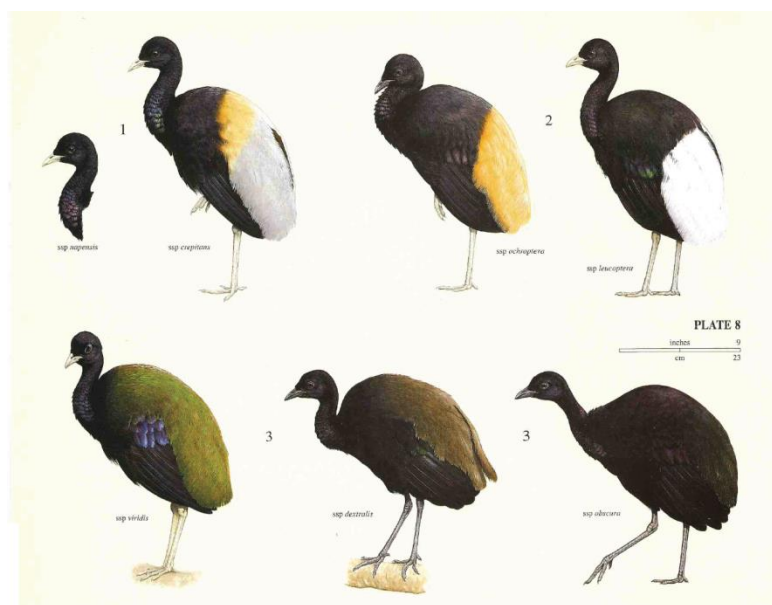


Figure 3. *Psophiidae* family, the 7 subspecies 1: Grey winged, 2: Pale winged & 3: Dark winged trumpeter (Sherman, 1996)

foraging. It also plays a role in inter-individual social displays. In pale winged trumpeters the colouring also seems to give information about the age of the individual bird. Juvenile pale winged trumpeters have a hind-wing patch that looks darker than in adults. It is not known if this phenomenon also occurs in the other species (Sherman, 1996).

When the chicks are hatched they are covered in a primary russet-coloured fluff with multiple stripes. This provides them with good camouflage to blend in with the dead and decaying vegetation on the forest floor. Within ten days, chicks start to show the black contour feathers and flight feathers. At the age of six weeks juveniles look like small versions of adults and can fly short distances (Sherman, 1996). When a juvenile pale winged trumpeter has grown its first full set of feathers, it shows a gradual pattern of moult throughout the year. The juvenile moults one to several primary or secondary feathers at a time. The moult patterns of the other two species are not known, but are presumed to be similar (Sherman, 1996). Within six months, the colour of the chick's legs change from black to blue-forest green. At eight months the chicks have reached 90% of their average adult body weight and the bills will colour blue-green (the female bill changes around 12 months) (Male, 1989; Sherman, 1996; Sherman, 2000).

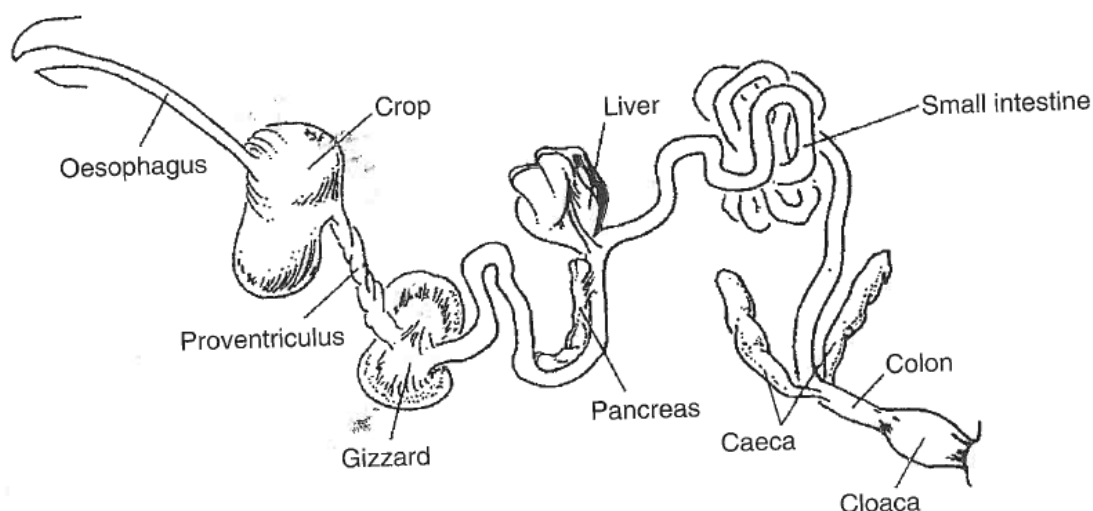
#### **1.4. Physiology**

Birds are warm-blooded and their body temperature varies between 37,7 °C and 44,6 °C (Howard & Heiser, 2004). The heart of the birds lies on the midline of the chest cavity, below the lungs. Unlike mammals, they do not have a diaphragm. Birds inhale in an entirely different way and have only a thin membranous partition that divides the body cavity in the thoracic and abdominal compartments (Howard & Heiser, 2004). The heart rate of the trumpeter is comparable to those of chickens, i.e. 250 to 300 beats per minute (Merck Sharp & Dohme Corp. , 2013).

The respiratory system of birds is considered the most efficient system among the vertebrate species (Irwin, et al., 2013). The respiratory rate of the trumpeter is comparable to those of chickens with 16 to 38 breaths per minute (Howard & Heiser, 2004).

##### **1.4.1. Digestive tract**

The digestive tract of birds consists of the beak, which carries a horny bill; the oesophagus and crop; the proventriculus and the gizzard; the small intestine; the caeca; the large intestine (colon) and the cloaca (Rees, 2011) (see figure 4).



**Figure 4. The digestive tract of a chicken, which is comparable with those of trumpeters (Cheeke & Dierenfeld, 2010)**

On the tongue of birds there are fewer taste buds than on the tongue of mammals (Irwin, et al., 2013). The oesophagus of the birds is highly extendible and there is a crop at the end of it (Rees, 2011; Irwin, et al., 2013). The crop is important for food storage, the start of the carbohydrate digestion and feeding the chicks (Irwin, et al., 2013). A thin layer of muscles over the surface of the crop squeezes food back in the oesophagus and into the stomach (Howard & Heiser, 2004). The stomach of birds is divided into two parts: the proventriculus and the gizzard (Irwin, et al., 2013). The proventriculus is elongated and has gastric glands which help with the breakdown of proteins in the food. The gizzard has the function of grinding the food (Howard & Heiser, 2004). The duodenum is looped around the pancreas and has ducts from the liver and gall bladder (Howard & Heiser, 2004; Irwin, et al., 2013). The final processes of the digestion take place in the small intestine (Howard & Heiser, 2004). The two caeca where the small intestine meets the large intestine (Rees, 2011) have the function of retaining material long enough for bacterial action to further break it down (Howard & Heiser, 2004). The large intestine has the function of reabsorbing water and forming the faeces. The large intestine ends in the cloaca. The cloaca is the combined opening to the bird's digestive, excretory and the reproductive system (Rees, 2011).

#### 1.4.2. Longevity

Little information is available about the longevity of the trumpeter. Research on wild population of the *P. leucoptera* and the *P. crepitans* shows that the average longevity is 18 years, the average age at which trumpeters first breed is three years and the calculated generation length is 10.4 years. However, the quality of the data is poor (Bird, et al., 2012). In captivity, the oldest male grey winged trumpeter is 25 years old, the oldest female grey winged trumpeter is 21 years old. The oldest pale winged trumpeter in captivity is 13 years old. The oldest dark winged trumpeter in captivity is 20 years old (ZIMS, 2014b)



## 2. Field data

### 2.1. Geography and ecology

#### 2.1.1. Distribution

The pale winged trumpeter is native to the Plurinational States of Bolivia, Brazil and Peru (IUCN, 2014c). The grey winged trumpeter is native to Brazil, Colombia, French Guiana, Guyana, Peru, Suriname and the Bolivarian Republic of Venezuela (IUCN, 2014b). The Dark winged trumpeter is native to Plurinational States of Bolivia and Brazil (see figure 5) (IUCN, 2014a).

#### 2.1.2. Habitat

The genus *Psophiidae* primarily lives in the deep tropical forest in the Amazon, the Orinoco Basins of South America and in the cloud forest at the eastern foothills of the Andes to the eastern lowland rain forests of Amazonia. The grey winged trumpeter and the pale winged trumpeter can appear in an elevation of 750 metres. All trumpeter species appear in areas of the forest where no or almost no human activity is seen (Sherman, 1996). Trumpeters have a preference for forests which are rich in fruiting trees, such as *Cecropia* and *Ficus* species (Potter, 2011). Most of the trumpeters live in permanent groups that are territorial and defend their territories. These territories have an average size of 72 ha) (Sherman, 1995b).

#### 2.1.3. Population

The population trend of the trumpeters is listed as declining (IUCN, 2014a; IUCN, 2014b; IUCN, 2014c; IUCN, 2014d; IUCN, 2014e; IUCN, 2014f).

#### 2.1.4. Conservation status

Although data about the population size of the trumpeters is lacking, the dark winged trumpeter is listed as vulnerable according to the criteria A4cd by the IUCN in 2014 (IUCN, 2014a). This is based on future deforestation in the Amazon basin and on the fact that the species is vulnerable to being hunted. It is concluded that the population will decline very rapidly over the next three generations (IUCN, 2014a). It is suspected that the dark winged trumpeter will lose 30-51% of its suitable habitat over three generations (31 years) (Bird, et al., 2012).

The grey winged trumpeter and the pale winged trumpeter are listed as near threatened by the IUCN in 2014 (IUCN, 2014b; IUCN, 2014c), which is based on a rapid population decline. This decline is caused by deforestation of the Amazon, vulnerability to being hunted and habitat fragmentation (IUCN, 2014b; IUCN, 2014c). The pale winged trumpeter population is suspected to decline by 25-29% over three generations from the year 2002 (IUCN, 2014c). It is assumed that the grey winged trumpeter will lose 12-17% of suitable habitat and the pale winged trumpeter will lose 15-20% of suitable habitat (Bird, et al., 2012). The populations will decline with 25% over three generations (31 years) (Birdlife International, 2014).



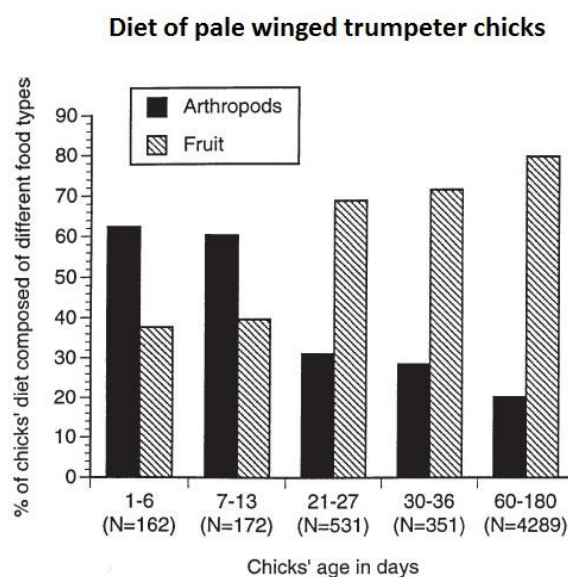
Figure 5. Distribution trumpeters (*Psophiidae*)

The subspecies *Psophia dextralis* is listed as endangered according to the criteria A4cd by the IUCN in 2014. This is based on suspected population decline of 50% or more over ten years or three generation period. This, again, is based on future deforestation in the Amazon basin and the species' vulnerability to being hunted (IUCN, 2014d). The subspecies *Psophia obscura* is listed as critically endangered according to the criteria A4cd; C2a(i) by the IUCN in 2014. This is founded on a predicted population decline of 80% or more over ten years or three generation period. This decline is also based on future deforestation in the Amazon basin and the species' vulnerability to being hunted. This would lead to a decline in mature individuals and the total estimated population with fewer than 250 mature individuals (IUCN, 2014e). The subspecies *Psophia ochroptera* is listed as least concern by the IUCN in 2014. This is based on the fact that the population does not approach the criteria for vulnerable status (IUCN, 2014f).

## 2.2. Diet and feeding behaviour

Trumpeters are frugivorous, which means that their diet exists mostly of fruit. Especially very ripe fruits that are easy to peel and lay on the forest floor. Small fruits (under 20 millimetres) are swallowed whole. All seeds that are swallowed are defecated intact and unscarred (Potter, 2011; Sherman, 1996). Fruit that is eaten includes species of the families *Moraceae*, *Lauraceae*, *Euphorbiaceae*, *Arecaceae*, *Myrtaceae*, and *Cucurbitaceae* (Erard, et al., 1991). The trumpeter eats fruit of small understory plants, but the majority of fruits that is eaten comes from medium to large trees that attract different groups of arboreal frugivorous animals like spider monkeys (*Atles*), capuchins (*Cubes*) and squirrel monkeys (*Saimiri*) (and to a less extent birds). The trumpeters mainly depend on primates to knock down or throw away ripe fruit (Sherman, 1996). Most fruits that they eat lie on the forest floor for several days before they rot or begin to mould. They rarely follow primate troops because they have little competition and can forage multiple times in the same area. Their diet consists of fruit for 90%. The other 10% consists of invertebrates and small vertebrates (Sherman, 1996). Trumpeters also feed on a wide variety of arthropods, such as millipedes, centipedes, ants and their larvae, beetles and their larvae, caterpillars, winged (alate) termites and their larvae, and various orthopterans, such as katydids and grasshoppers (Potter, 2011). Stinging or biting creatures are usually disabled by repeated pecking before being swallowed (Sherman, 1996).

Trumpeters have been observed eating larger millipedes. This species exudes hydrogen cyanide droplets when disturbed. Trumpeters wipe these species against the contour feathers below their wings before eating them. This preliminary wiping can last for several minutes. Quite commonly, trumpeters take turns in wiping and usually share the millipede when consuming it. This rubbing probably also serves to repel some of the trumpeter's ecto-parasites and has been reported in few other species (Potter, 2011). Trumpeters rarely consume small vertebrates. Small snakes, usually under 250 mm long, can be killed and eaten by trumpeters (Potter, 2011). Trumpeters can investigate larger snakes for at least several minutes but tend to not



**Figure 6. Proportion of fruits and arthropods in the diet of pale winged trumpeter chicks of different ages. N= total number of food items that chicks in each age category were observed ingest (Sherman, 2000).**



kill and eat them (Sherman, 1996). Trumpeters have been observed eating dead lizards, frogs and dead mice, but these instances are extremely rare (Potter, 2011; Sherman, 1996). Sometimes trumpeter groups follow army ants and pick up flushed insects (Willis, 1983).

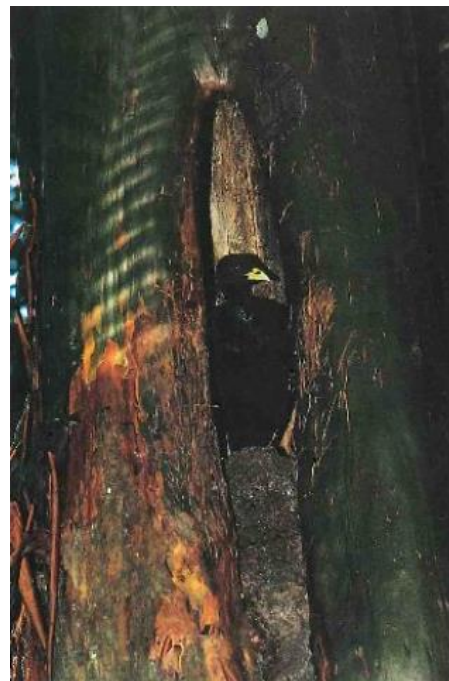
The diet of trumpeter chicks, from hatched until 6 days old, consists of 62% arthropods and 38% fruit. The proportion of insects declines when the chicks grow older. When the chicks reach the age of 2-3 months the ratio of arthropods (20%) and fruit (80%) will be similar to that in adults (Potter, 2011; Sherman, 1996; Sherman, 2000). Until the chicks are three weeks old, they are depended on other group members to be fed. The chicks start to eat by themselves at the age of four weeks and will gather 25% of their diet on their own (20% fruit and 5% arthropods) (see figure 6). This amount will increase until they feed nearly independently after 14 weeks (Sherman, 2000).

### **2.3. Reproduction**

Information about the reproductive behaviour of the trumpeters is based on field studies on the pale winged trumpeter and limited information on the grey winged and dark winged trumpeter. It is assumed to be similar in all three species.

Trumpeters have a cooperative breeding system, in which only the dominant pair reproduces (Sherman & Price, 1987). Two months before the female's fertile period, the dominant pair will start to investigate 10-12 different nesting spots in their territory. A week before the female starts laying eggs she will choose a nesting area (Sherman, 1995a). A month before the female's fertile period the copulations begin to increase in frequency. She will mate with every male in the group and the males will interfere with each other's copulation attempts (Eason & Sherman, 1995). Unrelated subordinate males assist in caring for the young (Horning, et al., 1988). Subordinate females also attempt to help, but are generally not tolerated by the dominant pair. The female will receive more help from different males in raising the chicks when their probability of filiation is higher (Sherman, 1996). Before mating, the female will take a special position: "crouched at about 2/3 her normal height, with a partially extended head and the neck horizontally, presenting the rump to the male" (Sherman, 1995a). She will shift her head horizontally from side to side and lift her feet one by one for a few centimetres (Sherman, 1995a). There is a high turnover in breeding females, with the average tenure being about 2 or 3 years (Sherman & Price, 1987).

Trumpeters nest high in a tree (around 14 meters). They do not build a nest but use holes that have been excavated by other animals (see figure 7) (Sherman, 1996). The hole is 20-50 cm high and has a diameter of 30-40 cm (Sherman, 2000). They don't have a clear roof but the eggs are protected from the rain. They remove the present twigs and leaves in their nest and lay eggs directly on the floor (Sherman, 2000). The first clutch is laid between September and October and hatches in approximately 28 days, around the beginning of the rain season in November (Ruschi, 1979; Sherman, 1995a). At least one female and two male birds take part in incubating. The dominant male takes up to 75% of the morning until dusk incubation shift and the other 25% is split almost equally between the Beta and Gamma males (Sherman, 1996; Sherman, 2000). Clutch size varies between four and ten eggs, with the exception of the *P.l. leucoptera*, which has an average of between two and four eggs (Horning, et al., 1988; Sherman, 1995a; Sherman & Price, 1987). The eggs



**Figure 7** Nesting site in tree of the trumpeter (Sherman, 1996)

are round, white and have a rough shell. They measure about 60x48 mm (Sherman, 1996). The chicks are nidifugous; after hatching they follow the parents and jump out of the tree to fall 14 meter down where they blend in with the decaying leaves (Rutgers & Norris, 1970; Ruschi, 1979). Offspring will usually help to raise one clutch of siblings before they separate from their natural social group (Sherman, 1996). Males will reach sexual maturity at the age of two, it is assumed this is the same for females. Around this time they leave and join a non-related social group, in an attempt to acquire a breeding position (Sherman, 1996). If they do not leave the group on their own, the group will chase them and force them out of the group (Sherman, 2000).

## **2.4. Behaviour**

Information about the behaviour of the trumpeters is based on field studies on the pale winged trumpeter and limited information on the grey winged and dark winged trumpeter. It is assumed to be similar in all three species.

### **2.4.1. Social structure**

Trumpeters are social birds that live in groups of three to thirteen individuals. The groups of the pale winged trumpeters are composed of an average of seven birds with three unrelated adult males, two unrelated adult females and sexually immature offspring (Sherman, 1995b). The other two trumpeter species (grey winged and dark winged) are assumed to have the same group composition, although there is very few data available about these two species in the wild (Sherman, 1996). In a group of trumpeters there is a dominance hierarchy within the sexes. The adult dominant males are also dominant over the adult dominant females (Sherman, 1995b).

### **2.4.2. Social behaviour**

Trumpeters are cohesive and social birds and they travel, forage, play, bathe, defend their territory and sleep together (Potter, 2011). At dawn, the group of trumpeters flies down to the forest ground from their roost. This is followed by a short moment of social interaction between the dominant birds and the other birds of the group lower in rank. They spread their wings and crouch before the dominant birds while giving a high-pitched twittering call ('wing-spread'), the same sound the young chicks make. This behaviour is performed by all birds regardless of the age and always towards a bird with a higher dominance rank. The dominant birds react to this 'wing spread' behaviour by rapidly flicking forward, bringing its folded wings to a vertical position and dropping them to cover the back (Sherman, 1996). After the social interaction, the group of trumpeters walks directly to a larger fruiting tree to eat. The group spends most of the day traversing their territory, feeding on different fruit trees and hunting for arthropods in the leaf litter. If the trumpeters detect another group of trumpeters that is entering their territory, they react immediately by running silently at full speed towards the other group. The females and juveniles of the resident group of trumpeters perform a loud territorial call during territorial fights (Sherman, 1996). Subordinate adult males can transfer between the groups of trumpeters during the territorial fight (Sherman, 1995b). If the males are low in rank they may choose to switch groups to try to acquire a higher rank in the other group. If this does not happen the males return to their original group (Sherman, 1996). Trumpeters straighten and clean the feathers of others with their beaks, this is called preening (George & Clark, 2004). This behaviour is performed in adults of the same sex, while juveniles perform this behaviour to other juveniles but also to adults. Trumpeters clean the feathers from mites and small bits of dried skin from the head and upper neck. Play behaviour involves a single trumpeter, several trumpeters or the whole group. Play behaviour is similar to the behaviour that trumpeters display during territorial fights. An individual flaps its wings, jumps into the air and runs in short burst. It does this with its head lowered and wings arched back. During play behaviour trumpeters also attack objects like leaves or fallen twigs. The playing behaviour lasts only a few minutes (Sherman, 1996). All individuals in the group exhibit helping behaviour. They assist in defending the territory, feeding and protecting the chicks and incubating the eggs (Sherman, 1995b). The trumpeters fly eight to fifteen metres up to



roost in the branches of trees after the sun sets. The groups do not choose specific sleeping sites on a regular basis (Sherman, 1996).

Sibling aggression is a common phenomenon in this species (Male, 1989; Sherman, 2000). Until the age of four weeks, the chicks will peck at their siblings' head and eyes with an open bill. The adult group members react directly to the aggressive behaviour of the chick(s). They do this by pecking on the chick's head, forcing the chick to the ground and pulling the aggressive chick away from the rest. The chicks will each go their own way (Sherman, 2000). Between the ages of four and six weeks the chick will fight with each other from time to time over food items. The adult group members will now rarely intervene between the chicks (Sherman, 2000).

#### 2.4.3. Vocal behaviour

Trumpeters are vocal birds that produce a variety of calls with different functions. It has been observed that the Pale winged trumpeter has eleven different calls (Seddon, et al., 2002). The call is loud and consists of a quick descending series of three to five staccato notes, followed by a long and low pitched descending resonant vibrato. Chicks cannot perform this call yet. This call is used for territorial uses. Other types of calls are produced by trumpeters during social interactions. When there is an aggressive threat the trumpeters utter a similar call to the territorial call, but it is a harsher, more cackling sound. Newly hatched chicks perform a high-pitched twittering sound and subordinate individuals perform the same sound during social interactions. Chicks also perform a 'food-begging' sound (Sherman, 1996).

#### 2.4.4. Predation

Trumpeters are preyed upon by a variety of mammals, as well as large snakes and birds. The Jaguar (*Panthera onca*) and the Ocelot (*Leopardus pardalis*) usually prey upon adult trumpeters. The nests of trumpeters are often emptied by primates and coati (*Nasua*). Trumpeters are highly sought after for food by humans. Humans also hold trumpeters as call birds (Potter, 2011).



## Section 2: Management in zoos

### 3. Management in zoos

Sixteen participants have given their advice on the best way to manage trumpeters in the zoos. The numbers that correspond with the specific participants can be found in the methodology chapter.

#### 3.1. Enclosure

General issues are taken into account when zoo planners design an enclosure. The enclosure has to be safe and easy to maintain (Veasey, 2005). The biological and psychological needs of the animals are taken into account (Curtis, 1982) and the keepers' needs are also considered (Simmons, 2005; Kleiman, et al., 2010). The ideal enclosure from the visitor's point of view is a natural looking enclosure. The more natural the enclosure looks, the better it helps to convey an ecological message. An ideal situation is where visitors have the idea that they are in the enclosure of the animals (Hosey, et al., 2009).



**Figure 8** Examples of enclosures for trumpeters; A is the enclosure in Zoo Frankfurt (Zoo Frankfurt, 2014), B is in Hagenbeck Zoo (Hagenbeck Zoo, 2014) and C is in Artis (Artis, 2014)

Trumpeters have an inside enclosure<sup>(1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15)</sup> and an outside enclosure<sup>(1,2,3,4,5,6,8,9,10,12,13, 14,15)</sup>. When maintaining trumpeters in captivity, all participants agreed that there is a need for a quarantine/surplus area. One participant<sup>(8)</sup> thinks a quarantine/surplus area might be needed only when birds arrive<sup>(8)</sup>. This quarantine/surplus area has at least an *inside enclosure*<sup>(1,2,3,4,5,6,9,10,11,12,13,14,15)</sup> and some participants<sup>(1,2,5,6,9,10,12,15)</sup> say that a quarantine/surplus area must have an *outside enclosure* too. A quarantine/surplus area is important in managing a social group, but could also be a separation of existing space and not necessarily an additional area<sup>(5)</sup>. It does not matter if the quarantine/surplus area is inside or outside, as long as the temperature and further holding parameters are appropriate and the birds are accustomed to be in/outside<sup>(7)</sup>. If the trumpeters is kept in the quarantine/surplus area for a short period, an inside enclosure is sufficient. For a long period, i.e. more than two months, an inside and outside enclosure is required<sup>(12)</sup>.

The participants are divided between “yes there is a need for an inside quarantine/ surplus area “(n=7) and “yes there is a need for an in- and outside quarantine/ surplus area “(n=7). One participant<sup>(8)</sup> gave another answer and thinks a quarantine/surplus area might be needed only when birds arrive.

### 3.1.1. Dimensions

The recommended accessible floor space per bird for the first four birds in the inside enclosure is  $2\text{-}4\text{ m}^2$ <sup>(3,5,14)</sup> /  $4\text{-}6\text{ m}^2$ <sup>(1,4,6,12)</sup> / *more than  $6\text{ m}^2$* <sup>(2,7,9,13,15)</sup> / *at least  $10\text{ m}^2$  and preferably divided into different cages*<sup>(10)</sup>. Regarding the outside enclosure, the recommended floor space is  $2\text{-}4\text{ m}^2$ <sup>(11)</sup> /  $4\text{-}6\text{ m}^2$ <sup>(3,14)</sup> / *more than  $6\text{ m}^2$* <sup>(1,2,4,5,6,7,12,13,15)</sup> / *minimal  $30\text{ m}^2$* <sup>(9)</sup> / *at least  $100\text{ m}^2$  and preferable covered with netting*<sup>(10)</sup>. One participant<sup>(7)</sup> thinks the larger the enclosure is, the better it is for the birds<sup>(7)</sup>. It is better to keep only two birds (1.1) instead of four birds in an inside enclosure of more than  $4\text{ m}^2$  and an outside enclosure of more than  $6\text{ m}^2$ <sup>(8)</sup>.

The advised height of the inside enclosure is *less than  $3\text{ m}$* <sup>(1,2,12)</sup> /  $3\text{-}5\text{ m}$ <sup>(3,4,5,6,8,9,10,13,14)</sup> / *more than  $5\text{ m}$* <sup>(8,15)</sup>. Regarding the outside enclosure, it is *less than  $3\text{ m}$* <sup>(1,2,8)</sup> /  $3\text{-}5\text{ m}$ <sup>(3,4,5,9,12,13,14)</sup> / *more than  $5\text{ m}$* <sup>(6,10)</sup>.

The height of the inside enclosure should not be less than  $2,5\text{ m}$ <sup>(5)</sup>. The height of the in- and outside enclosure must be at least  $3\text{ m}$ , so the birds can go into the trees<sup>(7)</sup>.

For every additional bird  $1\text{-}2\text{ m}^2$ <sup>(5,9)</sup> / *more than  $2\text{ m}^2$* <sup>(1,2,4,13,14,15)</sup> should be added to the accessible floor space. For every additional young bird  $1\text{-}2\text{ m}^2$ <sup>(8)</sup>. It depends on the flexibility of the enclosure how many  $\text{m}^2$  should be added to the accessible floor space with every additional bird<sup>(10)</sup>. It is better to keep adult trumpeters in pairs, not in groups<sup>(8)</sup>.

The recommended accessible floor space per bird for the first four birds in the quarantine/surplus area is  $2\text{-}4\text{ m}^2$ <sup>(3,14)</sup> /  $4\text{-}6\text{ m}^2$ <sup>(4,5,6,9,10,12)</sup> / *more than  $6\text{ m}^2$* <sup>(13,15)</sup> / *the size of the inside enclosure*<sup>(8)</sup>.

### 3.1.2. Boundary

Barriers are constructed for several reasons:

- To keep animals from getting out of the enclosure
  - To stop people or other animals from getting into the enclosure
  - To prevent physical contact between the visitors and animals
  - To prevent transfer of zoonoses
  - To protect the zoo keepers' safety
- (Hosey, et al., 2009)

Regarding the inside enclosure, *a glass window*<sup>(4,7,8,13,14)</sup> / *mesh*<sup>(2,3,10,13)</sup> / *a hard wall*<sup>(2,4,6,7,10)</sup> / *wood*<sup>(2,3,4,6,8,15)</sup> / *a combination with plexiglass*<sup>(9)</sup> / *a combination of glass window, hard wall*<sup>(14)</sup> and wood, as long as it be dry and protected from the wind<sup>(12)</sup> can be used as a barrier.

The participants were divided about the kind of barrier for the inside enclosure. The participants chose for a glass window (n=5), mesh (n=4), a hard wall (n=5), wood (n=6) and for a combination of barrier types (n=4). Seven participants answered more than one barrier type without choosing for the answer category 'combination of'.

As for the outside enclosure, *a glass window*<sup>(13,14)</sup> / *mesh*<sup>(2,3,6,8,9,12,13)</sup> / *a hard wall*<sup>(2,6)</sup> / *wood*<sup>(2)</sup> / *netting*<sup>(10)</sup> / *a combination of aviary netting and metal mesh*<sup>(2)</sup> / *a combination of glass, mesh and wood*<sup>(4)</sup> / *a combination of glass and hard wall*<sup>(14)</sup> / *a combination of mesh and planting*<sup>(15)</sup> can be used. One participant<sup>(1)</sup> states it does not matter what the barrier is made of and another participant<sup>(5)</sup> advises that it needs to be a washable surface, but the material of which the barrier is made is less important.

The recommended maximum opening of the mesh wire is  $4,5\text{ mm}$ <sup>(1)</sup> / *less than  $10\text{ mm}$* <sup>(3,15)</sup> /  $10\text{-}15\text{ mm}$ <sup>(2,4,6,8,14)</sup> /  $15\text{-}20\text{ mm}$ <sup>(12,13)</sup> / *more than  $20\text{ mm}$* <sup>(9,13)</sup>. The mesh wire of more than  $19\text{ mm}$  allows sparrows and rats to enter the enclosure. It is preferable to avoid this<sup>(5,7,10)</sup>.

Although trumpeters have short and rounded wings and have relatively large pectoral muscles, they do not have enough power to fly for long distances. Wild trumpeters are more likely to walk around small obstacles than fly over them (Sherman, 1996). All participants agreed that clipping the trumpeters is not advisable.

### 3.1.3. Substrate

Trumpeters are ground-dwelling birds (Potter, 2011; Sherman, 1996). Therefore, the floor substrate of the in- and outside enclosure is important. The substrate of the inside enclosure could be *bark* <sup>(4,6,8,9,13,14,15)</sup> / *sand* <sup>(2,3,4,6,7,10,12,13,14)</sup> / *water* <sup>(6,7,14,15)</sup> / *concrete with a layer sand on top* <sup>(1)</sup> / *preferably a combination of flooring, some use of peat moss and also dried leaves make an interesting flooring in a well-ventilated house* <sup>(5)</sup> / *fine bark mulch* <sup>(7)</sup> / *soil substrate* <sup>(13)</sup>. It is important that the bark mulch is fine, because a material that is too hard and rough might cause the trumpeters to get calluses <sup>(7)</sup>. In the outside enclosure, the floor substrate can be *bark* <sup>(2,8,14,15)</sup> / *sand* <sup>(2,12,14,15)</sup> / *grass* <sup>(2,9,13,15)</sup> / *water* <sup>(13,14,15)</sup> / *soil* <sup>(13)</sup> / *combination of bark, sand and grass* <sup>(1)</sup> / *combination of bark, sand, grass and water* <sup>(3,6,10)</sup> / *combination of bark, sand, grass and water with a dried leaves layer for enrichment purpose* <sup>(4)</sup> / *sand and woodchips (bark) is the easiest to clean, natural soil is very interesting for the birds do have problems due to higher levels of parasites* <sup>(5)</sup>. A combination of different kinds of floor substrates gives the trumpeters a more enriched life <sup>(10)</sup>.

The participants were divided about the floor substrate for the outside enclosure. The participants chose for bark (n=4), sand (n=4), grass (n=4), water (n=3) and for a combination of floor substrate aforementioned (n=4).

### 3.1.4. Furnishing

It is recommended to have one *bird entry* <sup>(2,8)</sup> / *two bird entries* <sup>(3,6,9,12,13,14)</sup> / *three bird entries* <sup>(4,5,10,15)</sup> between the inside and outside enclosures. *The number of bird entries depends on the group size, the more birds the more entries* <sup>(1)</sup>. These bird entries are at *ground level* <sup>(1,2,3,7,8,9,12,13,14,15)</sup> / *two on ground level and one on upper level* <sup>(4,5)</sup> / *ground level and 1m height* <sup>(6)</sup> / *at least one on ground level* <sup>(10)</sup>. The shape of the bird entries can be a *square* <sup>(1,2,3,4,7,8,9,12,13,14,15)</sup>. The shape of the bird entry is not of crucial importance <sup>(6,10)</sup>. Birds sometimes hit the lower edge of round entries. A square entry is normally the most feasible solution <sup>(5)</sup>. The bird entries can be made of *wood* <sup>(3,8,12,14,15)</sup> / *metal* <sup>(2,4,8)</sup> / *synthetic material* <sup>(7,9,13)</sup>. It does not matter what the bird entries are made of as long as the inside enclosure is insulated <sup>(1)</sup>. The material of which the bird entries are made is not crucial <sup>(5)</sup>. It doesn't matter where the bird entries are situated <sup>(6)</sup>.

The enclosures for the trumpeters could have *horizontal perches* <sup>(2,3,4,5,6,7,8,9,13,14,15)</sup> / *other type of perches* <sup>(3,6)</sup> / *tree stumps* <sup>(2)</sup> / *roots, logs on the ground* <sup>(5)</sup> / *diagonal perches that connect the horizontal perches* <sup>(4)</sup> / *trees* <sup>(2,3,4,5,6,7,8,9,10,11,13,14,15)</sup> / *vegetation* <sup>(2,3,4,5,6,7,8,9,10,11,13,14,15)</sup> / *rocks* <sup>(2,3,4,5,6,8,10,11,15)</sup>. A combination of all these elements is best <sup>(1,12)</sup>. Shrubs are recommended to be in the enclosure as shelter and for hiding. The enclosure is not too full and not too free of furniture <sup>(7)</sup>.

The trumpeters fly 8 to 15 metres up to roost in the branches of trees after the sun has set. The groups do not choose specific sleeping sites on a regular basis (Sherman, 1996). The recommended kind of sleeping accommodation provided for the trumpeters are *horizontal perches* <sup>(1,2,3,4,5,6,9,10,12,13,14,15)</sup> / *trees* <sup>(2,3,4,6,9,10,11,13,14,15)</sup> / *platforms* <sup>(3,4,10,13)</sup> / *boxes* <sup>(6,10)</sup> / *forked braches* <sup>(4,6,11,12)</sup> / *everywhere* <sup>(8)</sup>. *The horizontal perches on the top corner of the inside enclosure, make sure this is the highest place for the birds to sit* <sup>(1)</sup>. The recommended height to place the sleeping accommodation is *less than 1m* <sup>(8)</sup> / *1-3m* <sup>(2,4,5,6,8,10,12,14)</sup> / *3-5m* <sup>(6,9,13,14)</sup> / *more than 5m* <sup>(15)</sup> / *higher than all the other branches* <sup>(1)</sup> / *at different heights* <sup>(3,7)</sup>. The sleeping accommodation should not be on the floor <sup>(8)</sup>. All heights are possible for a sleeping accommodation when birds can fly freely in a greenhouse <sup>(11)</sup>. The

advised number of sleeping accommodations that have to be provided is at least *one for the whole group*<sup>(3)</sup> / *one per bird*<sup>(1,5,6,14)</sup> / *two or more per bird*<sup>(2,4,9,12,13,15)</sup>. There must be enough sleeping accommodations so the birds can choose<sup>(10)</sup>. The birds can decide when they are free in a greenhouse<sup>(11)</sup>.

The recommended thickness of the branches that are provided in the enclosure is *20mm*<sup>(5,6,14)</sup> / *25mm*<sup>(2,4,5,6,12,14)</sup> / *30 mm*<sup>(9)</sup> / *30 mm – 40mm*<sup>(8)</sup> / *50 mm – 100mm*<sup>(1)</sup>. Some trumpeters prefer perches with a diameter of 40 mm to 50 mm<sup>(13)</sup> or 40 mm to 60 mm<sup>(4)</sup>. A mixture of different thicknesses can be used<sup>(3,5,7,10,11,15)</sup>. Trumpeters like to perch on thick branches<sup>(2)</sup>.

### 3.1.5. Environment

The average temperature of the natural habitat of the trumpeters is usually 27,9 °C during the dry season and 25,8 °C during the rainy season (Kricher, 1997). The recommended temperature for the inside enclosure is *15-20 °C*<sup>(5,6,8,10,12,14)</sup> / *20-25 °C*<sup>(2,4,7,8,9,11,13,14,15)</sup> / *above 5 °C*<sup>(1)</sup>. The heating is on in the winter and the temperature does not drop below 15 °C<sup>(3)</sup>.

The participants are divided between two answers, 15-20 degrees Celsius (n=6) and 20-25 degrees Celsius (n=9) for the inside enclosure.

The recommended temperature for the outside enclosure is *15-20°C*<sup>(13,14)</sup> / *20-25 °C*<sup>(9)</sup> / *depends on the season*<sup>(3,6,15)</sup> / *depends on the season and only allowed to go outside when the temperature is more than 5 °C*<sup>(2)</sup> / *depends on the season and only allowed to go outside when the temperature is more than 10 °C*<sup>(8)</sup> / *depends on the season and it is the best if the birds can choose*<sup>(10)</sup> / *depends on the season. Trumpeters can be granted access to the outside when it is not freezing, if they are known to use the inside enclosure also. Observe strictly if all birds are allowed inside!*<sup>(5)</sup> / *depends on the season; in the winter the trumpeters stay outside*<sup>(12)</sup> / *above 5 °C*<sup>(1)</sup> / *minimal temperature of 18°C*<sup>(3)</sup>. For heating the inside enclosure there can be made use of *electric heating*<sup>(1,2,3,8,10,11,14,15)</sup> / *gas heating*<sup>(6,12,14)</sup> / *floor heating*<sup>(9)</sup> / *infrared lamp(s)*<sup>(2,11,14)</sup> / *a wood pellet stove*<sup>(2)</sup> / *central heating*<sup>(4)</sup> / *a gas fired hot water heater*<sup>(13)</sup>. All heating types, e.g. electric, gas, floor and infrared, are suitable for the inside enclosure<sup>(3)</sup>. All heating types are possible, although floor heating may not be very suitable as it dries the substrate, which causes dust problems<sup>(5)</sup>. The type of heating does not matter as long as the temperature is appropriate for the birds<sup>(7)</sup>.

About the heating for the inside enclosure the participants have different opinions, some chose for electric heating (n=8), some for gas heating (n=3), one for floor heating (n=1), some for infrared lamps (n=3) and some gave another option what was not mentioned before (n=3).

The relative humidity of the natural habitat of the trumpeter is quite high, at an average of 88% during the rainy season and 77% during the dry season (Kricher, 1997).

The recommended humidity for the inside enclosure is *50-60%*<sup>(13,14)</sup> / *60-70%*<sup>(2,4,5,6,7,9,13,15)</sup> / *70-80%*<sup>(5,11)</sup> / *more than 80%*<sup>(11)</sup>. No special humidity requirements are needed<sup>(1,12)</sup>. It depends on the outside weather<sup>(1)</sup>. Create a seasonal humidity, higher in the winter and lower in the summer<sup>(4)</sup>. Create humidity that as much equal as outside is<sup>(10)</sup>. One participant<sup>(7)</sup> thinks that trumpeters can cope with a cold and dry climate, but not with a cold and wet climate. This makes the interaction between the temperature and humidity important<sup>(7)</sup>.

The type of ventilation to use in the inside enclosure is *an open window*<sup>(6,12,13,15)</sup> / *an open door*<sup>(6,8)</sup> / *ventilation in the roof*<sup>(4,5,6,8,9,11,14,15)</sup> / *ventilation strip(s) in the door*<sup>(6,12,14)</sup> / *the entry would normally provide enough ventilation*<sup>(1)</sup> / *vents on the side*<sup>(2)</sup> / *electric suction fan*<sup>(5)</sup> / *roof lights that can be opened*<sup>(7)</sup>. For the ventilation of the inside enclosure chose 27% of the participants for an open

window, 13% for an open door, 53% for ventilation in the roof, 20% for ventilation strips in the door and 40% of the participants gave another option.

The advisable light used in the enclosure is *full spectrum light (visible light, UVA and UVB)*<sup>(2,4,5,8,9,10,11,14,15)</sup> / *standard fluorescent lamps*<sup>(12)</sup> / *nightlights*<sup>(5,9)</sup> / *daylight lamps*<sup>(1,12)</sup> / *LED lightning during winter*<sup>(2)</sup> / *HQI lamp*<sup>(13)</sup>. *Daylight might be the best for the trumpeters*<sup>(7)</sup>. The minimum amount of exposure to natural light and/or artificial UV lightning per 24 hours is advised to be six hours<sup>(3,14)</sup> / 10 hours<sup>(5,9,12)</sup> / more than 10 hours<sup>(4,7,11,13,15)</sup> / 12 hours<sup>(2,5)</sup> / *daily photoperiod*<sup>(8)</sup> / *as much as possible*<sup>(10)</sup>. It is always better to have the birds outside at all times, however it is not necessary to provide artificial UV light at all times during the winter. Special UV lights can be very strong and it is recommended to turn it on only one hour per day and take into account that the lights are far enough away from the birds so they do not cause eye damage<sup>(1)</sup>. It depends on the seasons<sup>(6)</sup>. The length of lighting can be adapted to the length of day in the natural habitats<sup>(7)</sup>.

### **3.2. Feeding**

It is nearly impossible to develop an optimal diet for trumpeters in captivity that is identical to what they consume in the wild. This chapter provides an overview of nutritional needs for the trumpeter in captivity, including special diet requirements and feeding methods.

The diet of trumpeters in the wild consists of fruit pulp (90%) and arthropods (10%) (Sherman, 1996).

#### **3.2.1. Basic diet**

Trumpeters are fed a variety of fruits<sup>(1,5,7,9,10,12,14,15)</sup>, (cooked<sup>(5,14)</sup>) vegetables<sup>(1,5,6,7,12,14,15)</sup>, animal proteins<sup>(1,5,6,7,10,12,14)</sup> (egg, minced meat and insects) and commercial food<sup>(1,5,6,7,10,12,14,15)</sup> (pellets and food mixtures). Food pellets contain most of what trumpeters need and they receive it every day besides fruit and vegetables<sup>(10)</sup>. If you keep a good diet, supplements are less essential<sup>(5)</sup>, but use supplements frequently for growing or laying birds<sup>(5)</sup>. See appendix IV for examples of a trumpeter diet used by different zoos<sup>(3,5,6,7,9,10,12,14,15)</sup>.

Pellets that are used at this moment: Versele laga all round pellets<sup>(5)</sup>, Versele laga hornbill pellets<sup>(15)</sup>, Gallus<sup>(6,9)</sup> and Beo<sup>(10)</sup>. Used grains: Claus rot/braun<sup>(14)</sup>

Different kinds of additional food items that might be added to the diet:

- Spinach, salad and dandelions (leaves and flowers)<sup>(5)</sup>
- Boiled rice<sup>(5,12)</sup>
- Boiled egg<sup>(14)</sup>
- Cottage cheese<sup>(14)</sup>
- Smelt<sup>(9)</sup>
- Shrimp<sup>(9)</sup>
- Ground meat and mice<sup>(9,12)</sup>
- Grit<sup>(12)</sup>
- Additional insects (grasshoppers, mealworms etc.)<sup>(9,14,15)</sup>
- \* Boiled Vegetable mixture (carrot, potato, turnips, red beet, broccoli)<sup>(5,14)</sup>

\* Note that tropical rainforest fruits have starch content, more like vegetables than like classic fruits consumed by humans<sup>(5)</sup>

#### **3.2.2. Food related problems**

- Too much animal protein can cause calcification of the veins<sup>(1)</sup>
- Trumpeters can be greedy, weighting adult birds is advisable<sup>(3)</sup>

- Citrus fruits can lead to diarrhoea<sup>(8)</sup>
- When feeding smelt, there is a chance the birds get Erysipelas<sup>(9)</sup>
- Iron accumulation<sup>(9)</sup>
- If you disperse food on the ground it can get contaminated with several worms, coccidiosis, blackhead and many other diseases to which trumpeters are susceptible. Also, sand will stick to the food and will be ingested, which can cause accumulation of sand in the stomach, leading to death<sup>(1)</sup>.
- Be careful with feeding too much bananas<sup>(14)</sup>
- If there are multiple species in the enclosure (e.g. primates) keep controlling the weight of the birds regularly to control if the birds get enough food<sup>(14)</sup>

### 3.2.3. Special dietary requirements

During the breeding season trumpeters receive *no additional food or supplements*<sup>(8,11)</sup> / *extra arthropods*<sup>(2,4,5,6,9,10,12,13,14,15)</sup> / *mince*<sup>(13)</sup> / *baby mice*<sup>(13)</sup> / *additional supplements*<sup>(1,2,3,4,7)</sup> (*calcium*<sup>(1,2,3,7)</sup>, *vitamins E+SE*<sup>(2)</sup>, *egg food*<sup>(4)</sup>). Chicks receive *extra arthropods*<sup>(2,4,5,6,7,8,9,10,12,13,15)</sup> / *mice*<sup>(1,2,3,8,9,10,12,15)</sup> / *egg (yolk)*<sup>(8,13)</sup> / *meat*<sup>(8,9)</sup> / *supplements*<sup>(9)</sup> / *Beaphar Sivo rearing food*<sup>(6)</sup>.

Other additional supplements that might be added to the (daily) diet:

- Avian Triovit<sup>(2)</sup>
- Avian FMA Fruit Mix Additive<sup>(2)</sup>
- Korvimin<sup>(4,7,13)</sup> ZVT<sup>(14)</sup> (spray)
- Multimusin<sup>(7)</sup>
- Necton S<sup>(8)</sup>
- Necton E<sup>(8)</sup>
- Ollocitasol<sup>(11)</sup>
- Aves- universal B<sup>(9)</sup>
- Multivitamins (liquid)<sup>(5)(13)</sup>

### 3.2.4. Method of feeding

Trumpeters are fed *once*<sup>(1,2,8,12)</sup> / *twice (only with chicks)*<sup>(12)</sup> / *three times*<sup>(4,15)</sup> / *more than three times*<sup>(6,9)</sup> per day. The feeding will take place in the *morning*<sup>(1,2,3,4,5,6,7,8,9,11,12,13,14,15)</sup> / *afternoon*<sup>(3,4,5,6,9,12,13,14,15)</sup> / *evening (end of the workday)*<sup>(6,7,15)</sup> / *as often as possible on different times*<sup>(10)</sup> in (the) *inside*<sup>(1,3,5,7,8,9,11,12,13)</sup> / *in- and outside enclosures*<sup>(2,4,6,14,15)</sup> / *different location each feeding*<sup>(10)</sup> / *depends on the season*<sup>(14)</sup>. The food is presented as *whole food items*<sup>(2,3,5,13,15)</sup> / *chopped*<sup>(2,3,4,5,6,8,9,11,13,15)</sup> / *squashed*<sup>(3,6,11)</sup> / *in a single fixed feeding station*<sup>(7,14)</sup> / *over several feeding stations*<sup>(2,3,4,5,6,8,9,11,13,15)</sup> / *scattered over the floor*<sup>(3,4,5,13)</sup> / *hidden in the enclosure*<sup>(2,6)</sup> / *in an enrichment device*<sup>(4,5,6,8,15)</sup> / *in a bowl which is more hygienic*<sup>(1,7)</sup> / *alternate*<sup>(10)</sup>. The diet should be weighted *every meal*<sup>(6)</sup> / *2-6 times per year*<sup>(4,14)</sup> / *annually*<sup>(15)</sup> / *never*<sup>(1,2,5,7,8,9,12,13)</sup> / *judged by sight*<sup>(3)</sup>.

More than one feeding a day is useful for adding less popular but valuable food items to the diet. E.g. less attractive foods offered in the morning in larger quantities and more attractive food offered in the afternoon<sup>(5)</sup>.

The best time to feed trumpeters is according to the participants one time per day (n=4), twice a day (n=7), three times a day (n=2), more than three times a day (n=2).

### 3.2.5. Water

Birds have no sweat glands but lose water through respiration and droppings. Bathing is an important part of feather maintenance, dampening the feathers makes their feathers easier to preen (RSPB, 2011).



The inside enclosure can contain *a pond*<sup>(6,7,9,13,15)</sup> / *a water bowl*<sup>(1,2,3,4,5,8,10,11,12,13,14)</sup> / *sprinkling system*<sup>(15)</sup>, the outside enclosure can contain *a pond*<sup>(3,4,5,6,9,10,13,15)</sup> / *water bowl*<sup>(2,4,5,8,13,14)</sup> / *sprinkling system*<sup>(5,15)</sup>, *no water supply (because of contamination through free flying birds*<sup>(1)</sup>*) (they drink in the inside enclosure*<sup>(12)</sup>*). All but two*<sup>(12,14)</sup> *participants agree that trumpeters should have access to a bath (or bowl that is big enough to bathe in*<sup>(1)</sup> *all year round*<sup>(1,2,3,4,5,6,7,8,9,10,11,13,15)</sup>*/depends on the season*<sup>(14)</sup>*. In the outside enclosure a bath should only be available with a minimum temperature of 15*<sup>(3)</sup> */ 20*<sup>(4)</sup> *degrees Celsius.*

### **3.3. Social structure**

#### **3.3.1. Basic social structure**

In a natural situation, trumpeters live in an average group size of seven individuals, three unrelated males, two unrelated females and two juveniles (Sherman, 1996). A group of captive trumpeters can best exist of *a male and a female 1.1*<sup>(1,2,3,7,8,9,15)</sup> / *1.2*<sup>(4)</sup> / *1.3*<sup>(11)</sup> / *2.1*<sup>(5)</sup> / *2.4*<sup>(4)</sup> / *3.1*<sup>(13)</sup>. But it does depend on the individual characters<sup>(5,10)</sup> and available space<sup>(14)</sup>. For years the combination of 1.1 has never resulted in chicks<sup>(6)</sup>.

Traditionally, zoos have always kept (and still keep) the species in pairs. It would be most interesting to create set-ups in zoos that are flexible and potentially suited for creating natural groups of more than two individuals so as to be able to experiment and gain valuable experience from this in order to increase the number of breeding trumpeter birds.<sup>(6)</sup>

#### **3.3.2. Changing groups structure**

It is *not*<sup>(1,2,6,8,11,15)</sup> recommended to introduce a new adult individual to the group. It can bring a lot of stress<sup>(7)</sup> and it is highly depended on the bird's character<sup>(4)</sup> if it could be successfully integrated. If it is necessary to introduce a new individual in the group, it is preferable to introduce a *female*<sup>(9)</sup> / *male*<sup>(13)</sup> *or female*<sup>(10)</sup> to the group. Juvenile trumpeters can be moved out at the age of *six months*<sup>(1,8,11)</sup> / *one year*<sup>(6,8,9,13,14)</sup> but it is recommended to keep a juvenile within the group as long as possible without aggression or displacement behaviour<sup>(5,7,8)</sup>. Long periods within the group could be beneficial for juveniles to develop social skills<sup>(5)</sup>.

To move a juvenile out of the participants recommend to do this at an age of six months old (n=3) and one year old (n=5).

The maximum duration of isolating an adult/ juvenile individual is less than *12 hours*<sup>(3,6)</sup> / *one day*<sup>(11,13)</sup> / *one month*<sup>(4,12)</sup> / *not relevant*<sup>(1,8,15)</sup> / *depends on individual characters and situation*<sup>(5,7,9,10)</sup>. During isolation it depends on the situation<sup>(3,4,5)</sup> how the individual is separated from the group, advised is to use *only mesh*<sup>(3,6,9,15)</sup> / *visual barrier*<sup>(10,11)</sup> / *visual and sound barrier*<sup>(1,10,13)</sup>. A visual barrier can be anything but mesh, birds tend to fight through the mesh and damage their feathers and beak<sup>(1)</sup>.

If the chicks and males/females are separated; the participants recommend to use only mesh for a barrier (n=4), a visual barrier (n=2) or a visual and sound barrier (n=3).

It is applicable and chicks need to be separated from parents or siblings (see 3.4.3 and 3.4.4), it is recommend to use *only mesh*<sup>(4,5,9)</sup> / *visual barrier*<sup>(1,13)</sup> (plywood<sup>(13)</sup>) / *visual and sound barrier*<sup>(10,14)</sup>. It is important to keep the chick in close contact with the parents to avoid imprinting on humans<sup>(5)</sup>. Also, with a mesh barrier you can check if you put the chicks with the right parent and if the other still wants to feed the chick<sup>(10)</sup>.

### 3.3.3. Sharing enclosure with other species

Most participants <sup>(1,2,3,4,5,7,8,9,10,11,12,13,14,15)</sup> advise to keep trumpeters in mixed species exhibits. This can be with *other (small<sup>(15)</sup>) bird species* <sup>(2,3,4,8,9,10,11,15)</sup> / *primate species* <sup>(4,8,10,13,14)</sup> / *other species* <sup>(1,4,10)</sup>; see table 4 for successful combinations with trumpeters. Some participants have encountered problems <sup>(2,7)</sup> with mixed species (roul-roul partridge <sup>(2)</sup>, ground pigeon species <sup>(2)</sup> and mammal species <sup>(3)</sup>). Others do advise to use non-aggressive non-ground dwelling species <sup>(1,3,12)</sup>, like mid-sized agile species <sup>(5)</sup> / passerines <sup>(9)</sup>. Also, individual trumpeter characters and the possibility to house species separately can play a role in the feasibility to be in a mixed species exhibit <sup>(5,7,10)</sup>.

**Table 4. Species that are or have been mixed successfully with trumpeters.**

Bird species	Primate species
<b>Green turaco</b> <i>Tauraco persa</i> <sup>(3,12)</sup>	<b>Goeldi monkeys</b> <i>Callimico goeldii</i> <sup>(4)</sup>
<b>Madagascar turtle dove</b> <i>Nesoenas picturatus</i> <sup>(3)</sup>	<b>The black-capped squirrel monkey</b> <i>Saimiri boliviensis</i> <sup>(8)</sup>
<b>Bali starling</b> <i>Leucopsar rothschildi</i> <sup>(3)</sup>	<b>White faced saki</b> <i>Pithecia pithecia</i> <sup>(10,14)</sup>
<b>Keel billed Toucan</b> <i>Ramphastos sulfuratus</i> <sup>(4)</sup>	<b>Emperor tamarin</b> <i>Saguinus imperator</i> <sup>(14)</sup>
<b>Violette toerako</b> <i>Musophaga violacea</i> <sup>(8)</sup>	
<b>Spreo superbus</b> <i>Lamprotornis superbus</i> <sup>(8)</sup>	<b>Other species</b>
<b>Black-throated laughingthrush</b> <i>Garrulax chinensis</i> <sup>(8)</sup>	<b>Central American agouti</b> <i>Dasyprocta punctata</i> <sup>(4)</sup>
<b>Scarlet-headed blackbird</b> <i>Amblyramphus</i> <sup>(11)</sup>	<i>Iguana</i> <sup>(4)</sup>
<b>Doves</b> <i>Streptopelia</i> <sup>(11)</sup> <i>Cacicus</i> <sup>(11)</sup>	<i>Tortoises</i> <sup>(4)</sup>

## 3.4. Breeding

### 3.4.1. Nesting

For the trumpeters, *one nesting opportunity* <sup>(1,7,8)</sup> / *2-3 nesting opportunities* <sup>(3,5,6,9,10,12,14,15)</sup> / *more than three nesting opportunities* <sup>(2,4,13)</sup> is/are recommended. These nesting opportunities consist of *nest boxes* <sup>(2,5,6,9,10,14,15)</sup> / *nest baskets* <sup>(2,3,4,5,8,10,12,15)</sup> / *nest logs with a big hole in the front* <sup>(1)</sup> / *open tree stumps* <sup>(2)</sup> / *open top boxes* <sup>(7)</sup> and are *only located in the breeding season* <sup>(3,4,5,8,15)</sup> / *always* <sup>(1,2,6,7,9,10,12,13,14)</sup> available for the birds.



**Figure 9 Examples of nest opportunities; A is a nest box and B is a nest basket (Koops, 2014)**

The sites for nesting can be located at a height of *less than 1*<sup>(13)</sup> / *1-3*<sup>(1,2,3,5,6,8,10,12,13,14)</sup> / *1,60*<sup>(7)</sup> / *3-6*<sup>(4,9,13)</sup> / *6-10*<sup>(4,15)</sup> meter(s). At least one of the nests has to be offered as high as possible, but the birds should be able to stand upright in the nest<sup>(5)</sup>. The opening will be placed *high in*<sup>(9,10,15)</sup> / *in the middle of*<sup>(1,2,6,14)</sup> / *near the bottom of*<sup>(4,5,13)</sup> / *at the top of*<sup>(7)</sup> the nest boxes.

The recommended materials to provide the trumpeters to build their nest with are *sand on the bottom of the nest to prevent the eggs from being crushed*<sup>(1)</sup> / *twigs*<sup>(2,3,4,6,14,15)</sup> / *bamboo*<sup>(3,5,15)</sup> / *fur of a mammals*<sup>(3)</sup> / *feathers*<sup>(3,5)</sup> / *coconut fiber*<sup>(3,14)</sup> / *moss*<sup>(2,3,5,14)</sup> / *hay*<sup>(3,8,12,15)</sup> / *bamboo leaves*<sup>(2)</sup> / *leaves*<sup>(4)</sup> / *dry and green leaves of different sizes*<sup>(5)</sup> / *fine bark mulch*<sup>(7)</sup> / *pine needles and wood shavings*<sup>(8)</sup> / *wood(chips)*<sup>(9,10)</sup> / *foliage*<sup>(14)</sup> / *nothing*<sup>(13)</sup>. Some females will lay their eggs directly in the nest basket (or nest box)<sup>(3)</sup>.

The advice of the participants is that the nesting opportunities have a height of *20 cm*<sup>(7)</sup> / *20-50*<sup>(3,5,12,14)</sup> / *50-80 cm*<sup>(2,6,10,13,15)</sup> / *more than 80 cm*<sup>(1,8,9)</sup> / *minimal 40 cm*<sup>(4)</sup> and a width of *30-40 cm*<sup>(3,8)</sup> / *40-60 cm*<sup>(1,2,4,5,6,9,10,12,13,14,15)</sup> / *50 cm*<sup>(7)</sup>.

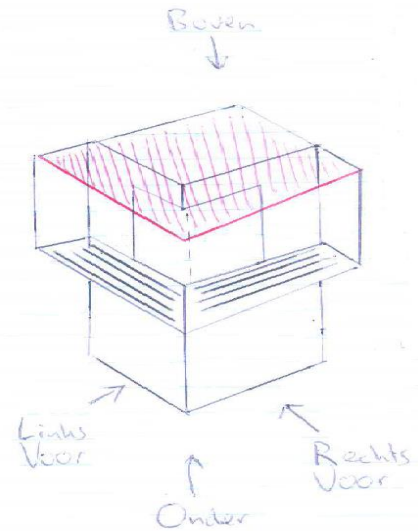


Figure 10 A model for a nest box (Burger's Zoo, 2014)

#### 3.4.2. Egg laying and incubation

The incubation of the eggs is advised to let occur *naturally*<sup>(3,5,6,8,9,10,12,14,15)</sup> / *with an incubator*<sup>(1,8,13)</sup> and *with multiple eggs at least one by natural incubation*<sup>(2,5)</sup>. However, it depends on the importance of the bloodline of your trumpeters<sup>(1)</sup>. You can leave the first nest up to the parents. If they fail, in the case of multiple eggs, leave at least one for natural incubation. If the parents fail several times, put the eggs in an incubator<sup>(4)</sup>.

Five participants<sup>(1,2,3,8,13)</sup> recommend using double clutching, which means removing the first clutch for the incubator and the second clutch for natural incubating. Double clutching can only be used if one has experienced foster birds available, such as a second group of trumpeters<sup>(5)</sup>. Some participants<sup>(4,6,7,9,10,15)</sup> advise not to use double clutching.

#### 3.4.3. Hatching

Chicks are mostly raised by the males of the group (Sherman, 2000). After the chicks are hatched it is recommended to *do nothing*<sup>(2,7,8,9,14,15)</sup> / *separate the males and female and place the chicks with the males*<sup>(6,13)</sup> / *separate the males and female and place the chicks with the females*<sup>(13)</sup> / *separate the breeding couple*<sup>(1)</sup> / *depends on the size of the enclosure*<sup>(14)</sup>. At first do nothing to see how the parents/ group handle the situation. If there is too much stress, separate the breeding couple with the chicks from the other adult group members<sup>(4)</sup>. What to do after the chicks are hatched depends on the behaviour of your group<sup>(5,10)</sup> and the males seems to be better in parenthood<sup>(10)</sup>.

The participants recommend to do nothing when the chicks are hatched (n=6), to separate the males and females and leave the chicks with the males (n=2), only one participant chose for to separate the males and females and leave the chicks with the females and two of the participants have given another option than the answer categories aforementioned.

#### 3.4.4. Development and care of chicks

Sibling aggression is a common phenomenon in the trumpeter (Male, 1989). It is recommended to *do nothing*<sup>(6,9)</sup> / *separate the aggressive chick from the group*<sup>(2,4)</sup> / *separate the weak chick from the*

*group*<sup>(1,7,15)</sup> / *separate all the chicks*<sup>(13)</sup> / *depends on situation*<sup>(14)</sup> when sibling aggression occurs. One holder recommends to offer a suitable structure in the enclosure with visual barriers or potentially split the group with an adults with each chick. Note that after some weeks the aggressive behaviour relaxes and it is important to introduce the chicks to each other in time<sup>(5)</sup>. If sibling aggression occurs give the chicks more food and more bowls<sup>(8)</sup>. The birds will show you which one should be taken out<sup>(10)</sup>.

The participants are divided about what to do with sibling aggression. Some recommend to do nothing (n=2), some recommend to separate the chicks and take the aggressive chick away (n=2), some recommend to separate the weak chick out of the group (n=3) and five participants gave another option than the aforementioned answer categories.

Abandoned chicks can be raised by *hand rearing*<sup>(1,2,3,7,12,15)</sup> and *replace*<sup>(12)</sup> / *foster parents that are other trumpeters*<sup>(4,5,6,8,10,13)</sup> / *foster parents of another bird species*<sup>(9)</sup>. Foster parents can be also a possible solution for abandoned chicks<sup>(7)</sup>.

The participants are divided about what to do with abandoned chicks. Some participants recommend to use hand rearing (n=6), some recommend foster parents which are other trumpeters (n=6) and one recommend other bird species as foster parents.

#### 3.4.5. Hand rearing

Hand rear the weak chick for better control<sup>(1)</sup>. When you hand rear the chicks, you can keep the chicks separate<sup>(3)</sup>. When you use hand rearing, as little as possible imprinting on humans should be considered<sup>(4)</sup>. Hand rearing can be used when foster parents fail to raise the chicks<sup>(10)</sup>. Hand rearing often means that the birds can get aggressive towards the keepers later on<sup>(14)</sup>.

### 3.5. Behavioural enrichment

Wild trumpeters spend 10-15% of their time on foraging and walk 3-7 km daily (Sherman, 1996). Therefore, enrichment is an important factor in animal welfare. It reduces stress and behavioural problems, it stimulates animals to express natural behaviour and improves the mental and physical health (King, 1999). Most avian enrichment efforts are focused on food, but there are other options to provide enrichment (King, 1999).

There are different types of enrichment *food enrichment*<sup>(3,4,5,6,7,8,9,11,12,13,14,15)</sup> / *play enrichment*<sup>(5,6,7,14)</sup> / *enrichment by sight*<sup>(6,7,14)</sup> / *structural enrichment (a more natural environment/ a nest box*<sup>(1)</sup><sub>(1,2,3,4,5,6,7,8,10,12,14)</sub> that are useful for trumpeters in captivity (see table 5).

**Table 5. Different types of enrichment and examples**

Food enrichment	Play enrichment	Structural enrichment (enclosure design)	Non- object enrichment
Live insects - grasshoppers <sup>(9)</sup> - mealworms <sup>(9)</sup>	Balls	Trees	Sounds
One day old mice <sup>(5,7,9)</sup>	Mirror	Shrubs	Lightning variables
Food in bamboo shoots <sup>(8)</sup>		Rocks	Climate variables
Half fruits in the trees <sup>(8)</sup>		Branches	Mixed species exhibits (1,2,3,4,5,7,8,9,10,11,12)
Peanuts & sunflower seeds <sup>(5)</sup>		Pond (1,2,3,4,5,6,7,8,9,10,11,13,15)	
Versele laga (tropical path��) <sup>(5)</sup>		Shelter	
Tubes filled with food		Nest box <sup>(1)</sup> See visitors through glass front <sup>(14)</sup>	

It is recommended to keep captive trumpeters busy for at least 5-10%<sup>(13)</sup> / 10-15%<sup>(2,3,4,5,6,9,10,12,13,14,15)</sup> / 15-20%<sup>(8,11)</sup> of their daily time with foraging. Also, with the help of a *large enclosure*<sup>(3,4,5,6,8,9,13,14,15)</sup> (250m<sup>2</sup><sup>(13)</sup>) / *food enrichment*<sup>(3,4,6,8,10,14,15)</sup> / *environmental enrichment*<sup>(1,2,3,4,10,12,14,15)</sup> / *mixed species exhibits*<sup>(3,4,10,14)</sup> / *Amazonian green house*<sup>(11)</sup>, trumpeters stay in motion. One participant<sup>(7)</sup> thinks it is not essential for the trumpeters to walk 3-7 km per day.

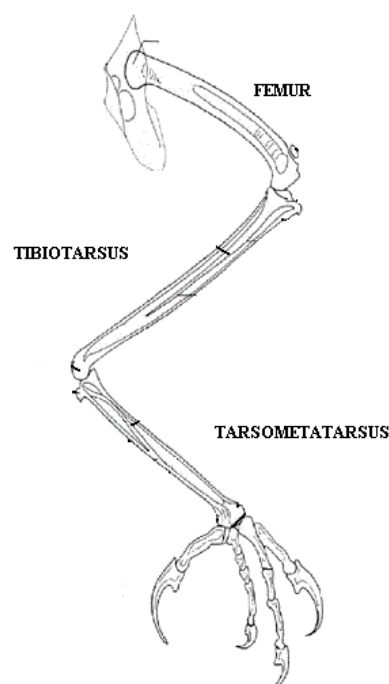
A visual barrier from the visitors and/or each other in the enclosure is *advised*<sup>(3,4,5,6,7,10,12)</sup> / *not advised*<sup>(1,2,8,9,13,14)</sup>. This can be made of thick shrubs, rocks, trees or artificial barriers.

### 3.6. Handling

#### 3.6.1. Identification

Almost all participants<sup>(1,2,3,4,5,7,8,9,11,12,13,15)</sup> agreed that a band is placed on the *Tarsometatarsus*. Only three participants<sup>(6,10,14)</sup> recommend that the location of a band must be on the *Tibiotarsus*. One participant experienced some problems with putting the ring on the *Tarsometatarsus*, the bird had problems with sticking the claws in the band<sup>(14)</sup>. Figure 11 shows the anatomy of the bird and explains where the *Tarsometatarsus* and the *Tibiotarsus* are located on the leg.

For the trumpeters it is recommended that they get an *open*<sup>(3,4,6,7,8,9,11,13)</sup> / *a closed*<sup>(1,2,5,8,10,12,15)</sup> band. The participants are divided when it is about the kind of band for identification of the trumpeters. The participants are divided between an open band (n=8) and an closed band (n=7).



**Figure 11 The anatomy of the leg (Anonymous, 2012)**

Banding chicks can take place at an age of *less than four weeks*<sup>(1,4,5)</sup> / *2-3 months old*<sup>(3,13)</sup> / *as late as possible*<sup>(14)</sup>. The age at which chicks are banded does not matter<sup>(6)</sup>. It can vary between the individuals and depends on the growth of the chicks<sup>(7)</sup>. Instead of banding the chicks, a microchip can be placed at the age of 1-2 months<sup>(8)</sup>.

### 3.6.2. Catching

Almost all participants agreed that the best way of catching a trumpeter is with *a net*<sup>(1,2,4,5,8,10,11,12,13,14,15)</sup> or *by hand*<sup>(1,3,4,5,6,7,9,10,11,13,15)</sup>. Two participants recommend catching a trumpeter with a box<sup>(8,15)</sup>.

Trumpeters can be transported in a *wooden crate*<sup>(2,6,11,12,13,14)</sup> / *plastic case*<sup>(6,9)</sup> / *carton box*<sup>(1,5,6,7,8,10,11,13)</sup>. They (*carton box*<sup>(3)</sup>, *plastic case*<sup>(3,4,15)</sup> and *wooden crate*<sup>(3,4)</sup>) are acceptable to use as long as they are padded<sup>(3)</sup> with a soft protective layer of foam on the sides and roof<sup>(4)</sup>. The ventilation of the transport crate consists of *holes of one cm in diameter*<sup>(1,3,4,5,6,7,8,10,11,13,14,15)</sup> / *holes of two cm in diameter*<sup>(2)</sup> / *vertical/horizontal trenches*<sup>(11,15)</sup> / *mesh*<sup>(5,9,13)</sup> / *larger holes covered with mesh*<sup>(14)</sup> or a combination of all aforementioned<sup>(12)</sup>.

The International Air Transportation Association (IATA) regulates animal transportation by air (IATA, 2014a), the Animal Transport Association (ATA) regulates animal transport by sea, air or land (ATA, nd). IATA has Live Animals Regulations (LARs). The LAR can be regarded as a general standard for air transport of animals, in a safe humane and cost-effective manner. Container Requirement 13 of the IATA LAR should be followed when transporting trumpeters by air (box 2) (IATA, 2014b).

## **Box 2. IATA Container Requirements 13 (IATA, 2006)**

### **1. Container construction**

#### **Materials**

Wood, plywood, non-toxic plastic, fibreglass, synthetics, weld mesh, wire mesh, muslin cloth or similar material.

#### **Principles of design**

The following principles of design must be met in addition to the General Container Requirements outlined at the beginning of this chapter.

#### **Frame**

Solid wood.

#### **Sides**

Wood or plywood of 1.3 cm (1/2 in) thickness. The front of the container must be sloped for extra ventilation. For large hornbills this must be made of a double layer of weld mesh with 8-10 cm (3-4 in) separating the two layers.

#### **Handling Spacer Bars/Handlers**

Must be provided as shown in the illustration.

#### **Perches**

A suitable wooden perch, which allows the birds to grip firmly and comfortably must be provided. It must be such a height that the tail of the bird does not make contact with the floor nor hit its head as it leaves the perch. It must be placed so that excreta does not fall into the food or water containers.

#### **Stocking Density**

Only the young of these species can travel in groups of not more than 25 but immature hornbills and toucans must be in smaller groups of up to 6 birds only. Only the same species must be put together in a group.

All mature birds on this list must be packed individually or in compatible pairs.

## Box 2. Continuation IATA Container Requirements 13 (IATA, 2006)

### Ventilation

Ventilation openings of 2.5 cm (1 in) placed at approximately 5 cm (2 in) intervals on 3 sides of the container must be present, they must be covered with wire mesh whose edges have been protected so that the birds cannot injure themselves.

### Feed and Water Containers

Only feed troughs, with outside access for refilling, are necessary as all these species obtain their moisture from the food supplied.

Soldered tin must not be used.

### 2. Preparations before dispatch

It is advisable that shippers must ensure that wild birds have been held after capture for approximately thirty days before dispatch to overcome stress of capture and allow them to become accustomed to confinement and their new diet. It is of the utmost importance that all birds be given, under close supervision, an opportunity to drink an ample supply of water before departure.

**Overcrowding must be avoided.** Birds must be able to move around freely. On no account must excess birds be loaded to ensure against mortality.

### 3. Feeding and watering guide

(For emergency use only)

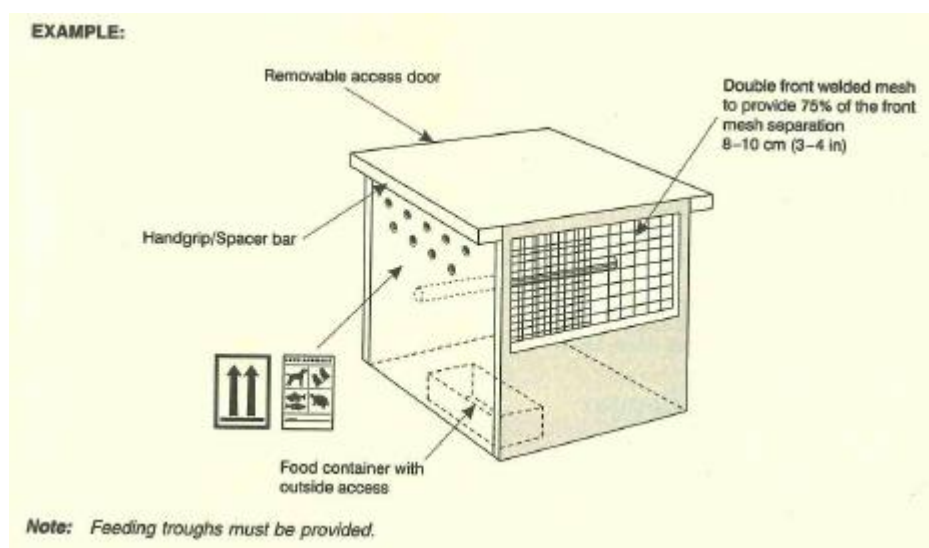
Birds do not usually require additional feeding during 24 hours following the time of dispatch.

If feeding is required due to an unforeseen delay, canned dog food, raw meat, chopped fruit and well soaked biscuit meal must be provided but care must be taken not to overfeed.

### 4. General care and loading

Birds are very nervous by nature and containers must be handled carefully. The container must not be jolted and unnecessary tilting must be avoided. Birds must be provided with water at the time of departure, transfer, layover and at destination.

Birds will not feed in the dark and must be stowed in at least dim light sufficient for them to see their food.



### **3.7. Veterinary issues**

#### **3.7.1. Health and welfare**

*Not eating*<sup>(1,3,5,7,11,12,14)</sup> / *losing weight*<sup>(1,3,5,10,11,12,14)</sup> / *feather pecking*<sup>(1,3,4,5,10,11,14,15)</sup> / *self-inflicting wounds*<sup>(1,5,10,11,14,15)</sup> / *shock*<sup>(1,14)</sup> / *non-active*<sup>(2)</sup> / *screaming*<sup>(8)</sup> / *diarrhoea*<sup>(8)</sup> / *stereotypic behaviour*<sup>(9)</sup> can indicate chronic stress. Feather pecking and self-inflicting wounds could also indicate behavioural disorders<sup>(1)</sup>.

When new individuals arrive at the institution, it is possible that it is necessary to keep them in quarantine for a while. How long depends on *pre-transport examinations*<sup>(3,5)</sup> / *time necessary to further tests*<sup>(8)</sup> and can vary between *1-2 weeks*<sup>(10,11,13)</sup> / *2-3 weeks*<sup>(14)</sup> / *3-4 weeks*<sup>(1,2,6,9,12,15)</sup> / *more than four weeks*<sup>(5)</sup>.

Trumpeter quarantine policy includes a minimum of 30 days (BALAI) and maximum of 45 days in quarantine with close observation, faecal exam and other examinations when needed. It is preferable that the trumpeters have cage mates in quarantine. Visual barriers are recommended in quarantine but an outside enclosure is not recommended. The size of the quarantine area depends on the situation and the duration of the quarantine<sup>(16)</sup>.

The important (first) signs that a trumpeter is sick are: fluffy feather coat, less active trumpeters, off feed, weight loss, dirty cloaca region, abnormal hyperactivity and affectionate behaviour in tame birds<sup>(16)</sup>. There is a similarity between the signs of stress and sickness. Important details that have to be monitored to discover any illness are among other: the real food intake, the body weight and the faeces size and faeces amount<sup>(16)</sup>.

#### **3.7.2. Cleaning and pest control**

Food and water trays need to be cleaned *daily*<sup>(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)</sup> (food trays when necessary<sup>(10)</sup>) and disinfected *never*<sup>(3,7)</sup> *daily*<sup>(1,2,4,5,6,9,11,12,13,14,15)</sup> / *weekly*<sup>(8)</sup> / *food trays do not have to be disinfected daily*<sup>(7)</sup>. It is advised to clean a pond *daily*<sup>(1)</sup> (*every second day*<sup>(7)</sup> *in the inside enclosure*<sup>(10)</sup>) / *weekly*<sup>(2,3,5,12,13)</sup> / *every month*<sup>(11)</sup> / *seasonally*<sup>(6,15)</sup> but also depends on weather conditions<sup>(10)</sup>, type/size of pond<sup>(4,5,14)</sup>, filter systems<sup>(5)</sup> and amount of users<sup>(14)</sup>.

Pest control is advised to be done with *mouse traps*<sup>(1,3,4,5,6,8,9,11,12,13,15)</sup> / *poison*<sup>(3,7,12)</sup> / *ultra sound*<sup>(12)</sup> / *glue outside aviary*<sup>(2)</sup>. Keep in mind if you use poison there is a risk that the birds will eat the pest animal<sup>(10)</sup> and get sick. A concrete floor for the inside enclosure and good fencing for the outside enclosure can also help to keep pests out<sup>(1)</sup>.

#### **3.7.3. Medical procedures**

The standard medical procedures for avian zoo species are: observation from a distance, if possible clinical-physical exam of the trumpeter, faecal exam and an additional examination (including blood, specific diseases through PCR, Elisa test, serology, etc.)<sup>(16)</sup>. Good methods to prevent spreading diseases in avian zoo species are quarantine and vaccinations<sup>(16)</sup>. For birds there are no concerns related to anaesthesia but it is advised to use Isoflurane and do not inject anaesthesia in birds (only in large ratites etc.)<sup>(16)</sup>.

#### **3.7.4. Common injuries and diseases(and treatment)**

A common injury in avian species is beak trauma, depending on the injury it can be treated with wound treatment and grinding. Another common injury is toe and leg trauma. Depending on the injury it can be treated with wound treatment, orthopaedic surgery and bandages<sup>(16)</sup>. The common chick related veterinarian problems are dietary problems and deficiencies or imbalances<sup>(16)</sup>.



Some commonly found bird diseases are described below:

#### **Avian mycobacteriosis**

“It is a chronic problem in many bird collections. The control measures are difficult because the pre-mortem tests are unreliable. Only aggressive sanitation of the infected enclosures and culling of the birds that are infected can help with limiting the disease spreading but it will not eliminate it” (Merck Sharp & Dohme Corp, 2014).

#### **Bumblefoot**

Bumblefoot/pododermatitis is common in bird species. It can occur on one or both sides of the body. The symptoms can be lameness, inflammation and swelling of the footpad due to localized bacterial infection. The effects of the infection can include chronic bumblefoot, septicaemia or amyloidosis. These effects can occur due to injury, infection, inappropriate substrate, obesity or trauma and arthritis. The treatment of bumblefoot includes the treatment of the primary problem, injecting antibiotics and the treatment of the symptoms. In advanced cases surgery is necessary (Merck Sharp & Dohme Corp, 2014).

#### **Encephalitis**

Encephalitis (*Dactylaria gallopava*) causes avian encephalitis and is mainly found in young chicks of one to seven weeks old. *Dactylaria gallopava* occurs in thermal soils, hot spring effluents, self-heated coal pile wastes and man-made heated habitats. In 1987 two cases of encephalitis were reported in young grey-winged trumpeter chicks (17 and 18 weeks old). The bark litter of the spruce and aerosol infection were the cause of the infection (Karesh, et al., 1987).

#### **3.7.5. Mortality**

The most frequent death causes in avian species are trauma, gastrointestinal parasites, dietary problem and husbandry mistakes. The general consensus and the advice of the avian veterinarian is to perform necropsy on every animal that dies. It is an important part of a health concept (like the “closed aviary concept”)<sup>(16)</sup>.

## Discussion & conclusion

The aim of this research is to produce a concept Best Practice Guidelines for the trumpeter in housing and husbandry as well as biology, conservation status and field data, written in the framework of the EAZA Best Practice Guidelines. Information is gathered with literature study and a questionnaire completed by 16 participants. The results are gathered and combined as the concept BPG and contains all the basic information.

The literature study shows that there has not been done a lot of research on wild trumpeters. The amount of research on wild trumpeters is very small and mainly done by one researcher, P.T. Sherman. Especially lacking is field research on the grey- and dark-winged trumpeters, the population size and longevity. The chapters biology and field data are based on literature study which gives a good overview and sufficient information about the trumpeter. This gives zoos background information on how trumpeters live in the wild and it can be used as a reference on how to keep trumpeters in captivity.

Overall the results of the questionnaires give a good overview on best practice of trumpeter husbandry. Sixteen participants completed the questionnaire. At this point especially the topics feeding, breeding and chick rearing and social structure raise some discussion. A lot of information is given about diet components but there is much variation in the nine enclosed diets (that are found in appendix IV). It was not possible to standardise the diet based on this information.

A group structure of 1.1 (one male and one female) is recommended by seven participants. This conflicts with a wild situation (3-13 individuals, with an average of 7 individuals). One zoo mentions that keeping the trumpeters in a pair could be a reason for their trumpeters not breeding for years. Factors that could have effect on why zoos recommended a groups structure of 1.1 are: zoos keep birds species traditionally in couples and/or participants answer according to their current situation instead of what they think is best for the trumpeters.

Most participants did not give accurate recommendations on breeding and chick rearing, mainly because they have never (successfully) bred with the trumpeters. The participants are not agreeing on what to do when sibling aggression occurs. Although it is a common phenomenon in the trumpeters, six participants recommend to separate one (the weak or aggressive one) or all chicks from the group. It can depend on the situation or zoos policy if it is necessary to interfere or not. All participants, except for one, agreed on having a mixed species enclosure. Half of the participants think it is best to keep trumpeters with other bird species (not ground dwelling), five participants advised primates and three participants advised other species. This is mainly based on the different experiences zoos have with mixed species exhibits. Which species suit best is also dependent on how big the enclosure is. Whether or not a visual barrier from the visitors is used also raise a discussion. Half of the participants recommend the use of visual barriers and the other half does not. It can depend on the enclosure designs and individual bird character if recommended.

Eight of the participants advise to use an open band and the other seven to use a closed band. This can be a matter of different law and legislation or the zoo policy.

The information that is gathered about the veterinarian issues via the questionnaire are limited, for additional information an interview with a veterinarian that is specialised in birds took place.

Although additional information is gathered some issues are not discussed. No information about the vaccination protocol for trumpeters did emerge from the questionnaires.

For the time period of 20 weeks that was available for this research, the used methodology was probably the best that could have been used. Personal interviews might have improved the quality and quantity of this report, but would have taken up much more time and planning than was made available. The selection of the 22 contacted zoos is based on zoos who showed interest in a BPG for the trumpeter and are likely to cooperate in this research. Four of the sixteen participants completed the whole survey. In the other cases some questions were skipped or the participant could not give any recommendations. This can be mainly caused because of a lack of experience. It also seems some questions are answered in the current situation where participants did not thought of what is best for the trumpeters. It is possible that different people interpret the questions asked differently. This can be an explanation for the answering of the questions in the current situation.

At this point the concept BPG covers all the topics of the standard contents of BPG of EAZA (that can be found in appendix I) and gives an indication for the best practice on the trumpeter in captivity. Two topics of the standard contents of the BPG of EAZA did not emerge from the questionnaire: specific problems and recommended research, and are left out of the concept BPG. The Gruiformes TAG committee will delete all the information that is not considered as best practice to get the final version of the Best Practice Guidelines for the trumpeter.



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# Appendices

## **Appendix I The standard contents of Best Practice Guidelines of EAZA**

### ***Section 1. Biology and field data***

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- 1.1 Taxonomy
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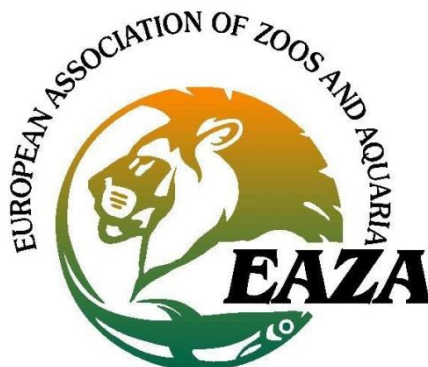
- 2.6.1 Identification
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## **Appendix II EAZA minimum standards for the accommodation and care of animals in zoos and aquaria**

2008 European Association of Zoos and Aquaria  
Update of the EAZA Standards for Accommodation and Care of Wild Animals in Zoos  
(1994) and the Minimum Standards for the Accommodation and Care of Animals in  
Zoos and Aquaria (2006)  
- Approved by EAZA Council on 19 September 2008 -

### **Introduction**

These standards are based on present knowledge and practice for the accommodation and care of animals in zoos and aquaria.

In this Annex the following definitions shall apply:

1. **Zoos and aquaria** shall refer to all establishments open to and administered for the public to promote nature conservation and to provide education, information and recreation through the presentation and conservation of wildlife. This definition shall include zoos, animal parks, safari parks, bird gardens, dolphinariums, aquaria and specialist collections such as butterfly houses as defined in article 2 of Council Directive 1999/22/EC of 29 March 1999. Zoos and aquaria situated in EU countries are requested to have a valid license under Council Directive 1999/22/EC of 29 March 1999. All others need valid licenses to operate, if these exist. The dates and/or numbers of these licenses have to be registered with the EAZA Executive Office;
2. **Animals** shall refer to all species of the animal kingdom including species of the classes Mammalia, Aves, Reptilia, Amphibia, Pisces, groups of Invertebrata;
3. **Welfare** shall refer to the physical, behavioral and social well-being of animals through the provision of appropriate conditions for the species involved, including but not necessarily limited to housing, environment, diet, medical care and social contact where applicable;
4. **Enclosure** means any accommodation provided for animals in zoos and aquaria;
5. **Enclosure barrier** means a barrier to contain an animal within an enclosure;
6. **Stand-off barrier** means a physical barrier set back from the outer edge of an enclosure barrier designed to prevent public access to the latter;
7. **Hazardous animals** means any representative of the groups or species listed in Annex 1 and any other animal which, because of its individual disposition, sexual cycle, maternal instincts, or for any other reason, whether by biting, scratching, butting, compression, injecting venom or by any other method, is likely to injure seriously or transmit disease to humans;
8. **Dangerous carnivores** means all members of the genera *Panthera*, *Acinonyx*, *Lynx* and *Neofelis*, the families *Ursidae* and *Hyaenidae*, *Canis lupus*, *Canis rufus* and *Lycaon pictus*.

## **The Standards**

### **ANIMAL CARE - WELFARE, HEALTH AND HYGIENE**

#### **Routine observation of the animals**

1. The condition and health of all animals in the zoo to be checked daily by the persons in charge of their care for that particular day.
2. Any animals which are noted to be unduly stressed, sick or injured to receive immediate attention and, where necessary, treatment.

#### **Accommodation - Space, Exercise and Grouping**

3. Animals to be provided with an environment, space and furniture sufficient to allow such exercise as is needed for the welfare of the particular species.
4. Enclosures to be of sufficient size and animals to be so managed:
  - a. to avoid animals within herds or groups being unduly dominated by individuals;
  - b. to avoid the risk of persistent and unresolved conflict between herd or group members or between different species in mixed exhibits;
  - c. to ensure that the physical carrying capacity of the enclosure is not overburdened;
  - d. to prevent an unacceptable build-up of parasites and other pathogens.
5. Animals not to be unnaturally provoked for the benefit of the viewing public.
6. Animals in visibly adjoining enclosures to be those which do not interact in an excessively stressful way.
7. Separate accommodation for pregnant animals and animals with young to be available, if necessary, in the interests of avoiding unnecessary stress or suffering.
8. Provide appropriate accommodation for animals being temporarily separated from a group.

#### **Accommodation - Comfort and Well-being**

9. The temperature, humidity, ventilation and lighting of enclosures to be suitable for the comfort and well-being of the particular species of animal at all times, and in particular:
  - a. consideration to be given to the special needs of pregnant and newly-born animals;
  - b. newly-arrived imported animals to be fully acclimatized bearing in mind that this may be only a gradual process;
  - c. tanks for fish and aquatic invertebrates to be adequately oxygenated, and appropriate water quality to be provided.
10. Animals in outdoor enclosures to be provided with sufficient shelter from inclement weather or excessive sunlight where this is necessary for their comfort and well-being.

## **Furnishings within Enclosures**

11. Animal enclosures to be furnished, in accordance with the needs of the species in question, with such items as bedding material, perching, vegetation, burrows, nesting boxes and pools.
12. Provide appropriate environmental and behavioural enrichment.

## **Prevention of Stress or Harm to Animals**

13. Enclosures and barriers to enclosures to be maintained in a condition which presents no likelihood of harm to animals, and in particular:
  - a. any defect noted in an animal barrier or in any appliances or equipment within animal enclosures to be repaired or replaced without delay;
  - b. any defect likely to cause harm to animals to be rectified at once or, if this is not possible, the animals to be removed from the possibility of any contact with the source of the danger;
  - c. any vegetation capable of harming animals to be kept out of reach.
14. All plants and fixed equipment, including electrical apparatus, to be installed in such a way that it does not present a hazard to animals and its safe operation cannot be disrupted by them.
15. Rubbish in animal enclosures to be cleared regularly to avoid any possibility of harm to animals.
16. Trees within or near animal enclosures to be regularly inspected and lopped or felled as appropriate to reduce the risk of animals being harmed by falling branches or using trees as a means to escape.
17. Smoking is prohibited in animal enclosures, in parts of buildings where animals enclosures are located and in areas where food is stored or prepared.
18. Animals to be handled only by, or under the supervision of, competent trained authorized staff; and this to be done with care, in a way which will avoid unnecessary discomfort, behavioural stress or actual physical harm to animals.
19. Any direct physical contact between animals and the visiting public only to be under the control of zoo staff and for periods of time and under conditions consistent with the animals welfare and not leading to their discomfort.

## **Food and Drink**

20. Food and drink provided for animals to be of the nutritive value and quantity required for the particular species and for individual animals within each species, bearing in mind the condition, size and age of each animal; the need to allow for special circumstances (e.g. fast days or longer periods of fast or hibernation) and special diets for certain animals (e.g. animals undergoing a course of veterinary treatment, or pregnant animals).

21. Veterinary or other specialist advice to be obtained and followed concerning all aspects of nutrition.
22. Supplies of food and drink to be stored, prepared and offered to the animals under hygienic conditions.
23. Natural behaviour of the animals, particularly social aspects to be considered when offering food and drink, and feeding and drinking receptacles if used, to be placed so as to be accessible to every animal kept within a particular enclosure.
24. Uncontrolled feeding by visitors is not permitted. Where feeding is permitted it should be on a selective basis only with suitable food provided and approved by the management.

### **Sanitation and control of disease**

25. Proper standards of hygiene, both in respect of the personal hygiene of the staff and that of the animal enclosures and treatment rooms, to be maintained, and in particular:
  - a. special attention to be given to the cleaning of animal enclosures and equipment within them, to reduce the risk of disease or disease transfer, including in the case of aquatic animals, regular monitoring of water quality;
  - b. non-toxic cleaning agents to be readily available, along with supplies of water and the means to apply them;
  - c. veterinary advice to be obtained and followed regarding all cleaning and sanitation requirements of enclosures or other areas following identification of an infectious disease in any animal.
26. The drainage of all enclosures to be capable of removing efficiently all excess water.
27. Any open drains, other than those carrying potable water, to be outside the areas to which animals have access.
28. Refuse material to be regularly removed and disposed of.
29. A safe and effective programme for the control of pests and, where necessary, predators to be established and maintained throughout the institution. It is also requested that animals must not escape from the zoo or aquarium, and create an ecological threat for native wild species.
30. Keeper staff to be instructed to report immediately if they have contracted or are in contact with any infection which they have reason to believe could be transmitted to, and adversely affect the health of, any animal; and management then to take appropriate action.
31. Keeper staff to be instructed to report in confidence any other disability which might affect their capacity to manage the animals in a safe and competent manner; and management then to take appropriate action.

### **ANIMAL CARE - VETERINARY ASPECTS**

32. Arrangements to be made for routine veterinary attendance. In case of fishes and invertebrates, other specialist attendance is also acceptable. This also applies to all other references to veterinary aspects in fishes and invertebrates in this document.
33. A programme of veterinary care to be established and maintained under the supervision of a veterinary surgeon or practitioner.
34. Routine examinations, including parasite checks, to be carried out and preventive medicine, including vaccination, to be administered at such intervals as may be recommended by a veterinary surgeon or practitioner.
35. Where a full veterinary service is located at the institution, the facilities to include: an examination table; a range of basic surgical instruments; anesthetic facilities; basic diagnostic instruments; sufficient power points to take light and other electrical fittings; facilities, where appropriate, to take blood and other samples and to prepare and dispatch them; and a comprehensive range of drugs.
36. Where a full veterinary service is not available at the institution, a treatment room to be provided at the premises for use where appropriate for the undertaking of routine examination of animals in clean, ventilated surroundings.
37. A room or rooms to be provided for the care of unduly distressed, sick and injured animals and facilities for hand-rearing and nursing animals.
38. Facilities to be available for collecting, restraining and, if necessary, for administering a general anaesthetic, for euthanizing animals and for the aftercare of animals recovering from sedation.
39. Reserve accommodation to be available, away from other animals, for the isolation and examination of newly-arrived animals, under quarantine restrictions (conditions) where necessary.
40. Newly-arrived animals to be kept isolated as long as is necessary to ensure proper examination before introduction to other animals in the collection.
41. Particular attention to be paid to hygiene in the quarters where isolated or quarantined animals are kept.
42. Where practicable, protective clothing and utensils used by staff in the isolation area should be used, cleaned and stored only in that area.
43. All animal drugs, vaccines and other restricted veterinary products to be kept safely under lock and key with access by authorized persons only.
44. Except under the direction of a veterinary surgeon or practitioner, members of the staff of the zoo not to possess or administer controlled drugs.
45. Zoo management to seek agreement with the consulting local veterinary adviser regarding the desirability of either the zoo or aquarium, a local hospital or the veterinary surgeon or practitioner himself, of holding supplies of antidotes to potentially toxic veterinary products used at the institution.

46. All unwanted, contaminated veterinary equipment to be disposed of safely and following relevant legislative prescriptions.

### **POST-MORTEM FACILITIES**

47. Dead animals to be handled in a way which avoids the risk of any transmission of infection.
48. The cause of death for each animal dying in the collection to be established where reasonable and practicable to do so, including, in the majority of cases, the examination of carcasses by a veterinary surgeon or a practitioner or a pathologist with relevant experience and training.
49. Where animal carcasses cannot be quickly removed to a professional veterinary laboratory centre outside the premises, facilities should be provided for conducting post-mortem examinations and the processing of samples resulting from them in a safe and hygienic manner. If immediate post-mortem examination is not possible, then in consultation with the veterinary surgeon or practitioner, refrigerated facilities or a deep freeze for storage to be provided pending the removal in a suitable insulated container to a post-mortem laboratory.
50. Facilities and equipment in any room provided on the premises for post-mortem examinations to include: an efficient drainage system; washable floors and walls; an examination table; an adequate selection of appropriate instruments; facilities for taking and preserving specimens; and, if larger animals are kept in the collection, a hoist.
51. Following post-mortem examinations conducted on the zoo premises, carcasses and organs to be removed swiftly and disposed of safely.

### **SAFETY AND SECURITY**

#### **General provisions**

52. Local safety and security legislation regarding zoos and aquaria must be applied.

#### **Enclosures**

53. Other than when elsewhere in the control of authorized staff, animals kept for exhibition in the zoo to be kept at all times in enclosures or, in the case of free-running non-hazardous animals, within the perimeter of the zoo.

#### **Enclosure barriers**

54. Enclosure barriers to be designed constructed and maintained to contain animals within the desired enclosures.

#### **Stand-off Barriers**



55. Where direct contact would be possible between visitors and hazardous animals through or over any enclosure barrier, to the extent that such an animal would be capable of causing injury, a stand-off barrier to be provided sufficiently far back to prevent such contact.

### **Perimeter Boundaries**

56. The perimeter boundary, including access points, to be designed, constructed and maintained to discourage unauthorized entry and, so far as is reasonably practicable, as an aid to the confinement of all the animals within the perimeter of the institution.
57. No perimeter barrier to include any electrical section less than 2 meters from the ground, except in those cases where it also serves as a normal animal barrier and cannot be reached by the visiting public.

### **Warning Signs**

58. In addition to a stand-off barrier, an adequate number of clearly visible safety signs to be displayed at each enclosure where there may be significant danger, including electric fences.

### **Exits**

59. Sufficient exits from the zoo or aquarium to be provided, having regard to the size of the institution and the number of visitors anticipated at any time who may need to leave quickly in an emergency.
60. Exits to be clearly signposted and marked.
61. Each exit from the zoo or aquarium to be kept clear and to be capable of being easily opened from inside to allow the release of persons from the institution. All such gates to be capable of being closed and secured to discourage the escape of animals.

### **Drive-Through Enclosures**

62. Unless there is stricter local legislation, this chapter will be applied to drive through enclosures.
63. Where dangerous carnivores are kept in drive-through enclosures, entry and exit to such enclosures to be through a system of double gates, with sufficient space between to allow the gates to be securely closed to the front and rear of any vehicle which may enter or need to enter the enclosures.
64. In the case of dangerous carnivores the access gates to be protected by fencing positioned at right angles to the perimeter fence on each side of the roadway with the enclosure, and of the same standard as that for the main enclosure barrier and extending back from the access for a distance of at least 25 meters.

65. Double gates to be designed and maintained so that, where hazardous animals are within or have access to the enclosure secured by the gates, one gate cannot be opened until the other has securely closed - though, provided no danger to the public is thereby caused, provision may be made for this arrangement to be overridden in the event of an emergency arising.
66. For other hazardous animals, except those grazing or hoofed animals where a cattle grid would be sufficient to contain them, single entry/exit gates, supervised at all times, to be provided.
67. Access points between enclosures to be controlled to prevent animals entering adjoining enclosures.
68. Electrified pressure pads, where used, to be designed and installed to ensure that in the event of their failure, any gate they control will close automatically or otherwise operate to ensure that animals are safely secured within their enclosure.
69. Gates which are mechanically-operated to have an alternative method of control whereby they can be opened and closed manually in the event of an interruption of the power supply or other emergency and to be designed to close automatically when subject to power failure.
70. Operators of mechanically-operated gates to have a clear, unobstructed view of the gates under their control and of the area within the vicinity of those gates.
71. A one-way road system to be used to assist the traffic flow and thus reduce the risk of accidents.
72. Stopping to be permitted only at places where the road is at least 6 meters wide.
73. Where dangerous carnivores and primates and (except where the enclosure is supervised by competent staff in a manner which prevents any danger to the public) any other hazardous wild animal are kept:
  - a. no vehicle to be allowed access unless a rescue vehicle capable of effecting its recovery is immediately available;
  - b. access to vehicles without a solid roof to be prohibited at all times;
  - c. notices, which are readily visible and easy to read, to be displayed to warn visitors whilst in the enclosure to:
    - I. Stay in vehicle at all times;
    - II. Keep all vehicle doors locked;
    - III. Keep vehicle windows and sun-roof closed;
    - IV. Sound the horn or flash the headlights and await the arrival of a rescue vehicle if they break down.
74. Continuous observation to be maintained over the entire area of each enclosure containing any hazardous animal.
75. The staff member in overall control of supervision to be armed with an appropriate firearm and to be trained in its use so that a hazardous animal can be killed in an emergency if this will save human life or injury.

## **Removal of animals from enclosures**

76. Hazardous animals not to be allowed out of their usual enclosures for the purpose of direct contact with the public, except, where the zoo operator is satisfied that such animals are not, when under control, likely to cause injury or transmit disease.
77. Where hazardous animals are allowed out of their usual enclosures an authorized and experienced member of the staff to accompany each animal.
78. Zoo operators to exercise caution and discretion in the case of the removal of non-hazardous animals since the behaviour of all animals may be less predictable when away from their usual enclosures.
79. Precautions to be taken to avoid injury to visitors when animals are used for rides.

## **Escape of animals from their enclosures**

80. Zoo operators to assess whether any danger may arise in the event of an animal escaping from its enclosure and to consider the possible or likely attempted escape route within and from the institution if this were to happen.
81. In the case of the escape of animals emergency plans must be available and fully understood and practiced by all staff.
82. This emergency plan should include a member of staff to be readily available at all times to take decisions regarding escaped animals, including the use of firearms if needed.
83. Every employee with tasks under the emergency procedures to undergo periodic refresher training and practice.

## **Safety of access for the public**

84. Buildings, structures and areas to which the public has access to be maintained in safe condition.
85. Trees within areas where visitors are likely to be walking or sitting to be regularly inspected and lopped or felled as appropriate to avoid visitors being harmed by falling branches etc.
86. Warning to be given of all edges where a person might fall, including into water; and, where necessary, such edges to be guarded by a barrier which would be capable of restraining children from falling.
87. Each walkway over an animal enclosure to be designed, constructed and maintained to withstand safely the weight of the maximum of adults who could use it at any time; and maintained, sited or protected so as to withstand any contact by hazardous animals and prevent contact between such animals and visitors.

88. The visiting public not to be allowed to enter any buildings or other areas of the zoo premises which could present an unreasonable risk to their health and safety.
89. Any buildings to which visitors are not allowed on the grounds referred to above, to be kept locked and warning notices to be displayed to indicate that access is both unsafe for, and not permitted to, the public.
90. Other areas to be clearly defined, e.g. by means of barriers and similar warning notices, or by suitable notices together with road markings where frequent access is necessary for vehicles operated by zoo staff along roadways to which the public are not admitted.

### **Emergency First-Aid**

91. First-aid equipment and written first-aid instructions to be readily accessible on the premises.
92. Where venomous animals are kept, the appropriate and up-to-date anti-venom to be held at the zoo or a local hospital or within a reasonable time frame ensuring the safety of staff and visitors, and kept in accordance with the manufacturer's instructions.
93. Written instructions to be provided for staff on the procedure to be followed in the event of an incident involving any venomous animal and a visitor or another staff member. These instructions to include:
  - a. immediate action to be taken in respect of the patient and;
  - b. required information on a pre-prepared form for forwarding to the local hospital which would include:
    - I. the nature of the bite or sting and the species inflicting it;
    - II. the specification, for cross-reference purposes, of the anti-venom which accompanies the patient;
    - III. the telephone number of the nearest poisons centre;
    - IV. the telephone number of the institution.

### **MISCELLANEOUS**

#### **Insurance against liability for damage or injury caused by animals**

94. Zoo operators to hold a current liability insurance policy or other legal arrangements which indemnifies them and every other person under a contract of service or acting on their behalf, against liability for any damage or injury which may be caused by any of the animals, whether inside or outside the zoo, including movement by vehicle. Any upper limit on the sum involved which is included in the terms of such insurance to be set at an adequate and realistic level.

#### **Stock records**

95. Records to be kept by means of an established and globally recognized and accepted record system and maintained in relation to all individually recognized animals and groups of animals.

96. Where animals are disposed of or die, the records to be kept in the appropriate recording system as described in Article 95.
97. The records to be kept on a computer system using the ARKS software, or Zoological Information Management System when available, and to be included on the global zoo animal database of ISIS, by means of which information can be quickly retrieved.
98. The records should provide the following information:
- the correct identification and scientific name;
  - the origin (i.e. whether wild or captive born, including identification of parents, where known, and previous location/s, if any);
  - the dates of entry into, and disposal from, the collection and to whom;
  - the date, or estimated date, of birth;
  - the sex of the animals (where known);
  - any distinctive markings, including tattoo or freeze brands etc.;
  - clinical data, including details of and dates when drugs, injections, and any other forms of treatment were given, and details of the health of the animal;
  - the date of death and the result of any post-mortem examination;
  - the reason, where an escape has taken place, or damage or injury has been caused to, or by, an animal to persons or property, for such escape, damage or injury and a summary of remedial measures taken to prevent recurrence of such incidents.
99. In addition to the individual records, an annual stock list of all animals to be kept preferably in the form given below. (Estimated numbers should be available for all fish and invertebrate species).
- Common and scientific names of the species
  - Total in the collection at 1 January
  - Number of arrivals into the collection from all sources during the year
  - Number of births into the collection during the year
  - Number which died within 30 days of birth
  - Number which died older than 30 days after birth/hatching
  - Number departed collection, including sales, breeding loans, etc.
  - Total remaining in the collection at 31 December

This record, giving details of male/female/unsexed animals as appropriate, to be set out in columns for ease of compilation and reference, e.g.: All records can be kept in the local language or in the English language (in order to facilitate the international exchange of information and cooperation).

Common name	Scientific name	Group 1-1-05	Arrive	Born	Neonatal death	Death	Depart	Group 31-12-05
Bennett's wallaby	Macropus rufogriseus	5.11.0	1.0	1.1.8	1.0.3	1.2.0	1.1	4.9.5

100. Surplus animal stock only to be passed on to responsible persons who have the appropriate facilities and expertise (cf also EAZA Code of Ethics).

### **Transportation and Movement of Live Animals**

101. Facilities suitable for hoisting, crating and transportation of all the kinds of animals kept within the zoo, to destinations both inside and outside the zoo, to be available if not kept at the zoo.
102. Any animal taken outside the zoo to be in the personal possession of the operator of the zoo, or of competent persons acting on his behalf, and adequate provision to be made for its safety and well-being at all times.
103. Any hazardous animal taken outside the zoo to be kept securely at all times. Such animal to be kept away from direct contact with persons other than the zoo operator or competent persons acting on his behalf, except where the zoo operator is satisfied that it is not likely, when under control, to cause injury or transmit disease.

## **Appendix III Trumpeter questionnaire**

### **Survey best practice guideline trumpeters (*Psophiidae*)**

It is our intention that this survey takes up as little of your time as possible, but at the same time gathers as much information as possible. Most of the questions are multiple choice questions where you simply tick off your answer in the boxes. Other questions require a small written explanation. At the end of the survey there is space for you to give comments on anything you may consider important on the best practice husbandry of this species.

**Please fill in this survey as complete as possible.**

All questions are about what you recommend and/or consider as the best practise and NOT necessarily about the actual situation in your zoo.

We would like to thank you very much for taking the effort and the time to fill in this survey.

With kind regards,  
Tara Koops and Bridget Maste

*If you have any questions about this survey, do not hesitate to contact us using this email address: [trumpeterhusbandrysurvey@gmail.com](mailto:trumpeterhusbandrysurvey@gmail.com)*

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#### **A. Contact information (1/13)**

First Name: Click here to fill in your first name

Last Name: Click here to fill in your last name.

Job description: Click here to fill in your job description.

Your institution: Click here to fill in your institution.

City: Click here to fill in your city.

Country: Click here to fill in your country.

Email Address: Click here to fill in your email address.

#### **B. Enclosure (2/13)**

*The measurements mentioned in this chapter are based on literature study and other same size bird species (chickens).*

1. What would be the recommended accessible floor space in the inside enclosure per bird for first 4 birds?

☐ < 2 m<sup>2</sup>

☐ 2-4 m<sup>2</sup>

☐ 4-6 m<sup>2</sup>

☐ > 6 m<sup>2</sup>

☐ Other Click here to fill in your answer.

2. What would be the recommended accessible floor space in the outside enclosure per bird for first 4 birds??

☐ < 2 m<sup>2</sup>

☐ 2-4 m<sup>2</sup>

- ☐ 4-6 m<sup>2</sup>
- ☐ > 6 m<sup>2</sup>
- ☐ Other [Click here to fill in your answer.](#)

3. What would be the recommended height of the inside enclosure?

- ☐ < 3 meter
- ☐ 3-5 meter
- ☐ > 5 meter
- ☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended height of the outside enclosure?

- ☐ < 3 meter
- ☐ 3-5 meter
- ☐ > 5 meter
- ☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended m<sup>2</sup> for each additional bird (on top of the 4 individuals) in the social group?

- ☐ < 1 m<sup>2</sup>
- ☐ 1-2 m<sup>2</sup>
- ☐ > 2 m<sup>2</sup>
- ☐ Other [Click here to fill in your answer.](#)

6. Is a quarantine/ surplus area needed?

- ☐ Yes is needed, inside enclosure
- ☐ Yes is needed, outside enclosure
- ☐ Yes is needed, in and outside enclosure
- ☐ No is not needed
- ☐ Other [Click here to fill in your answer.](#)

7. What would be the recommended accessible floor space in the quarantine/surplus area per bird for first 4 birds?

- ☐ < 1 m<sup>2</sup>
- ☐ 2-4 m<sup>2</sup>
- ☐ 4-6 m<sup>2</sup>
- ☐ > 6 m<sup>2</sup>
- ☐ Other [Click here to fill in your answer.](#)



### C. Door- and floor design (3/13)

1. What would be the recommended number of bird entries between the inside and outside enclosure?

- ☐ 1 entry
- ☐ 2 entries
- ☐ 3 entries
- ☐ > 3 entries
- ☐ Other [Click here to fill in your answer.](#)

2. What would be the recommend height for the bird entry?

- ☐ Ground level
- ☐ 1m
- ☐ Other [Click here to fill in your answer.](#)

3. What would be the recommend shape of the bird entry?

- ☐ Square
- ☐ Circle
- ☐ Eclipse
- ☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended material for the doors to be made of?

- ☐ Wood
- ☐ Metal
- ☐ Synthetic material
- ☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended floor substrate for the inside enclosure?

- ☐ Bark
- ☐ Sand
- ☐ Concrete
- ☐ Water
- ☐ Other [Click here to fill in your answer.](#)

6. What would be the recommended floor substrate for the outside enclosure?

- ☐ Bark
- ☐ Sand
- ☐ Grass
- ☐ Water
- ☐ Combination of above (please specify) [Click here to fill in your answer.](#)
- ☐ Other [Click here to fill in your answer.](#)

#### D. Barriers (4/13)

1. What would be the recommended kind of barrier for the inside enclosure?

☐ Glass window

☐ Mesh

☐ Hard wall

☐ Wood

☐ Combination (please specify) [Click here to fill in your answer.](#)

☐ Other [Click here to fill in your answer.](#)

2. What would be the recommended kind of barrier for the outside enclosure?

☐ Glass window

☐ Mesh

☐ Hard wall

☐ Wood

☐ Combination (please specify) [Click here to fill in your answer.](#)

☐ Other [Click here to fill in your answer.](#)

3. If applicable what would be the recommended maximum opening of the mesh wire?

☐ < 10 mm

☐ 10 -15 mm

☐ 15- 20 mm

☐ > 20 mm

☐ Other [Click here to fill in your answer.](#)

4. Would it be recommend clipping the birds?

☐ Yes

☐ No

☐ Other [Click here to fill in your answer](#)

**E. Furniture (5/13)**

1. What would be the recommended kind of furniture for the enclosures? (multiple answers possible)

- ☐ Horizontal perches
- ☐ Other type of perches (please specify) [Click here to fill in your answer.](#)
- ☐ Trees
- ☐ Vegetation
- ☐ Rocks
- ☐ Other [Click here to fill in your answer.](#)

2. What would be the recommended kind of sleeping accommodation to provide? (multiple answers possible)

- ☐ Horizontal perches
- ☐ Trees
- ☐ Platforms
- ☐ Boxes
- ☐ Forked branches
- ☐ Other [Click here to fill in your answer.](#)

3. What would be the recommended thickness (diameter) of the branches?

- ☐ 10 mm
- ☐ 15 mm
- ☐ 20 mm
- ☐ 25 mm
- ☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended height to place the sleeping accommodation?

- ☐ < 1 m
- ☐ 1-3 m
- ☐ 3-5 m
- ☐ > 5 m
- ☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended number sleeping accommodations?

- ☐ None
- ☐ 1 for the whole group
- ☐ 1 per bird
- ☐ 1 per two birds
- ☐ 2 or more per bird
- ☐ Other [Click here to fill in your answer.](#)

**F. Temperature, humidity and light (6/13)**

1. What would be the recommended temperature for the inside enclosure?

☐ 15-20 °C

☐ 20-25 °C

☐ 25-30 °C

☐ > 30 °C

☐ Other [Click here to fill in your answer.](#)

2. What would be the recommended temperature for the outside enclosure?

☐ 15-20 °C

☐ 20-25 °C

☐ 25-30 °C

☐ > 30 °C

☐ Depends on the season (please specify) [Click here to fill in your answer.](#)

☐ Other [Click here to fill in your answer.](#)

3. What would be the recommended type of heating for the inside enclosure?

☐ Electric heating

☐ Gas heating

☐ Floor heating

☐ Infrared lamp

☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended type of ventilation for the inside enclosure?

☐ Open window

☐ Open door

☐ Ventilation in the roof

☐ Ventilation strip in the door

☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended humidity for the inside enclosure?

☐ 50-60 %

☐ 60-70 %

☐ 70-80 %

☐ > 80 %

☐ Other [Click here to fill in your answer.](#)

6. What would be the recommended kind of light to use?

☐ Full Spectrum Light (visible light, UVA, and UVB)

☐ Standard fluorescent lamps

☐ Incandescent and halogen

☐ Nightlights

☐ Other [Click here to fill in your answer.](#)

7. What would be the recommended minimum hours of exposure to natural light and/or artificial UV lighting per 24 hours?

☐ 6 hours

☐ 8 hours

☐ 10 hours

☐ > 10 hours

☐ Other [Click here to fill in your answer.](#)

### G. Feeding (7/13)

The diet of trumpeters exists of fruit pulp (90%) and arthropods (10%) (Sherman, 1996).

1. Do you have negative experiences with certain food items? If yes please specify.

[Click here to fill in your answer.](#)

2. If applicable, what would be the recommended kind of minerals or supplements to feed and at what moment (season, life stage, illness, etc.)?

[Click here to fill in your answer.](#)

3. What would be the recommended feeding times a day?

☐ 1 time

☐ 2 times

☐ 3 times

☐ > 3 times

☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended time when the feedings occur? (multiple answers possible)

☐ Morning

☐ Afternoon

☐ Evening (end of the work day)

☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended place where the feedings to occur?

☐ Inside enclosure

☐ Outside enclosure

☐ Both

☐ Other [Click here to fill in your answer.](#)

6. What would be the recommended presentation of the food? (multiple answers possible)

☐ Whole food items

☐ Chopped

☐ Squashed

☐ Single fixed feeding station

☐ Over several fixed feeding stations

☐ Scattered over the floor

☐ Hidden in enclosure

☐ In an enrichment device

☐ Other [Click here to fill in your answer.](#)

7. How often would you recommend weighting the diet?
- ☐ Every meal
  - ☐ Weekly
  - ☐ Every month
  - ☐ 2-6 times per year
  - ☐ Annually
  - ☐ Never
  - ☐ Other [Click here to fill in your answer.](#)
8. If applicable, what are the 3 main food related problems with the trumpeters?
1. [Click here to fill in your answer.](#)
  2. [Click here to fill in your answer.](#)
  3. [Click here to fill in your answer.](#)
9. What would be the recommended adjustments to the diet during the breeding season?  
(multiple answers possible)
- ☐ None
  - ☐ Feeding extra arthropods
  - ☐ Feeding extra fruit
  - ☐ Adding supplements (please specify) [Click here to fill in your answer.](#)
  - ☐ Other [Click here to fill in your answer.](#)
10. What would be the recommended adjustments to the diet for chicks?
- ☐ None
  - ☐ Feeding extra arthropods
  - ☐ Feeding mice
  - ☐ Feeding egg yolk
  - ☐ Other [Click here to fill in your answer.](#)
11. What would be the recommended kind of water supply for the inside enclosure?
- ☐ Pond
  - ☐ Water dispensers
  - ☐ Water bowl
  - ☐ Sprinkling system
  - ☐ Other [Click here to fill in your answer.](#)
12. What would be the recommended kind of water supply for the outside enclosure?
- ☐ Pond
  - ☐ Water dispensers
  - ☐ Water bowl
  - ☐ Sprinkling system
  - ☐ Other [Click here to fill in your answer.](#)

**Please send us the current diet for the trumpeters that you use and every customized diet (in case of chicks, breeding, illness etc.)**

## H. Social structure (8/13)

*In a natural situation trumpeters live in an average group size of 7 individuals, 3 unrelated males, 2 unrelated females and 2 juveniles (Sherman, 1996).*

1. What would be the recommended group size of adult birds?

☐ 1.1 birds

☐ 2.2 birds

☐ 1.3 birds

☐ 3.1 birds

☐ Other [Click here to fill in your answer.](#)

2. Would it be recommended to introduce a new male or female into a group?

☐ No

☐ Yes a male

☐ Yes a female

☐ Does not matter

☐ Other [Click here to fill in your answer.](#)

3. What would be the recommended age to move a juvenile out of the group?

☐ 6 months old

☐ 1 year old

☐ 2 years old

☐ 3 years old

☐ > 3 years old

☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended maximum duration of isolating an individual from its group to avoid social instability?

☐ < 12 hours

☐ 1 day

☐ 1 week

☐ 1 month

☐ Not relevant

☐ No isolation possible

☐ Other [Click here to fill in your answer.](#)

5. If applicable, when isolating an individual would you use a visual and/or sound barrier?

☐ No, only mesh

☐ Yes a visual barrier (please specify type of barrier) [Click here to fill in your answer.](#)

☐ Yes a sound barrier (please specify type of barrier) [Click here to fill in your answer.](#)

☐ Yes both (please specify type of barrier) [Click here to fill in your answer.](#)

☐ Other [Click here to fill in your answer.](#)

## I. Breeding (9/13)

*In a natural situation there will be one dominant female in a social group, only she will reproduce (Sherman, 1996).*

1. What would be the recommended number of nesting opportunities to be available for 4 trumpeters?

- ☐ 1 nesting opportunity
- ☐ 2-3 nesting opportunities
- ☐ More than 3 nesting opportunities
- ☐ Other [Click here to fill in your answer.](#)

2. What would be the recommended kind of nesting opportunities?

- ☐ Nest boxes
- ☐ Nest basket
- ☐ Other [Click here to fill in your answer.](#)

3. What would be the recommended kind of material to provide for the trumpeter to build their nests?

- ☐ Twigs
- ☐ Bamboo
- ☐ Fur of a mammal (please specify) [Click here to fill in your answer.](#)
- ☐ Feathers
- ☐ Coconut fibber
- ☐ Moss
- ☐ Catton thread
- ☐ Hay
- ☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended height to place the nesting opportunities?

- ☐ < 1 meter
- ☐ 1-3 meter
- ☐ 3-6 meter
- ☐ 6-10 meter
- ☐ > 10 meter
- ☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended location of the opening of the nest boxes if you use those?

- ☐ High
- ☐ In the middle
- ☐ Low
- ☐ Other [Click here to fill in your answer.](#)



6. If applicable, what would be the recommended height of the inside of the nesting opportunities?
- ☐ 20-50 cm
  - ☐ 50-80 cm
  - ☐ > 80 cm
  - ☐ Other [Click here to fill in your answer.](#)
7. If applicable, what would be the recommended width of the inside of the nesting opportunities?
- ☐ 30-40 cm
  - ☐ 40-60 cm
  - ☐ > 60 cm
  - ☐ Other [Click here to fill in your answer.](#)
8. What would be the recommended time or period to provide nesting opportunities?
- ☐ Breeding season
  - ☐ Always available
  - ☐ Other [Click here to fill in your answer.](#)
9. What would be recommended to use: an incubator or natural incubating?
- ☐ Natural incubating
  - ☐ Incubator
  - ☐ With multiple eggs at least one in the incubator
  - ☐ With multiple eggs at least one by natural incubation
  - ☐ Other [Click here to fill in your answer.](#)
10. Sibling aggression is a common phenomenon in this species (Male, 1989), what would be the recommended action when with multiple chicks that attack each other?
- ☐ Nothing
  - ☐ Separate, take the aggressive chick out the group
  - ☐ Separate, take the weak chick out of the group
  - ☐ Other [Click here to fill in your answer.](#)
11. What would be the recommended action when chicks are hatched?
- ☐ Do nothing
  - ☐ Separate males and females, chicks with the males
  - ☐ Separate males and females, chicks with the females
  - ☐ Other [Click here to fill in your answer.](#)
12. If applicable, when you separate chicks from the males or females. Would it be recommended to use a visual and/or sound barrier?
- ☐ No, only mesh
  - ☐ Yes a visual barrier (please specify type of barrier) [Click here to your answer.](#)
  - ☐ Yes a sound barrier
  - ☐ Yes both
  - ☐ Other [Click here to fill in your answer.](#)

13. What would be the recommended action with abandoned chicks?

- ☐ Hand rearing
- ☐ Foster parents (other trumpeters)
- ☐ Foster parents (other bird species)
- ☐ Other [Click here to fill in your answer.](#)

14. Would you recommend double clutching?(remove first clutch for the incubator and second clutch for natural incubating)

- ☐ Yes
- ☐ No
- ☐ Other [Click here to fill in your answer.](#)

#### **J. Behaviour and enrichment (10/13)**

1. Would it be recommended to keep the trumpeter in a mixed species exhibit?

- ☐ No
- ☐ Yes with other bird species (please specify) [Click here to fill in your answer.](#)
- ☐ Yes with primates (please specify) [Click here to fill in your answer.](#)
- ☐ Yes with other species (please specify) [Click here to fill in your answer.](#)
- ☐ Other [Click here to fill in your answer.](#)

2. What would be the recommended kind of enrichment to provide in the enclosure?  
(multiple answers possible)

- ☐ Food enrichment
- ☐ Play enrichment
- ☐ Enrichment by sight
- ☐ Structural enrichment (toys, more natural plants etc.)
- ☐ Other [Click here to fill in your answer.](#)

3. Would it be recommended to making use of visual barriers?

- ☐ No
- ☐ Yes (please specify type of barrier) [Click here to fill in your answer.](#)
- ☐ Other [Click here to fill in your answer.](#)

4. Would it be recommended to provide a pool/bath for trumpeters?

- ☐ No
- ☐ Yes only above 30 °C
- ☐ Yes all year round
- ☐ Other [Click here to fill in your answer.](#)

5. Wild trumpeters use 10-15% of their time on foraging. What would be the recommended time for foraging in captivity? (Sherman, 1996)

- ☐ < 5%
- ☐ 5-10 %
- ☐ 10-15 %
- ☐ 15-20 %
- ☐ Other [Click here to fill in your answer.](#)

6. Wild trumpeters walk 3-7 km daily. What would be the recommended adjustment to achieve this as best as possible in captivity? (Sherman, 1996) (multiple answers possible)

☐ Large enclosure (please describe large) [Click here to fill in your answer.](#)

☐ Food enrichment

☐ Environmental enrichment

☐ Multiple species in one enclosure

☐ Other [Click here to fill in your answer.](#)

7. Which behaviour could indicate chronic stress? (multiple answers possible)

☐ Not eating

☐ Losing weight

☐ Feather pecking

☐ Self-inflicting wounds

☐ Shock

☐ Other [Click here to fill in your answer.](#)

#### **K. Transportation and handling (11/13)**

1. What would be the recommended kind of tool to catch a trumpeter (more answers are possible)

☐ A net

☐ By hand

☐ Box

☐ Other [Click here to fill in your answer.](#)

2. What would be the recommended kind of material for the transport crate?

☐ Wood

☐ Plastic case

☐ Metal case

☐ Carton box

☐ Other [Click here to fill in your answer.](#)

3. What would be the recommended type of ventilation?

☐ Holes of 1 cm in diameter

☐ Holes of 2 cm in diameter

☐ Vertical/horizontal trenches

☐ Mesh

☐ Other [Click here to fill in your answer.](#)

4. What would be the recommended age to band the chicks?

☐ < 4 weeks

☐ 1 month old

☐ 1-2 months old

☐ 2-3 months old

☐ Other [Click here to fill in your answer.](#)

5. What would be the recommended location to place the band on the leg (see figure 1. below)?

- ☐ Femur
- ☐ Tibiotarsus
- ☐ Tarsometatarsus
- ☐ Other [Click here to fill in your answer.](#)

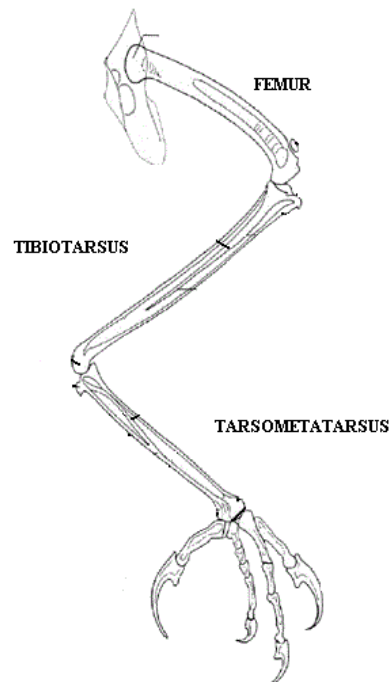


Figure 1. The anatomy of a bird leg (Anonymous, 2012)

6. What would be the recommended kind of bands to be used?

- ☐ Open
- ☐ Closed
- ☐ Other [Click here to fill in your answer](#)

**L. Veterinarian considerations for health, cleaning and welfare (12/13)**

1. If there is a quarantine, what would be the recommended number of weeks a newly arrived individual to be placed in quarantine before it is joined with the social group?
  - ☐ 1 week
  - ☐ 1-2 week(s)
  - ☐ 2-3 weeks
  - ☐ 3-4 weeks
  - ☐ > 4 weeks
  - ☐ Other [Click here to fill in your answer.](#)
  
2. What would be the recommended number of times to clean and disinfect the food dishes?
  - ☐ Daily
  - ☐ Weekly
  - ☐ Other [Click here to fill in your answer.](#)
  
3. What would be the recommended number of times to clean and disinfect the water supply?
  - ☐ Daily
  - ☐ Weekly
  - ☐ Other [Click here to fill in your answer.](#)
  
4. What would be the recommended kinds of method of pest control to be used? (multiple answers possible)
  - ☐ Mouse traps
  - ☐ Poison
  - ☐ Ultra sound
  - ☐ Other [Click here to fill in your answer.](#)
  
5. If there is a pond present in the enclosure, what would be the recommended number of times to clean it?
  - ☐ Not
  - ☐ Weekly
  - ☐ Monthly
  - ☐ Seasonally (please specify)
  - ☐ Other [Click here to fill in your answer.](#)

### **M. Special issues (13/13)**

Are there any comments or information which you would like to add and/or share with us?

[Click here to fill in your answer.](#)

---

Thank you for taking the time to complete this survey. Your responses will be valuable in making the concept Best Practice Guidelines for trumpeters.

As a reminder, please **do not forget** to send the following to the email address below:

1. Trumpeters current and customized diet (for chicks, breeding, illness, etc).
2. Recent photos of the trumpeters in your collection (of the enclosure and of the birds them self).
3. And any other related material or information.

The email address you can send this information to is [trumpeterhusbandrysurvey@gmail.com](mailto:trumpeterhusbandrysurvey@gmail.com)

Once again thank you for your time and cooperation. If you have any questions about this survey, do not hesitate to contact us using the same email address

## **Appendix IV Enclosed diet sheets**

### **Paignton Zoo <sup>(3)</sup>**

Daily amount for one pair;

- 18g Raw minced meat
- 24g Cooked minced meat
- 15g Grated hard boiled egg
- 7g Uni pate
- 4g Soaked Mazuri Diet A
- 142g chopped Fruit (Apple, Pear, Banana, Tomato, Grated and chopped Carrot)
- Sprinkle of Calciare



Another 142g of chopped fruit to be given pm if dish is empty.

### **Heidelberg Zoo (past Walsrode) <sup>(5)</sup>**

Morning standard with some variation: 30% Fruit mixture (Pear, Papaya, mango, banana, apple, tomato, pineapple, cucumber, grapes, blue-berries, oranges, kiwis plus seasonal variation like berries and local fruits). Greens like spinach, salad, dandelion (also flowers). 30% Boiled Vegetable mixture (carrot, potato, turnips, red beet, broccoli) note that tropical rainforest fruits have a starch content more like vegetables than like classic fruits consumed by humans. 5% Small amount of grain Ardenner mixture (versele laga), 15% Allround pellets (versele laga), 10% Unipaté (versele laga) with boiled rice. Total amount so that it is finished by next morning. Afternoon standard with some variation: 50% Dusted Mealworms or crickets, 50% soaked T16 Pellets (Versele Laga). Sometimes Tropical paté (versele laga) or shelled peanuts or shelled sunflowers or day old mice. Amount so that it is finished within 5-10 minutes

### **Dierenpark Emmen <sup>(6)</sup>**

- 300 g gallus
- 40 g universeelvoer insect
- 55 g kattenbrokjes
- 12 gram meelwormen
- 20 gram andijvie fijn.

Goed mengen! (universeelvoer = nieuw per 21/1/'11)

- Americasa: 1 keer 205 gram (2 vogels)
- Toekangebouw: 1 keer 205 gram (2 vogels)

Jonge vogels hebben we al lange tijd niet gehad, maar die voerden we Sivo Start en Sivo Opfok.

## Zoo Frankfurt <sup>(7)</sup>

August 2014

2x daily (in the morning and in the afternoon):

- 20g **“coarse soft food”** (“grobes Weichfutter”): 1l dried insects (Aleckwa), 1l honey insect food (Claus), 1l zwieback meal, ½ l boiled eggs, ½ l boiled rice, ½ l ground carrots, house flies.  
➔ When all is mixed, it’ll be a fine crumbling mixture. If too dry, add a bit of carrot juice.
- 40g **“goose food”** (“Gänschenfutter”): ca. 0.5 l ground vegetables (depending on the supply, red cabbage, green cabbage, radish etc.), “dumpling food” (see below), “shorebird food” (see below), “coarse soft food” (see above)
- 30g **“dumpling food”** (“Klößchenfutter”): 1l dried insect food (Aleckwa), 1.0 to 1.5 l honey insect food, ~ ½ l boiled rice, ½ to ¾ l ground carrots, 1l zwieback meal, 1l “Frankfurt Zoo omnivore mix (Standardfutter A”); see below), 0.5l ground minced meat
- 50g fine ground vegetables and fruits
- 40g coarse ground vegetables and fruits
- 30g small cut vegetables and fruits

**“Frankfurt Zoo omnivore mix”** (“Standardfutter A”):

1l mix of maize, barley, wheat, oats, linseeds, soya; added minerals, yeast, softened lucerne, minced meat

**Shorebird-food** (Limikolenfutter):

- 1 l dried insect food (Aleckwa)
- 1 l honey insect food (Claus)
- 1 hand of house flies
- 0,5 l Standardfutter A („Frankfurt Zoo omnivore mix“)
- ½ l minced meat
- ca. ¾ l ground shrimps
- ➔ The mix is a bit moist and crumbly

1x daily in the morning:

- 25g germinated pigeons food (Teurlings)
- 30g **“Thrush food”**:

Ca. 2 l minced meat, ½ l **„Goose food”**, 1l ground shrimps, ½ l frozen shrimps

- 1x daily in the afternoon:
  - 30g smelts with wader food pellets (Lundi Micro)

Supplements:

- 1x a week Korvimin (Spray)
- 1x a week Korvimin (powder)





Burgers Zoo <sup>(9)</sup>

**Koninklijke  
Burgers' Zoo b.v.**

Antoon van Hooffplein 1  
6816 SH Arnhem

**Diet Grey-winged trumpeter (*Psophia crepitans*)**

*(October 2011)*

**T** 026 44 24 534

**F** 026 44 30 776

info@burgerszoo.nl

www.burgerszoo.nl

Once a day they get the course in the morning. The following is presented:

**Main diet**

A hand of:

- Gallus maintenance
- Anseres maintenance
- Minced fruit --> apple, pear, banana, and sometimes melon/kiwi/pineapple. Whatever is available.

Some:

- Coarse pigeon seed
- Smelt
- Shrimp
- AVES B (= supplement, see attachment)

**Varying extras**

- grapes
- soaked Warme Hap Diner
- mealworm
- '1 day' mouse
- grasshopper



**Koninklijke  
Burgers' Zoo b.v.**

Antoon van Hooffplein 1  
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**T** 026 44 24 534  
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www.burgerszoo.nl

## Analyse van AVES-Universeel-B:

Geproduceerd door AVESPRODUCT B.V., Postbus 671, 7400 AR Deventer, NL

Komt in zakjes van 200 gram. Universeel A is voor kleine insectenetende vogels, Universeel B is voor grote insectenetende vogels.

Voedingswaarde (ds):

Gross Energy	Energie	7.32	MJ/kg
	Benutbaar eiwit	150	g/kg
Crude Oil	Ruw vet	51	g/kg
	Linolzuur	8	g/kg
	Verteerbaar Calcium	4.6	g/kg
Phytate phosphorus	Phytinezuur-vrije fosfor	2.3	g/kg

AVES-UNIVERSEEL-B bevat de volgende vitaminen, mineralen en spoorelementen:

Vitamine A, D<sub>3</sub> (cholecalciferol), E (dl- $\alpha$ -tocopheryl acetate), K<sub>3</sub>, B<sub>1</sub> (thiamine), B<sub>2</sub> (riboflavine), B<sub>6</sub> (pyridoxine), B<sub>12</sub> (cyanocobalamine), biotine (H), choline, foliumzuur (B<sub>c</sub>), nicotinezuur (PP), panthotheenzuur (B<sub>3</sub>) en vitamine C (ascorbinezuur); Na (natrium), Cl (Chloor), Ca (Calcium), P (fosfor), K (kalium), Mg (Magnesium), Fe (ijzer), Zn (zink), Mn (Mangaan), Cu (Koper), J (Jodium), Co (Cobalt), Se (Selenium) en Mo (Molybdeen).

## Analyse ingevoerd op 1 juli 2002 door Marc Damen

Aves Universeel B= 108,3 mg/kg toegevoegd ijzer. (4-12-13)

**Dieet grijsvleugeltrompetvogel *Psophia crepitans*:**

**Gaiapark Kerkrade Zoo**

**Groep van**

**Datum: 20-05-2011**

**Product**                      **per vrouw**    **per man**    **aantal x per week**

beo	40	2 handjes	
Meelwormen (g)	3	3	7
Fruit (g)	80	80	7

Fruit: banaan, peer, appel, druif, papaja, etc.  
Gehakt = gehakt met universeelvoer en uni-patee

**tinamoe**

beo                      handje

fruit

andijvie

gallus

**parkiet**

brok

beo

fruit

**koekoek**

gehakt

visjes

kuikenpootje

muisjes

insekten

## Antwerp Zoo<sup>(12)</sup>

01 January 2014	<i>Psophia crepitans</i>		Grey-winged trumpeter	
feed ingredient (per animal)	Qty g	food preparations	frequency	comments
			1-7 working hrs	
fine fruit mixture	99			
hornbill mixture	32,5			
pheasant mixture	54,17			
grasshopper	2,00			
basic mixture	13,33			
worms mixture	2,5			
fresh mealworms	1,83			
crickets	3,17			
baby mouse	1,50			
fresh buffalloworms	2,17			
1 grasshopper = +- 2 gram				
1 baby mouse = +- 1,5 gram				

<b>Fine fruit mixture (pieces 0,5 cm/0,5cm)</b>	
raisins	6,50%
carrot chopped finely	1%
savoy chopped finely	1%
witlof	2,60%
apple	29%
grapes	16,80%
papaya	18,40%
banana	6,40%
tomato	16,50%
cucumber	2%

<b>Hornbill mixture</b>	
mixture boiled meat and dog food	
rice	16%
savoy chopped finely	8%
carrot chopped finely	4%
minced fresh meat	4%
shredded egg	10%
shredded potatoe	6%
little bit of water	52%

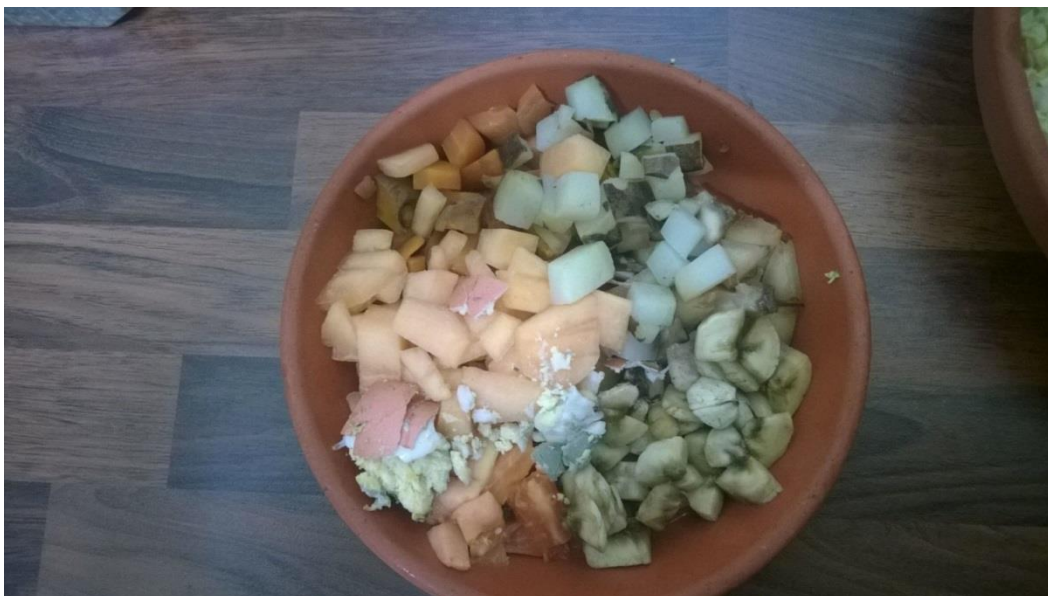
<b>Basic mixture</b>	
Mixture of soaked dog food and boiled meat (rate 20/1)	7,20%
carrot chopped finely	16,20%
savoy chopped finely	13%
rice	16,20%
Eggfood	13%
Paste of insects	21%
Shredded eggs	11,50%
Grit	2%
<b>notice: 1 egg =+- 50 gram</b>	

<b>Phaesant mixture</b>	
carrot chopped finely	7,50%
savoy chopped finely	23,90%
grit	1,40%
boiled corn	5,40%
witlof	3,80%
apple	16,30%
eggfood	6,80%
raisins	1,70%
rice	10,40%
pheasant grain	20,30%
broccoli	2,40%

<b>Mixture of worms</b>	
Mealworms	33,30%
buffalloworms	33,30%
pinkies	33,30%

**Diet trumpeters (*Psophia crepitans*)**

- different grains for birds: Claus rot/braun
- <http://www.vogel-shop.de/index.php?p=content&id=5&name=Weichfutter&area=1>
- -chicken feed
- mealworms, grasshoppers, boiled egg, cottage cheese, etc.
- fruits: apple, melon, papaya, banana, etc.
- vegetables: carrots (boiled)
- -Korvimin ZVT (vitamin- & mineral- supplement)



## **Artis Zoo** <sup>(15)</sup>

1/3 part: H16, (hornbill pellet from Versele laga)

1/3 part: chopped mixed fruit and vegetables

1/3 part; Softbill food (mash) it is also called "universal pate"

Occasionally some insects (mealworms, crickets)