

# **Animal Husbandry Manuals - A guide to production.**

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Animal husbandry manuals (or captive-management manuals) are invaluable resources for those working in zoos and places where captive wild animals are kept. Most manuals should reflect both natural history, to give keeper's a background in the animal, as well as their captive requirements. Most are compiled through thorough research of the literature available as well as through unpublished personal experiences. Some manuals have been compiled through the running of workshops which gathers a number of people experienced with the species to discuss all options. One example is the Cassowary Husbandry Manual produced by Currumbin Sanctuary in 1995.

Over the years the format of manuals has been developed to try and give people a guideline for what should be included. This work has been previously carried out by ASZK and ARAZPA members. The International Zoo Yearbook published an article by Stephen Jackson in Vol 38, (2003) on the standardized guidelines for terrestrial vertebrate captive-

management manuals based on much of this work.

Following is a summary of the guidelines for people to follow when developing their own manuals. For people undertaking their own manual please refer to the whole of Stephen Jackson's article which is referenced at the end for more detail on presentation of information. ASZK is willing to organise suitably qualified people to review draft manuals.

## Outline for a Husbandry Manual

*Preferably a photo of the species should appear on the front cover.*

Title Page – including:

Common Name

Scientific Name

Author/s and their Institution/s

Date of Preparation ie. Month and Year.

Status ie. Endangered, Vulnerable, Rare, Insufficiently Known.

State:

Federal:

IUCN:

Species Coordinator:

## Table of Contents

### 1. Introduction

- General features of the species or group.
- History in captivity.
- Value as a tool for education, conservation and research.

### 2. Taxonomy

#### 2.1 Nomenclature

Class :

Order :

Family :

Genus Species :

#### 2.2 Subspecies

#### 2.3 Recent Synonyms

- This can be important in some cases as there is sometimes confusion created by different countries or even individuals that adopt different scientific names. These can include changes to both the species name and very often changes to the genus name due to reclassification.

#### 2.4 Other Common Names

- This can be important as some zoos and counties know species by different common names. For example some zoos call *Phascogale tapoatafa* the Brushtailed Phascogale while others call it the Tuan. Similarly some call the *Trichosurus vulpecula* the Mountain Brushtail Possum while others call it the Bobuck.

### 3. Natural History

- In putting together the background information it is important to provide a good coverage on the biology of the species, with particular reference to information that may be relevant to captive husbandry.
- The information used in the natural history part of the manual and the additional references suggested in the bibliography serve several purposes. These include:
  - 1) Providing the reader with further information if they want to follow up a particular aspect of the species biology.
  - 2) Telling the reader how much or little we know about this species.
  - 3) Telling us what research could be done in a captive situation. eg. have growth and development curves been done for this species. Other research can follow on to fill in some of these gaps.

For example, when writing a husbandry manual on Ghost bats, you could write something like: "To date various studies have been conducted on the biology of the ghost bat *Macroderma gigas* including: prey-catching behaviour and echolocation (Guppy & Coles 1983; Guppy *et al.* 1985; Kulzer *et al.*, 1984); echolocation and acoustic communication signals (Guppy *et al.* 1985); diet and foraging behaviour (Vesjens & Hall 1977; Tideman *et al.* 1985); body temperature, oxygen consumption and heart rate (Leitner & Nelson 1967); ⇒ past and present distribution (Molnar *et al.* 1984) and brain morphology (Pirlot & Nelson 1980).

#### 3.1 Morphometrics.

- Weights and basic measurements. eg. head-body length, total length, height.
- Sexual dimorphism in size and/or weights.
- Include weights for different locations if the species has a wide latitudinal distribution.
- Diagnostic features.

- ie. distinguishing features that separate this species from other similar species.

#### 3.2 Distribution and Habitat.

- Include a distribution map if possible.
- Worldwide distribution.
- Include if it is migratory and where it travels to and from.

- eg. open woodland, rainforest, coastal dunes.

### 3.3 Conservation Status

- ie Is the species considered Common, Rare, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild or Insufficient Known according the IUCN categories.

### 3.4 Wild Diet.

### 3.5 Longevity.

#### 3.5.1 Wild.

- Include maximum and average if possible.

#### 3.5.2 Captivity.

- Include maximum and average if possible.

#### 3.5.3 Techniques to Determine the Age of Adults.

- eg molar progression in macropods, tooth wear, or skeletochronology in frogs.
- This may be required if you want to know the age of wild born individuals or if they have come from an institution where no record has been kept.
- This may help explain why an individual has not bred as it may not have reached sexual maturity or may be reached sexual senescence.

## 4. Housing Requirements

### 4.1 Exhibit Design.

- General principles.
- Precautions and mistakes often made.

### 4.2 Holding Area Design.

- Can often be of a very different design than enclosures for public display.
- Can often be a lot smaller than display enclosures.

### 4.3 Spatial Requirements.

- Including state regulations eg. Exhibited Animals Protection Act in New South Wales, Australia that governs the minimum standards for keeping animals in captivity in that State.
- Include the area for one animal and for each additional animal.

### 4.4 Position of Enclosures.

- Is there a particular aspect that best suits the species? eg. from wind and rain.

### 4.5 Weather Protection.

- Does it need to be fully enclosed, semi open or open.

### 4.6 Heating Requirements.

### 4.7 Substrate. eg

⇒ Soil, dolerite, sand, sawdust, mulch or concrete.

### 4.8 Nest Boxes or Bedding Material.

- Include the dimensions of nest boxes, size of entrance, bedding material added.

### 4.9 Enclosure Furnishings.

- eg branches, rocks, grass tussocks, streams or ponds.
- Behavioural enrichment furniture.
- Nesting requirements eg material that should be supplied for the animal to rest in or built a nest for shelter eg. tussocks, rocks, hollow logs, soil to build a burrow.

## 5. General Husbandry

### 5.1 Hygiene and Cleaning. eg.

- ⇒ Regime of cleaning enclosures.
- ⇒ Changing of nest material, soil or branches.
- ⇒ Cleaning of nest boxes.
- ⇒ Chemical agents which can or should not be used eg. bleach.

### 5.2 Record Keeping. eg.

- ⇒ health problems.
- ⇒ veterinary examinations with treatments provided.
- ⇒ behavioural problems.
- ⇒ reproductive stage, condition or behaviour.
- ⇒ changes in diet.
- ⇒ movements within and between institutions.
- ⇒ weights and measurements.

### 5.3 Methods of Identification. eg.

- ⇒ Ear tags.
- ⇒ Passive Integrated Transponders (PIT) Tags.
- ⇒ Tattoos – eg in ear, inside thigh or elsewhere and the numbering system used.
- ⇒ Leg bands.
- ⇒ Face or other body markings.

### 5.4 Routine Data Collection. eg

- ⇒ Records which may be required as part of a long-term study such as growth and development and blood biochemistry.

## 6. Feeding Requirements

### 6.1 Captive Diet.

- Does it change throughout the year eg. breeding and non-



breeding diet.

- Alternative diets used by other institutions and why used.

6.2 Supplements. eg.

⇒ Saltlicks.

⇒ Carotene in the water of many species of birds to maintain feather colour.

⇒ Vitamins and minerals.

6.3 Presentation of Food.

- Placed in bowls/troughs or scattered around exhibit.
- Behavioural enrichment methods. eg. fish or fruit in ice cubes.

## 7. Handling and Transport

7.1 Timing of Capture and Handling.

- Is there a best time to catch? eg. in the morning prior to the public arriving and when it is cooler, or at night when less mobile.

7.2 Catching Bags.

- Size and fabrics used.

7.3 Capture and Restraint Techniques.

- Use figures if possible.
- Use of catching nets and include the distributor, if bought, in the Appendix.
- Chemical restraint eg. darting.
- Precautions that need to be taken. eg.
  - ⇒ Venomous spur of the male platypus.
  - ⇒ Feet of macropods and ungulates.
  - ⇒ Talons in birds of prey.
  - ⇒ Beaks of many birds.
  - ⇒ Being bitten by mammals and reptiles.

7.4 Weighing and Examination.

- Techniques to restrain while examining.
- Techniques for pouch checking.

7.5 Release.

- Are there general principles in releasing this species? eg
  - ⇒ Time of day.
  - ⇒ Location within the enclosure. eg releasing kangaroos away from obstacles as they are prone to hopping off after release into obstacles.

7.6 Transport Requirements.

- eg. IATA regulations.

7.6.1 Box Design.

- Give dimensions and materials used for transport boxes.
- Include furnishings of transport box.
- Show a figure if possible of the transport box with dimensions.

7.6.2 Furnishings.

7.6.3 Water and Food.

- Types of food.
- How much should be provided.
- Techniques for keeping it from spilling.

7.6.4 Animals Per Box.

- Include if the animal is transported awake or under anaesthetic.

7.6.5 Timing of Transportation.

7.6.6 Release from the Box.

## 8. Health Requirements

8.1 Daily Health Checks

- Observations are generally undertaken during cleaning and feeding each morning and include:
  - ⇒ All limbs appear to be moving freely.
  - ⇒ Feeding well.
  - ⇒ Eyes clear and fully open.
  - ⇒ General appearance - body condition and condition of coat.
  - ⇒ Discharges - any nasal, ocular or cloacal discharges should be noted.
  - ⇒ Changes in behaviour.
  - ⇒ Consistency of faecal material - is it sloppy, not the normal colour or contains blood?

8.2 Detailed Physical Examination.

- Include general anaesthetic procedures if possible.
- Details of key things that are looked for to gauge the health of this species.

8.3 Routine Treatments. eg.

- ⇒ Worming.
- ⇒ Vaccinations.

8.4 Known Health Problems.

- List the health problems known for that species or group of species.
- Include identification, treatment and prevention of these problems if able to.

- Subheadings for each problems include:
- ⇒ Cause – Species or genera of parasites, bacteria, viruses or other problems.
- ⇒ Signs – Are there distinctive features that can be observed or are tests required.
- ⇒ Treatment – Can it be treated eg. antibiotics, anthelmintics or others.
- ⇒ Prevention – eg through drugs, hygiene or diet.

## 8.5 Quarantine Requirements.

## 9. Behaviour

### 9.1 Activity.

- Knowledge of this can help develop idea to increase natural behaviour and provide a more active exhibit. eg.
- ⇒ The amount of time spent active and when.
- ⇒ Do they undergo torpor or hibernation.

### 9.2 Social Behaviour

- ⇒ Group size.
- ⇒ Social interactions including home range size, aggression displayed, tolerance of sexes towards each other.

### 9.3 Reproductive Behaviour.

- Courtship displays used.
- Time of year when these displays occur.

### 9.4 Bathing.

- Are there any particular water bodies that are suggested to provide bathing.
- May include water bathing and/or sand or dust bathing.

### 9.5 Behavioural Problems. eg.

- ⇒ Stereotypic behaviour.
- ⇒ Behaviour created by public feeding animals.
- ⇒ Aggression towards keepers or the public.

### 9.6 Signs of Stress.

- These include escape behaviour and self mutilation.

### 9.7 Behavioural Enrichment.

- Techniques used to minimise behavioural problems.
- Methods used to increase the species time on display.

### 9.8 Introductions and Removals

- Make sure of quarantine requirements.
- Aggression problems that may be associated with introductions eg dingoes.
- Are there precautions that need to be made when

removing animals. eg If the animal is to be returned after treatment should the time away be minimised to reduce aggression upon the animals return to a partner or social group.

### 9.9 Interspecific Compatibility.

- Is it highly territorial.
- Will it eat the eggs or offspring of other species.
- Can diseases be passed from other species to this species or visa versa?

### 9.10 Intraspecific Compatibility

- ⇒ Eg. Are there problems if two males are put together.

## 10. Breeding

- An adequate knowledge of the reproductive biology of a species is fundamental to the intensive captive management of any species. Even if these values are estimates based on what is known at present (or estimates based on similar other species – making sure the information from the similar species is clearly stated) they are still a start and can be modified in time as more information becomes available. They also highlight gaps in our knowledge which can then be addressed. Information that should be located or researched to find includes:

### 10.1 Mating System.

- ie. monogamous, polygynous, polyandrous, polygamous (or a combination of these).
- ⇒ Monogamous – mating of a male with a female involving no extra individuals of either sex. Usually the bond operates through the breeding season and in some cases may extend through the adult life of two individuals.
- ⇒ Polygynous – where a male has more than one female partner, during a single breeding season.
- ⇒ Polyandrous – where the female has more than one male at a time (usually during a single breeding season).
- ⇒ Polygamous – a pattern of mating in which both males and females have more than one sexual partner during a single breeding season.

### 10.2 Ease of Breeding.

- Is it easy to breed, have had some success or no success.
- Are there triggers to make them breed.

### 10.3 Reproductive Condition

- Identify stages of reproductive condition that females and, if possible, males can be categorised as this helps the



establishment of more accurate records and the establishment of more accurate breeding seasons or peaks in reproduction.

#### 10.3.1 Females

- Eg. for marsupials these can include:
  - 1) Juvenile non breeding – pouch clean and dry and teats very small.
  - 2) Adult non breeding – pouch dry and dirty.
  - 3) Oestrus – Can often be detected by behaviour or the presence of cornified epithelial cells.
  - 4) Pregnant – Pouch pink in colour and glandular in appearance.
  - 5) Pouch young present.
  - 6) Female lactating, with the young on the back or in the nest.
  - 7) Post breeding with teat expressing only clear liquid and/or regressing.
- Eg for eutherians can include:
  - 1) Juveniles - The vagina is imperforate and the nipples are not clearly visible and the weight is below that of adults.
  - 2) Non Breeding Adults - The vagina is perforate or imperforate and they have the adult weight.
  - 3) Oestrus – Sometimes can be visible by vaginal swelling, behaviour or cornified epithelial cells.
  - 4) Pregnant - Can be determined in the more advanced stages of pregnancy using palpation. The nipples are also usually enlarged.
  - 5) Lactating - the teats are large and elongated and surrounded by rings of bare skin. It is often not easy to express milk from the teats.

#### 10.3.2 Males

- Can include if adult size, reproductively active, physical features such as horns, gland development or colouration.

#### 10.4 Techniques Used to Control Breeding

- These can include:
  - ⇒ separation of sexes.
  - ⇒ immuno-contraception.
  - ⇒ vasectomy.
  - ⇒ tubal ligation.
  - ⇒ removal of pouch young or eggs.
  - ⇒ castration.

⇒ culling.

⇒ egg removal.

#### 10.5 Occurrence of Hybrids

- Is this species known to hybridise with any other species or subspecies if held together? Eg. numerous species of kangaroos, even of different genera, are known to hybridise.

#### 10.6 Timing of Breeding

- Are they seasonal or continuous breeders.
- If possible do a figure of month vs the number of young born, for all known captive births at your institution (and others if you can). If there are litters or clutches of more than one, break it up into litters of one, two, etc. This will show the breeding season and period of peak births (eg. Fig. 1). For continuous breeding species it may show one or more peaks in breeding.

#### 10.7 Age at First Breeding and Last Breeding

- Can be important to determine the reproductive lifespan as opposed to longevity, as many species go through reproductive senescence in captivity well before they die. This can be critical in managing species which have short breeding lives but comparatively much longer lives

#### 10.8 Ability to Breed Every Year

#### 10.9 Ability to Breed More Than Once Per Year

- If the first young are maintained through to weaning.
- If young are lost or removed for fostering or incubation.
- Do they breed more often in captivity with increased food.

#### 10.10 Nesting/Hollow or other Requirements

- Size and shape of nesting areas

#### 10.11 Breeding Diet

- Changes prior to breeding, eg. trigger diets.
- Diet changes while breeding.
- Is more food eaten? If so of which types?

#### 10.12 Oestrous Cycle and Gestation Period (or Incubation Period)

- Also include pouch life for marsupials.

#### 10.13 Litter Size or Clutch Size

- Include mean and maximum litter or clutch size if known.
- Egg weights and measurements.
- What proportion of litters have 0,1, 2, etc. young (eg. Fig. 1).
- Sex ratio at birth.

#### 10.14 Age at Weaning/Fledging

- Mortality rate for age class if known.
- At what age are young independent and the female can re-breed.
- Is there any difference in juvenile mortality if several young are raised together in a nursery.
- Will other males or females attack the adults or young upon their return to the group.
- Knowing the answers to questions such as these and no doubt others, you can greatly increase the reproductive efficiency in the management of a species.

#### 10.15 Age at Removal from Parents

- The time when the young would naturally disperse and when they often suffer aggression from their parent/s to facilitate their dispersal. If held longer the young can be killed by the parents in some species.

#### 10.16 Growth and Development

- Include a growth chart with age vs several measurements if possible.
- ⇒ For mammals you could include: age vs weight, head length, head width, tibia, foot length, or ear length.
- ⇒ For birds you could include: age vs bill length, head length, tail length, tarsus length, and wing chord length.
- ⇒ For reptiles you could include: age vs total length, snout to vent length, shell length and width.
- ⇒ This can be taken from the literature (being aware of clinal variation in body size).
- If a growth chart and the stages of development are not adequately known then endeavour to do this.
- In addition to the growth curve, developmental notes should be included wherever possible. This should include the age of certain development stages. eg. ears free, fur appearing, moulting, eyes open, out of pouch, weaned, fledging.

### 11. Artificial Rearing of Mammals

#### 11.1 Housing.

- Size of enclosure.
- Fabrics used (if appropriate).

#### 11.2 Temperature Requirements.

#### 11.3 Diet and Feeding Routine.

- Temperature of food.
- Methods used to feed.
- Amount of food.
- Frequency of feeds.

#### 11.4 Specific Requirements. eg.

⇒ Transport.

#### 11.5 Identification Methods.

- Are they different to those for adults?
- What age can there be different identification techniques be used?

#### 11.6 Hygiene.

#### 11.7 Behavioural Considerations.

- eg. imprinting and the use of puppets, audio tapes.

#### 11.8 Use of Foster Species.

- Can be used to increase the reproductive output of a species. eg.

⇒ Parma wallabies being used as fosters for brush-tailed rock-wallabies.

#### 11.9 Weaning.

- Age.
- Changes in diet.

#### 11.10 Rehabilitation Procedures.

### 11. Artificial Incubation and Rearing of Birds

- The use of incubators and cross fostering allows the opportunity to increase the number of young by promoting double or triple clutching of the target species.

#### 11.1 Incubator Type. eg.

⇒ Still air.

⇒ Fan forced.

⇒ Auto/manual turn.

⇒ Brands and models recommended.

#### 11.2 Incubation Temperatures and Humidity.

#### 11.3 Desired % Weight Loss.

#### 11.4 Hatching Temperature and Humidity.

#### 11.5 Normal Pip to Hatch Interval.

#### 11.6 Brooder Types / Design.

#### 11.7 Brooder Temperatures.

#### 11.8 Diet and Feeding Routine.

- Temperature of food.
- Methods used to feed.
- Amount of food.
- Frequency of feeds.

#### 11.9 Specific Requirements.

- eg. nest substrates.

#### 11.10 Pinioning Requirements.

- Is it needed? When?

#### 11.11 Identification Methods.

#### 11.12 Hygiene.

#### 11.13 Behavioural Considerations. eg.

⇒ Imprinting and the use of puppets or audio tapes to minimise this.

#### 11.14 Use of Foster Species.

#### 11.15 Weaning.

#### 11.16 Rehabilitation Procedures.

### 11. Artificial Incubation and Rearing of Reptiles

#### 11.1 Incubator Type. eg.

⇒ Still air.

⇒ Fan forced.

⇒ Brands and models recommended. Why?

#### 11.2 Incubation Temperatures and Humidity.

#### 11.3 Desired % Weight Loss.

#### 11.4 Hatching Temperature and Humidity.

#### 11.5 Normal Pip to Hatch Interval.

#### 11.6 Diet and Feeding Routine.

- Temperature of food.
- Methods used to feed.
- Amount of food.
- Frequency of feeds.

#### 11.7 Specific Requirements.

- eg. nest substrates.

#### 11.8 Identification Methods.

#### 11.9 Hygiene.

#### 11.10 Behavioural Considerations.

#### 11.11 Weaning.

### 12. Acknowledgments

Thanks to those that have provided information, references, read and made comments on the manuscript or have been helpful in other ways.

### 13. References

- All references should be presented in alphabetical order in the reference section with articles by the same author/s in the same year being identified by a letter “a”, “b”, “c” (eg. Lindenmayer *et al.* 1990a; 1990b – written as full references below) and so on. These should be written. eg.

Abramsky, Z., Rosenzweig, M.L., Pinshow, B., Brow, J.S., Kotler, B. & Mitchell, W.A. (1990) Habitat selection: an experimental field test with two gerbil species. *Ecology* 71: 2358-69.

- Unusual references should be given in sufficient detail to allow library retrieval.

### 14. Bibliography

- Include additional references not used but which may be of use.

### 15. Glossary

- Include different technical terms used so that lay people can understand them. eg.

⇒ Veterinary terms.

⇒ Ecological / Biological terms.

⇒ Jargon.

### 16. Appendix

- Include a list of suppliers for specialised food and equipment eg.

⇒ Hand-rearing formulas.

⇒ Catching equipment.

⇒ Incubators.

- Include relevant state or national captive requirements.

- Export protocols if very specific eg. macropods and koalas.

### References:

Jackson, S.M. (2003) Standardising captive-management manuals: guidelines for terrestrial vertebrates. *International Zoo Yearbook* 38: 229-243.

Romer, L (Ed) (1995) *Cassowary Husbandry Manual*. Currumbin Sanctuary - unpublished.

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