Husbandry Guidelines For
Satin Bowerbird

Ptilonorhynchus violaceus

Aves: Ptilonorhynchidae

Photograph by Alex Metcalfe

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WORK HEALTH AND SAFETY RISKS

WHS Introduction

Within the zoo industry, there are work health and safety risks related with performing daily tasks. The *P. violaceus* is not classified as dangerous or hazardous and is therefore unlikely to impose any serious injury. However, there is potential for WH&S risks to be present whilst working within the animal's enclosure and surrounding areas.
Below you will find potential hazards and ways to reduce injury or illness:

Trip and slip hazards: Paths, walkways and airlocks should be kept clear at all times, no equipment to be left when tasks are complete, any natural debris to be removed immediately. Depressions and holes to be flagged and repaired as soon as possible. Slippery surfaces should be blocked off or treated to reduce the risk of slipping over.

Furniture and structure: Branches and perches can be fixed to a low point; a mind map can be made to be aware of these when working in the enclosure. If possible, these should be fixed to a place that will avoid injury. Low doorways and beams can cause injury, these should be made aware of and where possible a piece of foam can be attached to the low beam.

Working outdoors: A zookeeper's duties are carried out mostly outside and this comes with a large WH&S risk. Sun damage can be reduced by wearing the correct personal protective clothing. This includes wearing sunscreen and reapplying throughout the day, sunglasses that are UV protectant, a hat, a long-sleeved shirt and long pants. Especially during the hotter months of the year, keepers need to be mindful of their water intake.

Zoonoses: Working with avian animals carries the risk of zoonoses such as Psittacosis, Salmonellosis and Campylobacter. Following correct personal hygiene procedures whilst carrying out your duties, such as hand washing and wearing the appropriate PPE (dust mask, gloves and goggles) will reduce the risk of contracting these.

Heavy lifting: If a load is too heavy to lift alone, ask for help and use equipment such as a trolley or wheelbarrow to transport the load. When lifting by yourself, the correct lifting technique needs to be used to reduce back injury. This means keeping your back straight and bending at the knees.

A workplace will review hazards and risks on a regular basis. Anything new or ongoing will be recorded and actioned accordingly. Keepers should keep up to date with their workplace WH&S policies and procedures and report anything they come across immediately or as soon as possible.

Species Risk Category

P. violaceus falls into the low risk category. It is a medium sized bird (27 – 33cm) that has the capability of scratching with its claws or biting with its beak, therefore safety precautions should be followed when handling this species. Possible zoonotic diseases from this species are avian tuberculosis and salmonellosis, to reduce the risk of these, safety precautions should be followed.

Workplace Risk Types

Biological
Zoonosis such as Psittacosis, Salmonellosis and avian tuberculosis are transmittable from affected birds to humans. To help prevent the transmission of these diseases, the use of personal protective equipment (dust mask and gloves), using good personal hygiene (antibacterial handwash, and sanitation measures are to be followed.

Chemical
After using equipment such as scrubbing brushes and buckets in aviaries, disinfectants should be used when cleaning these. There are a number of disinfectant options to choose from. Milton solution for example stays sterile for 24 hours and sterilizes items in 15 minutes. With this solution, items do not need to be rinsed after applying it and is a much safer chemical to use than bleach.

Environmental
When working outdoors, wearing the correct PPE will reduce the risk of excessive sun exposure. This includes; a hat, sunglasses, sunscreen, a long-sleeved shirt and long pants. When continuous rain is predicted, keepers should be prepared with rain protective clothing and spare clothes.

Ergonomic
Heavy lifting can cause serious injury if not carried out in a safe manner. Correct lifting procedures should be in place at the workplace and adhered to at all times. Bending the knees and keeping your back straight when lifting, or such tasks could be carried out by two or more people, or using equipment such as a wheelbarrow or trolley. Work benches and sinks should be at a reasonable height to suit most people.

Physical
During the task of catching birds, keepers need to be aware of potential hazards such as furniture, anything on ground level such as rocks and logs, other animals and any nesting areas. Using a trap cage can be an option to eliminate the task of chasing a *P. violaceus*. Any task undertaken around bush areas, such as collecting nesting material or live food, care should be taken and be aware of wild animals, for example snakes.

Psychological
When caring for animals of any species, keepers should try their best not to become emotionally attached. When and if a death occurs, this could affect the keeper's mental wellbeing and if this does affect a keeper, support should be offered.

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1 Introduction

Ptilonorhynchidae are sturdy medium to large passerines, larger than thrushes but smaller than crows. Renowned for constructing elaborate bowers used in courtship, but not all species do so. All but the catbirds are polygynous, the female builds and attends a well-hidden nest alone, with no assistance from the male. Maturity of most male bowerbirds is long-delayed and, in those brightly coloured species that have been studied thoroughly, the adult male plumage is not attained till year 5 to 8. Younger males are similar to adult females; they have narrower tail feathers and primaries, but this difference is difficult to assess and many 'plain' birds cannot be sexed. (Menkhorst. P, Rodgers. D, Clarke.R, Davies. J, Marsack. P, Franklin. K 2017)

The male *P. violaceus*, perhaps the most studied and widely known species, has a penchant for bright blue and violet coloured objects, which may or may not be linked to his glossy blue-black plumage and violet-blue iris. These objects include parrot feathers, flowers and berries, and pilfered objects such as blue pegs, bottle tops and straws. They are also famed for painting their bowers. The paint consists of chewed up vegetable matter which the bird wipes on the inside walls of the bower with its bill or by using a stick. (Rowland. P 2008)

P. violaceus are a captivating species of bird, because of their morphology, habits and behaviour around courtship, they make a very interesting animal to exhibit. The vocal range that the male produces is mesmerizing, along with their beautiful plumage. Witnessing a male *P. violaceus* display around his bower is something I will always find fascinating and amazed at this marvel of nature.

At the start of a display season each adult male builds a new bower. The bower consists of two parallel walls of sticks placed upright into a foundation platform of fine sticks. A male can build a bower within a day or two, consisting of up to 2000 sticks and have up to 200 decorations. The male *P. violaceus* does not place decorations within their avenue but only on the platforms outside its entrances. A great diversity of mostly blue, decorations are used. (Frith & Frith. 2004)

Figure 1: Male *P. violaceus* decorating his bower (photographs by Graham Gall)

2 Taxonomy

2.1 Nomenclature

Class: Aves
Order: Passeriformes
Family: Ptilonorhynchidae
Genus: *Ptilonorhynchus*
Species: *violaceus*

2.2 Subspecies

Ptilonorhynchus violaceus minor (A. J. Campbell, 1912) – isolated in the Cairns district of northern Queensland. This subspecies rarely uses blue decorations but lines the avenue and one or both platforms with green moss.
Ptilonorhynchus violaceus violaceus (Vieillot, 1816) – southern Queensland into Victoria. Decorates the surrounding platform outside the entrances (but not the avenue itself) with a great diversity of mainly blue decorations. (The Australian Bird Guide: Menkhorst. P, Rodgers. D, Clarke. R, Davies. J, Marsack. P, Franklin. K 2017)

2.3 Recent Synonyms

None found

2.4 Other Common Names

None found

3 Natural History

3.1 Morphometrics

P. violaceus is a large stocky bowerbird with the feathering extending far onto the relatively stout bill.

3.1.1 Mass and Basic Body Measurements

Length: 270 – 330mm
Wing: 157 – 177mm
Bill: 29 – 40mm
Weight: 160 – 270g
(Menkhorst. P, Rodgers. D, Clarke.R, Davies. J, Marsack. P, Franklin. K 2017)

3.1.2 Sexual Dimorphism

P. violaceus are sexually dimorphic at maturity. The sexes of this species are very easily identifiable visually. A mature male's entire plumage is dark glossy indigo-blue, with a pale and heavy bill, violet-blue iris and a short-rounded tail. The female is mainly greenish above, with contrasting brown flight feathers and tail. Underparts are creamy white with heavy chevron-shaped dark scaling, along with a dark blue iris. (The Australian Bird Guide: Menkhorst. P, Rodgers. D, Clarke. R, Davies. J, Marsack. P, Franklin. K 2017)

The immature female has duller and browner underparts, with fine off-white shaft-streaks on its mantle, back and upper-wing coverts. The iris is brown but only briefly. An immature male begins with female plumage, has brown tinges in the iris and the legs are darker, by year 3 – 4 the male will start to develop a pale bill and have more extensive green on the throat, by year 5 – 6 the dark blue plumage will develop. (The Australian Bird Guide: Menkhorst. P, Rodgers. D, Clarke. R, Davies. J, Marsack. P, Franklin. K 2017)

Figure 2: Mature male *P. violaceus* with courting material and female to the right (photograph by Alex Metcalfe)

Figure 3: Female *P. violaceus* (photograph by Alex Metcalfe)

Figure 4: Immature male *P. violaceus* starting to develop adult plumage (photograph by Roly Deighton)

3.1.3 Distinguishing Features

P. violaceus have very distinguishing features. The adult male has striking glossy blue-black plumage, a pale bluish white bill and a violet-blue iris. Younger males and females are similar in colour to each other and are collectively referred to as 'green' birds. They are olive-green above, off-white with dark scalloping below and have brown wings and tail. The bill is browner in colour.

Immature or female *P. violaceus* can resemble Green Catbirds, but are distinguished by a blue eye, a darker bill and a more scalloped patterning on the underbody. They also tend to be more olive-green rather than a bright green.

There are four different types of bowers built by *ptilonorhynchidae;* the mat, court, avenue or maypole. *P. violaceus* builds an avenue, which consists of two parallel walls of sticks built on the ground.

3.2 Distribution and Habitat

P. violaceus are found along most of the eastern and south-eastern coast of Australia. See figure 5 below.

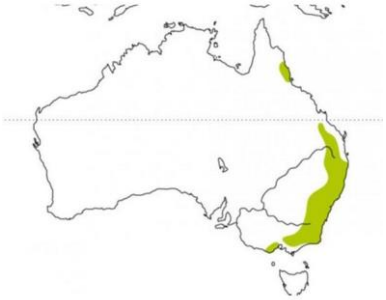


Figure 5: Distribution map of *P. violaceus*

P. violaceus prefer rainforests and contiguous wet eucalypt forest, especially edges and ecotones with other habitats including woodlands and modified habitats such as parks, orchards and gardens. Found mainly in ones and twos near bowers when breeding, but often form foraging flocks in late summer, autumn and winter of 3-200 birds; flocks typically dominated by female and immature males. (Menkhorst. P, Rodgers. D, Clarke.R, Davies. J, Marsack. P, Franklin. K 2017)

3.3 Conservation Status

According to the IUCN Red List, *P. violaceus* are of least concern. (The ICUN Red List of Threatened Species, 2012)

Below are federal and state listings:
Federal – secure; NSW – secure; NT - not present; QLD – secure; SA - not present; TAS – not present; VIC – secure; WA - not present

3.4 Longevity

3.4.1 In the Wild

Longevity of both sexes is around 20 - 30 years. The record longevity in the wild is twenty-six years and is the greatest for any banded passerine. (environment.gov.au)

3.4.2 In Captivity

30 – 40 years (S. Sass pers.comm)

3.4.3 Techniques Used to Determine Age in Adults

The age of a mature bird is difficult to determine, unless accurate records have been kept up to date and passed on with the individual. Mature male *P. violaceus* reach maturity around the age of 7 years when they have fully molted into the blue plumage.

4 Housing Requirements

4.1 Exhibit/Enclosure Design

When designing an exhibit for *P. violaceus*, there are certain key features that need to be well thought out. For all aviaries, a double doorway system must be installed where a person enters through one doorway into an enclosed area and then shut the first door, before entering the aviary through a second door. It is essential for all doors to have secure latches/locks for security and to control unauthorised entry.

Pests and predators can cause significant loss of birds and reduce breeding performance. Here is a list of potential pests and predators and how to lessen the threat:

- birds of prey
  - install a mirrored object such as a gazing ball on the roof of the aviary

- double mesh on side walls, to prevent birds getting in close to the birds in the aviary
• rats and mice
- 0.5 m high tin sides will help prevent mice climbing up and onto the aviary
- aviary walls dug at least 0.5 m into the ground
- a concrete foundation will help deter vermin digging into the aviary
- good hygiene and cleaning up food will help prevent mice
- feeding stations off the ground, with sides to stop food being scattered onto the floor
• snakes
- use narrow gauge mesh and prevent mice as these are what snakes usually come after
• insect pests, e.g. ants, lice, mites
- use the appropriate insecticide twice yearly around the edges and corners of the aviary
- insecticidal pest strips can be hung in wire containers in the enclosed sections of aviaries

Any aviary requires a space with the opportunity for birds to feel secure, a chance to rest and to avoid disturbance (Steve Sass, pers. comm). A shelter is the best option for these, which can be heavily brushed. Enclosures should be designed for the ease of maintenance. For example, keeping paths free from furniture and over hanging perches and allow access to refresh brush.

Figure 6: Enclosure housing three *P. violaceus* (photograph by Alex Metcalfe)

4.2 Holding Area Design

Holding areas can either be built into the structure of an aviary, as a separate aviary or a transportable carry box. An aviary at 4m x 1.5m x 1.8m high, would be of a sufficient size (S. Sass pers.comm). The aviary should be furnished the same as a main aviary. It should include perches, appropriate browse, food and water, shelter from the weather and be able to access sun and shade.

Carry boxes are useful to act as a temporary holding area as they can be made and are easily transportable. They can be used to house birds when doing maintenance or cleaning of an aviary. They are also ideal to use when doing an internal transfer or performing health checks.

For example, once a bird has been caught and examined it can be released in a carry box to prevent the same bird being caught twice.

When using a carry box for an extensive time to house *P. violaceus*, it needs to have a perch, small amount of browse, food, and water. Carry boxes can come with a removable slide cover for privacy of the bird whilst inside the box. The box should be an appropriate size to allow some movement, the box should hold no more than one bird at a time and for no more than 2 hours.

4.3 Spatial Requirements

The General Standards for Exhibiting Animals in New South Wales written by NSW Department of Primary Industries, clause 18: Spatial requirements states as follows:

1. The size and shape of enclosures must provide freedom of movement, both horizontally and vertically.
2. An enclosure must be of sufficient size, and the animals in the enclosure must be so managed, as to:
    a. avoid undue domination of a herd or group by an individual or individuals; and
    b. avoid the risk of persistent and unresolved conflict between herd or group members or between different species in enclosures containing different species; and
    c. make it possible for an animal to avoid, or withdraw from, contact with other animals or with people; and
    d. ensure that the carrying capacity of the enclosure is not exceeded; and
    e. prevent an uncontrolled accumulation of parasites and other pathogens; and
    f. encourage and permit exercise and behavioural enrichment.
3. Each animal must be provided with sufficient space in all directions to enable it:
    a. to take exercise; and
    b. to be protected from undue dominance and conflict; and
    c. to be provided with its social, breeding and husbandry needs.
4. With the approval of the Secretary, a bird rendered flightless may be kept in an enclosure smaller than that which would be required if it could fly.

In an outside aviary, *P. violaceus* require a minimum width of 2m and length of at least 4m. The aviary should be a minimum of 2.4m in height. However, this is for only one bird. It is recommended that that these dimensions are multiplied by the number of *P. violaceus* to be housed in the aviary. As mentioned, these are minimums, *P. violaceus* are a very active bird and should be housed in a large aviary.

4.4 Position of Enclosures

An aviary for *P. violaceus* should be positioned to protect the bird from the prevailing weather - wind, rain, drafts, damp, and temperature. For example, aviaries in Australia should face north to north east to avoid the afternoon sun, while protecting from cold southerly winds. (Vince, M. 1996)

4.5 Weather Protection

Birds should be protected from extreme hot and cold temperatures and other weather extremes. Any aviary which is exposed to the weather should be constructed so that all birds are able to perch in a place that is sheltered from wind, rain, and direct sunlight. To protect from cold and hot prevailing winds, provide a fully enclosed back section. It is preferable to enclose one end of an aviary on three sides. The roof needs to provide protection and cover at least one third of the aviary. (Vince, M. 1996)

4.6 Substrate and Landscaping

In a small aviary, paving stones or concrete make an easily sanitized floor covering that can be decorated with plants in troughs and pots. Concrete can be covered with a thin layer of sand for ease of cleaning. Paving stones can also be used to form a pathway if frequent access is required. Grass can greatly enhance an aviaries appearance, planting turf can save time and soon become established if well-watered. (Vince, M. 1996)

Plants are of great value in an aviary, giving protection from the weather and encouraging breeding. Trees and bushes offer excellent nesting sites, dense foliage acts as a windbreak, helps to create shade and deflects rain. Fruiting varieties can add to a *P. violaceus* diet and attracts insects to the aviary. Avoid toxic plants, e.g., oleander, rattlepod, deadly nightshade, eggplant, cestrum, avocado and angels trumpet. (Vince, M. 1996)

4.7 Enclosure Furnishings

The best type of perches are natural branches, as not only do these have varying diameters to exercise feet and keep toenails trimmed, but they can have bark, twigs and leaves, which can keep birds occupied. Dowelling is easy to clean but natural branches are easy to collect and dispose of when dirty. The perch size should be proportional to the size of the bird. In aviaries, perches are best put at either end of the flight area to encourage flying and then additional roosting perches placed in the sheltered area. (Vince, M. 1996)

Feed and water containers should be non-porous and easy to clean. Do not place under perches or under mesh roof, to prevent birds defecating in them. They should be kept out of reach of vermin, by hanging from the roof or putting up on a stand. (Vince, M. 1996)

Nesting baskets should be provided in smaller aviaries as the *P. violaceus* nest above ground. Nesting baskets may only be necessary in smaller aviaries if there is a lack of furnishings for the *P. violaceus* to create its own nest. In larger aviaries it is recommended to either have brush, Melaleuca decora, attached to the enclosed sides of the aviary or more ideally to have small trees/shrubs so nests can be built in the forks. (Vince, M. 1996)

Nesting material should be provided. For example, species of fern leaves, grasses cut to approximately 20cm, the leaves from lamandras, Lamandra longifolia, vine tendrils from Pandorana, Pandorea pandorana and also the brush around nesting sites such as the Melaleuca decora. Other materials that could be used are kikuyu grass runners, Casuarina spp. needles and stems and a variety of leaves. (Sindell, S. 1991)
Other furniture required can include rocks, logs, ponds.

Educational and interpretive signs can be placed inside an open aviary or on the outside of a closed aviary. These signs should be species specific and contain information including common and scientific name, distribution, habitat, feeding and diet, breeding, communication and conservation status. Such information provides visitors with the ability to identify what they are observing.

4.8 Interspecific Compatibility

The ideal arrangement in an aviary is a single pair of *P. violaceus*, additional birds of this species may cause territorial disputes. There has been no evidence found though to suggest that either groups of males or females cannot be housed in single sex aviaries. However, for the purposes of breeding, a single pair would be housed per aviary.

Birds that can be suitably housed and some of which have been successfully housed at On the Perch with *P. violaceus* are native pigeons and doves such as:

- Wonga Pigeons *Leucosarcia melanolauca*
- Emerald Doves *Chalcophaps indica*
- Topknot Pigeons *Lopholaimus antarcticus*
- White-headed Pigeons *Columba leucomela*
- Bronzewing Pigeons *Phaps chalcoptera*
- Bar-shouldered Doves *Geopelia humeralia*
- Rose-crowned Fruit Doves *Ptilinopus regina*

Finches such as:

- Diamond firetails *Stagonopleura guttata*
- Black-throated finches *Poephila cincta*

Other Bowerbirds such as:

- Green Catbirds *Ailuroedus crassirostris*
- Regent Bowerbirds *Sericulus chrysocephalus*

Note: Green Catbirds will prey on the young of all these species during breeding season.

When introducing any new bird to an aviary, it should be observed to ensure no aggression occurs towards it, or that it doesn't become aggressive towards others.

5 General Husbandry

5.1 Hygiene and Cleaning

Appropriate cleaning and hygiene are important to keep the occupants of aviaries healthy. The use of chemicals within an enclosure holding *P. violaceus* should be kept to a minimum. Chemicals such as bleach are harsh and should be avoided. Mild disinfectants can be used as an alternative and always follow the safety precautions for each chemical. Disinfectants that can be used include Milton, eucalyptus disinfectant, and F10. (Sass. L 2017) MSDS sheets of these products can be found in appendix 2.

5.1.1 Annual cycle of Activity

	DAILY	WEEKLY	MONTHLY	BI-ANNUALLY	ANUALLY
Water dishes emptied, scrubbed, refilled	X				
Feed dishes removed, washed/disinfected, replaced	X				
Water dishes scrubbed free of algae		X			
Perches scrubbed to remove faeces		X			
Faeces cleaned from aviary surfaces		X			
Accumulative droppings removed		X			
Floor substrate scarified		X			
Rodent bait stations checked and bait replaced if needed		X			
Water dishes disinfected			X		
Remove seed build up from shelter floor			X		
Dry nesting brush in shelter replaced				X	
Mulch in nesting boxes replaced				X	
Replace perches if required					X
Replace floor substrate if required					X

The above tasks can be followed as a general guide, these can be adjusted at your discretion and needs. Nesting brush and mulch should only be replaced in the off-breeding season and can be done in two stages if required.

5.2 Record Keeping

It is extremely necessary to keep records on individual birds, these are core pieces of information needed for systematic animal management. This type of information assists with history, health, breeding and behavior.

Information that should be recorded for *P. violaceus* is as follows:

- Date of birth
- Sex
- Identification number
- Internal movements
- Captures
- Behavioral observations
- Breeding observations
- Diet and feeding requirements
- Physical condition
- Medical notes
- Date of death

5.3 Methods of Identification

Birds within captive settings can be identified by using a band attached to a leg, which is suited to that particular species. The Australian Bird and Bat Banding Scheme recommends a size 08 (09, varies geographically) stainless steel (ss) band for *P. violaceus*. These bands are extremely durable and appear to be immune from crevice-attack and staining. However, they can be difficult to close tightly due to "spring-back". (Environment Australia, 2000)

5.4 Routine Data Collection

Data collection should be kept daily or routinely (depending on the situation) on individual *P. violaceus.* This information builds up within a daily diary and can be assessed for varying details. Information to collect and record includes:

- Feeding behaviours and dietary changes
- Breeding behaviours
- Nesting activity
- Unusual behaviours
- Worming treatment
- Medication
- Health checks

6 Feeding Requirements

6.1 Diet in the Wild

P. violaceus are predominately frugivores, eating a wide variety of fruits, as well as some flower petals, stamens and nectar, leaves, seeds and animals, mostly insects. Woodland-dwelling birds eat more leafy matter and less fruits than rainforest-dwelling ones do. About 80% of fruit eating involves drupes and berries, but capsular fruits are also eaten. Fruits are mostly taken by birds perching upright and reaching head down to pluck fruit but some, such as large figs, are eaten *in situ* or taken in flight or from the ground. (Frith & Frith. 2004)

During spring and summer *P. violaceus* mostly forage for plant foods in the canopy, but during winter flocks visit pastures to graze upon shoots of grasses and small ground-dwelling herbaceous plants. They travel to gardens and orchards to eat cultivated green vegetables and soft fruits. Birds also eat seeds and nectar is lapped from garden plants including grevilleas, banksias and camellias. (Frith & Frith. 2004)

The animal diet includes cicadas, beetles, plant bugs, stick insects, caterpillars, sawfly larvae, ants, insect eggs, millipedes, spiders and winged termites during their nuptial flight eruptions. Most such animals are taken from foliage, but some from tree trunks, limbs, branches, twigs, and a few from the ground or snatched in the air. (Frith & Frith. 2004)

6.2 Captive Diet

In captivity a *P. violaceus* diet should be made up of about 80% of fruits and 20% invertebrates such as grubs, worms, maggots, fly pupae, crickets and grasshoppers (Good. A 2009). Daily scarifying of the mulch and compost substrate can provide many insects. Mealworms should be used sparingly as they have little nutritional value. Always supply some form of protein year-round. Figs are a favourite of their wild diet but not always easily sourced. Fruits that can be used are apple, pear, banana, grapes, types of melons, tomato, berries, passionfruit and kiwi fruit. Stone fruit can also be used when in season. To prepare fruits, they need to be cored and diced up into different sized pieces for enrichment purposes. Live food to be presented in containers where they cannot escape. For example, fluon solution can be painted onto containers as a barrier for cockroaches (please see appendix 1 for fluon directions).

Nestlings in the wild are largely fed on beetles, grasshoppers and cicadas until they can fly. Therefore, in captivity live food will change to an increased amount during this time. This can include termites gathered from wild mounds, maggots (please see appendix 7 for maggot breeding recommendations) and cockroaches which can be bred on site and mealworms. During the breeding season, fruits will also be increased for the adult birds to reflect energy use when raising their chicks.

No alternative diets found to be used by any other institutions.

Browse species used can include Lilly pilly, callistemon, grevillea, acacia, banksia, myrtle and eucalyptus. Offering different coloured flowers and foliage will provide excellent added enrichment for *P. violaceus*.

A variety of native shrubs and grasses planted in the aviary to allow for cooler seasonal foliage feeding behavior. If more than one individual of *P. violaceus* or mixed species, the quantity of food will represent to the number of animals in that exhibit. When numbers of birds aggregate at a food source aggression can be common, adult males invariably dominating younger birds. To combat this, several feed stations to be fixed into the enclosure. Seasonal variation will occur with sourcing a variety of fruits, however *P. violaceus* will not be finicky with what fruits they are presented with.

6.3 Supplements

Insectivore is a complete food for rearing and supplementing insectivorous and carnivorous birds. These species require a high proportion of protein in their diet. It is enriched with omega 3&6, carotenoids, vitamins and minerals to enhance feather condition and chick health. It also contains added taurine, an essential nutrient for growing passerine chicks. This can be incorporated into the meat mixture, see directions below.

- Meat mixture: 1kg kangaroo mince
  8 hard-boiled eggs, shelled and mashed
  135g wet dog biscuits as a paste
  635g chicken crumbles
  1 1/3 cups insectivore
  465g grated cheese
  The mixture is thoroughly combined by hand, making sure all ingredients are as evenly spread as possible and the meat is broken up into small pieces.

Madeira cake is provided as a source of protein, fats and carbohydrates.

Charcoal is a good mineral to offer in aviaries. It acts as a digestive aid, which combats hyperacidity in the crop and stomach.

6.4 Presentation of Food

Feeding trays to be placed on holders at least 3ft off the ground. Out-door fruit trays to have holes to allow water to drain. There should be several feeding and water stations if more than one individual is housed. Fruits to be spread across each tray, madeira cake broken up into small pieces and placed in a separate bowl, meat mixture also placed on a separate tray. One feed per day is sufficient. Morning feeds are prepared and stored correctly the day before. Fruits and vegetables prepared, placed in a specific container and stored in the fridge. Meat mixture container taken out of the freezer and stored in the fridge. Madeira cake cut to size and stored in an airtight container in room temperature.

Figs can be stashed away within the shrubbery of the exhibit; these are sought after fruits and can provide great enrichment. Sultanas, currents and leafy greens can also be scattered around the enclosure. Nail fruit is another opportunity to offer fruit and provides an added source of enrichment. Presenting it this way replicates fruit growing from a tree, allowing the bird to feed with a more natural technique. (Good. A 2009)

Mealworms are scattered across the ground for the birds to forage for.

The meat mixture contains raw mince, it needs to be divided into containers reflecting the enclosure and stored separately in the freezer to avoid cross contamination.

6.5 Sustainability aspects of feeding including food security

P. violaceus feed mostly on fruits and insects. Fruits should be sourced locally and only purchase fruits that are in season. Staple fruits that are usually cheap to buy are apples and pears. Fruits and berries can be harvested from trees and bushes on site if available and when in season to reduce costs.

Insect costs can be fairly low, due to the ability to attract, harvest and breed them.
- Mealworms: Can be purchased from insect breeders such as ‘Pisces’. However, this is not a very sustainable way to feed mealworms. Instead, they can be purchased and then bred on site.
- Maggots: Can be bred and is of very low cost. Breeding maggots does take a bit of time to get the right set up and to maintain (please see appendix 7 for maggot breeding recommendations).
- Cockroaches: Can also be bred on site.

Other various insects can be attracted to aviaries using a variety of techniques. For example, using a night light will attract bugs overnight. If feeding *P. violaceus* foods such as eggs and meat mixtures, local ingredients should always be sourced and try to have minimal food waste where possible. If you have chickens, the eggs produced from them can be used.

7 Handling and Transport

7.1 Timing of Capture and Handling

Ideally any forms of capture and handling should be done in the cooler parts of the day such as the morning and late afternoon, especially in the warmer months of the year. *P. violaceus* are very agile and nimble birds and if you fail in your first attempt it will only become harder so have a strategy and set yourself in a position where you're more likely to capture the bird. Capturing the bird within a shelter area if possible, makes for a swifter scenario, the animal has less space to move around in and less obstacles for the handler to avoid. Preferably you should have at least two people involved in the catch up. Avoid chasing the bird, your presence in the aviary will usually be enough for them to become more active. If you fail after the first three or four attempts come back later unless it's absolutely necessary. Always avoid having to catch up *P. violaceus* prior to and during breeding season. (Good. A 2009)

7.2 Catching Equipment

Padded bird nets are ideal for catching *P. violaceus*. The hoop should be around 50cm in diameter with padding around the hoop to protect the bird. The bag should be made of a light fabric such as cotton for easy maneuvering and have at least a few of these tools that have handles at different lengths. For example, a 50cm handle, a 1m handle and a 1.5m handle, either one would suit the sizes of most aviaries. (Good. A 2009)

7.3 Capture and Restraint Techniques

After the bird has been caught, seal the bag by twisting it at the top. Once you have discovered where its beak and legs are, you can slide your hand inside the bag and restrain the bird while it is still in the bag. This can be done with one hand if you are on your own, or two hands if you have a second person. Take a firm hold of the bird, but not too tightly that you prevent the animal from breathing. (Good. A 2009)

Figure 7: Restraining a mature male *P. violaceus* in the airlock after capture (photograph by Steve Sass)

P. violaceus will not cause any serious injuries, scratches from claws only. It is best to use your bare hands for capture to allow dexterity, however if the animal is suspected of carrying a disease, latex gloves should be used. Hands to always be thoroughly washed after handling birds and apply first aid to any scratches as soon as possible. (Good. A 2009)

7.4 Weighing and Examination

These processes should always be carried out by at least two people so it can be done efficiently, safely and as quick as possible. When weighing a *P. violaceus*, it can be done by either placing in it a secure box or in a cotton bag and weighted on a handheld scale. (Good. A 2009)

Performing examinations requires one person to restrain the bird, while the other person carries out the examination. When it comes to examining the wings, care needs to be taken making sure you have your thumb and index finger holding the elbow of the wing before stretching it out to its full length. (Good. A 2009)

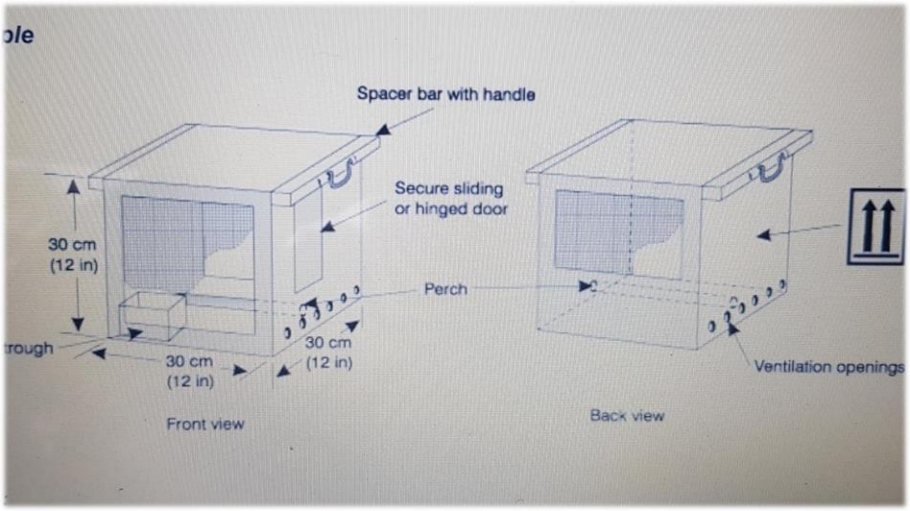
7.5 Transport Requirements

Because the transport of any animal causes stress, this should be done as efficiently as possible. Transport boxes or cages should not be too large, but should allow enough space for the bird to move around in. Birds do not fare well in extremes of temperature, therefore, should not be left in parked vehicles in the sun or hot weather. “Live birds” writing should be visibly displayed on large labels on at least two sides of the container. (Good. A 2009)

7.5.1 Box Design

The normal habits and necessary freedom of movement of the bird species involved will determine the size. An adult *P. violaceus* size range from 27cm to 33cm. The height of the container must allow the bird to leave the perch or gripper bar without touching the top of the container. Solid wood with a minimum thickness of 1.3 cm (1/2 in) or other material of equivalent strength is suitable. The whole of one side and the top half of the opposite side must be made of welded wire mesh no greater than 19 mm x 19 mm (¾ in x ¾ in) and at least 1.5 mm (0.06 in) or thicker. The front of the container may be sloped for extra ventilation. A muslin, or similar material, curtain, which can be raised and lowered can be used to cover the meshed areas. The interior of the container must have not any sharp edges or protuberances on which the birds can injure themselves. Wood, Plywood, non-toxic plastic, fiberglass, synthetics, weld mesh burlap/muslin or other light material to be used.

Example of a transport box with dimensions, IATA standard:



7.5.2 Furnishings

A wooden perch installed appropriate to the size of the box to allow the bird to grip onto whilst in transit, is a must. It must be fixed in a position so that the head and tail of the bird does not come into contact with the top or bottom of the box. It should also be away from any food or water dishes (Good. A 2009). Wood shavings placed on the bottom as a substrate.

7.5.3 Water and Food

Transportation times in excess of 1 hour will require a water dispenser inside the box. There can be variables however with the weather, if travelling on a hot day a water dispenser will be provided regardless. In the event of a long or overnight transport process, food must be provided (Good. A 2009), for example half an apple or a few grapes provided in a small dish will suffice. For *P. violaceus*, only feed troughs with outside access for refilling are necessary as they obtain their moisture from the food supplied.

For short local distances, it is not necessary to provide food or water.

7.5.4 Animals per Box

Adult *P. violaceus* will always be transported singularly. Transporting this species separately is safer, being in a confined small dark space that they are unfamiliar with is stressful enough without having another bird to contend with in the box.

7.5.5 Timing of Transportation

Transportation ideally should be carried out in the morning, as early as possible, or late afternoon to nighttime. If this is not possible, then assess whether or not food or water needs to be provided. Transporting during the day in summer months should be avoided at all costs, if it does have to be done the vehicle needs to have air-conditioning. However, sufficient management and planning of the process should avoid this happening. (Good. A 2009)

7.6 Release from Box

When releasing or introducing a new *P. violaceus* in an aviary, consider using a welded-wire cage as a way of introducing it to the existing birds already occupying the aviary, especially if you are going to release into an aviary which already has *P. violaceus* or honeyeaters. The ideal time to release is in the morning as to give the bird the day to adjust in the aviary. Perform the release at ground level and away from obstructions and allow the bird to come out of its own accord if it doesn't immediately come out. (Good. A 2009)

7.7 Sustainability

Transport systems have significant impacts on the environment, accounting for between 20% and 25% of world energy consumption and carbon dioxide emissions. The majority of the emissions, almost 97%, came from direct burning of fossil fuels. Greenhouse gas emissions from transport are increasing at a faster rate than any other energy using sector. Road transport is also a major contributor to local air pollution and smog.

Moving animals between facilities cannot be avoided, therefore careful thought should be made when deciding on the mode of transport. Transporting *P. violaceus* can be done via road or air, considering whether it will be more environmentally friendly to go by car or plane will be up to each individual circumstance.

8 Health Requirements

8.1 Daily Health Checks

Observations by keepers are noted daily and recorded in the daily diary record system. These are to be carried out during morning exhibit checks, as well as during feeding and cleaning. Keepers with *P. violaceus* will know the history of individuals and what behaviours and signs to look out for. Listlessness, not eating, dull appearance in feathers and lack of their usual personal habits are some of the signs of ill health. (Good. A 2009)

8.2 Detailed Physical Examination

When carrying out physical examinations when restrained, they should be as brief as possible but thorough.

- Head and eyes: Eye check – swollen lids, discharge, squinting, or a change in colour of the globe. If head trauma is suspected, wet the crown down and you will be able to see if there is any meningeal hemorrhaging. (Good. A 2009)
- Beak and mouth: Check the evenness of the beak. If trauma is suspected, the beak should be palpated for fracture or other damages. Nares should be checked for any plugs or discharges. The beak often opens in vocalisation which can allow viewing inside the mouth. Mucous membranes are usually pink in a *P. violaceus*. (Good. A 2009)
- Auditory canal and neck: Check auditory canals, for exudates, blood, and infection. Trauma of the canal from aggression can be observed as partially closed, swollen, and filled with blood. Neck, oesophagus and trachea should be palpated for the presence of liquids, solids, or air. The lower section of the cervical oesophagus called the crop should be checked, gross distension indicates blockage or impaction. (Good. A 2009)

- Body condition scoring: BCS is a useful tool for assessment of a patient's general health status and evaluation of a patient's food supply. The BCS system is based on scores between 1 and 5, with 1 being emaciated and 5 being obese for the "generic" bird. (Good. A 2009)
- Abdomen: Gently palpate for internal masses, ovulated eggs, and fluids. The vent area can be checked for growths, lesions, protrusions and for urates or faeces accumulating on the feathers. (Good. A 2009)
- Skin and plumage: Check for parasites, skin swellings, and missing or damaged feathers. Feathers which are dull, frayed or split may indicate nutritional deficiencies, stress, or hormonal imbalances. Skin irritation and broken feathers or an area of missing feathers are an indication of possible self-mutilation, which is usually associated with stress or boredom. (Good. A 2009)
- Wings and legs: Check all bones and joints. Swellings, abrasions, or bruising are common on the carpus. Check for broken/missing nails, or for swollen areas on toes or foot. (Good. A 2009)

8.2.1 Chemical Restraint

Chemical restraint is not necessary for *P. violaceus.*

8.3 Routine Treatments

P. violaceus should be wormed routinely every 3-4 months along with all other birds in that aviary. There are a number of products to use to best achieve this, for example, Cydectin Plus, Panacur 100, Avitrol Plus (please see appendix 4 for Avitrol Plus details) or Ivomec, which are mixed into a single water source. It is important to have a single water source such as a pond or water dish to ensure that the *P. violaceus* and other aviary birds' intake the worming treatment. Also perform worming when you know that there will be no rain for at least a few days. Treatment to be administered for 3 consecutive days, this way of worming is for large aviaries with many birds. (Sass, H. 2017)

Coccidiosis can be treated against using a product such as Baycox (please see appendix 5 for Baycox details). It comes as a syrup which is diluted at the ratio 3:1000 or 3ml per litre of water. The two days before Baycox is administered, apple cider vinegar can be added to drinking water at 5:1000 or 5ml per litre. The reason for giving apple cider vinegar before Baycox is to acidify the bird's gut which enhances their natural resistance to a variety of possible bacterial and fungal infections. This is then followed with two days of Baycox and water solution at the ratio 3:1000 or 3ml per litre of water. This treatment should be given during/after extended wet and/or humid weather. (Sass, H. 2017)

8.4 Known Health Problems

- Problem: Avian Tuberculosis.

Cause: Mycobacterium avium
Signs: Bone problems. Anorexia, weight loss, abdominal organ enlargement, presence of masses on radiograph, and an elevated WBC count.
Diagnosis: Laparoscopy, faecal culture, and liver biopsy.
Treatment: Difficult to treat and usually unsuccessful
Prevention: Quarantine, identification and removal of carriers, and good hygiene.

- Problem: Coccidia.

Cause: Protozoan.
Signs: Oocytes found in faecal test. Large infestation — dysentery, anorexia, depression and dehydration.
Treatment: Baycox and Trimethroprim/sulfa
Prevention: Hygiene and ongoing monitoring.

- Problem: Shock

Cause: Trauma, injury and or disease
Signs: Dilated pupils, shock and/or abnormal, slow behaviour

- Problem: Salmonella

Cause: Carriers of Salmonella, contaminated food.
Signs: Found in faeces. However, the first time you know your *P. violaceus* has salmonellosis would most likely be after an autopsy.
Treatment: Either of the following antibiotics – Trimethroprim-sulfa, Tetracycline or Ampicillin.
Prevention: Find and eradicate carriers. Correct food storage if feeding out meat products during breeding season.

8.5 Quarantine Requirements

On arrival, carry out a physical examination and faeces check. If the bird appears injured or sick, contact a vet immediately and arrange immediate transfer to a vet clinic.
Check the history if provided with the animal and place animal into the quarantine facility. SPARK (please see appendix 9 for SPARK details) water on arrival in accordance with manufacturer's directions. Three days post arrival, cease SPARK and routinely worm if animal has not been wormed within the last eight weeks. (S. Sass pers.comm)
Animal is to remain in quarantine for a minimum of four weeks.

9 Behaviour

9.1 Activity

P. violaceus are a very active bird for around three quarters of diurnal hours. Both sexes will spend time seeking out food sources. The male will be seen patrolling his territory which makes up a large portion of their daily activity. Males will be heard regularly calling, which is most common during breeding season when he is displaying, as well as when wild *P. violaceus* are in the area of the aviary. If they are housed in an area of wild *P. violaceus*, the captive male will defend against visiting males and spend time attracting visiting females. (S. Sass pers.comm)

9.2 Social Behaviour

P. violaceus are a social species and shouldn't be keep solitary all year round. Some institutions will keep males singularly, which is not always appropriate. In the wild through non-breeding periods, *P. violaceus* can be found in flocks of up to 200 birds grazing on pastures. Females in captivity will always visit a bower no matter how good or bad the structure is.

Males will be social around their bower but keep an eye out that the male doesn't pursue a female around the enclosure. This behaviour should be monitored and if it does happen, a male's wing can be clipped to reduce this behaviour. (S. Sass pers.comm)

9.3 Reproductive Behaviour

At the start of display season, an adult *P. violaceus* male will build a new bower on or adjacent to the spot used in a previous season. A bower of two outwardly curving parallel walls of sticks placed upright into foundation platform of fine sticks and grass straws on ground. Walls may form an arch as uppermost twigs meet and intermesh above avenue, the area of platform sticks laid upon ground court extends beyond the avenue and the bower can comprise more than 2000 sticks. (Frith and Frith 2004)

An adult male displays alone to females in ritualized progression of movements and postures (displays also to immature or subadult males, or when alone, but in less ritualized way); courtship involves two display elements, the first an active one involving vocalised buzzing accompanied by body movements with rapidly and vigorously repeated opening and closing of wings while picking at/up decoration (male mostly hidden from female's line of sight) interspersed with struts/strides across and directly in front of avenue entrance (i.e. in view of female). (Frith and Frith 2004)

The second one is static and involving the male in continuous vocal mimicry and raising and lowering himself on flexing legs; also presents nape to female while holding decoration in its bill; if female solicits, by crouching and vibrating lowered wings and raising rump, the male enters far avenue entrance to mount her from behind. (Frith and Frith 2004)

Nest takes 1–2 weeks to build by the female, a shallow saucer of sticks and twigs with eggcup lining of green and dry leaves. She will solely incubate the eggs, defend the nest, and feed her chicks. Once a female goes to nest, the male may still pursue her, this needs to be closely observed. If this behaviour continues, the male should be removed. (S. Sass pers.comm)

Females are secretive and you may not know she has gone to nest, in terms of managing this, she needs to be spotted every day. A giveaway for nesting is the female's activity, once the eggs hatch, the female will be frantic with feeding. Females can also flee the nest when you enter the aviary. So, to get a more definitive answer, monitoring behaviour through remote cameras will confirm if the female is nesting without disturbing her. (S. Sass pers.comm)

9.4 Bathing

P. violaceus can be seen in small groups bathing at creeks and small water courses, they will also readily use bird baths in gardens. Bathing is a part of their daily activity; therefore, it is important to provide a water dish large enough or build a small pond for them where they are housed.

9.5 Behavioural Problems

As a species that is highly active, *P. violaceus* can be easily bored. They may present behaviours such as pacing up and down the aviary, hoping from one perch to another. To address this problem, it can be resolved by offering enough stimulation and enrichment.

This can be done by providing a variety of browse, introducing a young male and providing enough bower building material. (S. Sass pers.comm)

P. violaceus can also be over stimulated by wild *P. violaceus*, which can also result in pacing behaviour. This is a behaviour that cannot be prevented and is believed to be self-managed by resting during parts of the day. Wild birds don't tend to stay around anyway, so this trigger of behaviour should not last long. (S. Sass pers.comm)

9.6 Signs of Stress

Behavioural signs of stress in *P. violaceus* can come about by not providing what they need and require. The male *P. violaceus* builds a bower for courtship and this is maintained throughout the whole year. Therefore, making sure he has enough sticks and gifts at all times throughout the year is essential. Pacing can be a result of not providing this as bower building is a natural behaviour for this species. (S. Sass pers.comm)

Both sexes require regular enrichment to promote their well-being in captivity. If a good standard of management for this species is not followed, stress behaviours will begin.
These can include: Excessive pacing
Feather plucking
Lack of socialization

9.7 Behavioural Enrichment

In the wild *P. violaceus* are found in woodlands and open nearby areas. They rapidly hop between branches when patrolling their territory, so it is recommended that there is enough perches and plant species in their aviary which helps encourage this natural behaviour.

Providing courting and bower building material, for example, sticks, gifts of assorted colours and flowering browse. Offering a mix of man-made and natural gifts is important, the male will collect anything he likes the colour and shape of in the wild. Partially destroying the bower, moving gifts, taking out and adding gifts is a great enrichment strategy, as this will occur naturally in the wild from neighbouring males. *P. violaceus* are primarily frugivores, offering fruits and berries on branches if possible is a great source of enrichment. (S. Sass pers.comm)

Introducing a young male with caution to the aviary will add interest to a mature male as well as the female. If the institution is located in a region where *P. violaceus* are endemic, then the wild birds will be attracted to the captive birds and provide invaluable enrichment. If there are no wild occurring birds, a recording of a wild *P. violaceus* could be played outside the enclosure. (S. Sass pers.comm)

9.8 Introductions and Removals

When introducing newly acquired *P. violaceus* into an aviary, it can be done firstly by using a cage for the new bird. Observations should be carried out closely to note any issues and generally issues will arise straight away. When introducing a male to female, or a female to male you don't tend to have any issues, however introducing a young male into an aviary with a mature male, this may cause disputes. If this happens, that young male should be removed immediately.

If an existing young male is housed with a mature male, when the younger male starts bower building, he will need to be removed. (S. Sass pers.comm)

9.9 Intraspecific Compatibility

The ideal arrangement in an aviary is a single pair of *P. violaceus*, additional birds of this species may cause territorial disputes depending on the age and sex. There has been no evidence found though to suggest that either groups of males or females cannot be housed in single sex aviaries. However, for the purposes of breeding, a single pair would be housed per aviary.

9.10 Interspecific Compatibility

Birds that can be suitably housed and some of which have been successfully housed at On the Perch with *P. violaceus* are native pigeons and doves such as:

- Wonga Pigeons *Leucosarcia melanolauca*
- Emerald Doves *Chalcophaps indica*
- Topknot Pigeons *Lopholaimus antarcticus*
- White-headed Pigeons *Columba leucomela*
- Bronzewing Pigeons *Phaps chalcoptera*
- Bar-shouldered Doves *Geopelia humeralia*
- Rose-crowned Fruit Doves *Ptilinopus regina*

Finches such as:

- Diamond firetails *Stagonopleura guttata*
- Black-throated finches *Poephila cincta*

Other Bowerbirds such as:

- Green Catbirds *Ailuroedus crassirostris*
- Regent Bowerbirds *Sericulus chrysocephalus*

Note: Green Catbirds will prey on the young of all these species during breeding season.

When introducing any new bird to an aviary, it should be observed to ensure no aggression occurs towards it, or that it doesn't become aggressive towards others.

9.11 Suitability to Captivity

P. violaceus display beautifully and are very captivating when they are housed in a suitable environment. Factors to keep in mind when considering keeping this species are as follows:

- As they are a very active medium sized bird, an appropriately sized aviary is therefore important to enable short or long spurts of flying.
- A well planted aviary for them to hop around and take cover in
- Species which *P. violaceus* can be housed with
- Providing bower building material, which includes appropriately sized twigs and blue and other coloured gifts.

10 Breeding

10.1 Mating System

The *P. violaceus* has a polygynous mating system in which males attract females to bowers for mating; females choose mates based on multiple aspects of males and their bowers.

10.2 Ease of Breeding

Female *P. violaceus* use some cues to decide which males to examine closely and other cues to decide which males to mate with. Female visitation rates to bowers are significantly related to male size and the males' 'solitary' display rates, and, to a lesser extent, to the numbers of bower decorations. Female *P. violaceus* make a series of visits to males before mating and appear to use multiple male signals to assess potential mates. The quality of bower construction and the number and types of bower decorations influence female mate choice, as do the males' displays. Coleman *et al*. (2004) showed that the relative importance of different male traits depends on the age of the female and varies through the mate choice process (T. Robson, A. Goldizen, D. Green, 2005). If a female continually rejects a male, she will need a new male to impress her if breeding is desired. Minimum disturbance to nesting sites is of high importance, as this can result in breeding failure.

Figure 8: Bower built by residing mature male *P. violaceus* (photograph by Alex Metcalfe)

10.3 Reproductive Condition

10.3.1 Females

Females to be of breeding age (from 2 to 3 years), as well as in optimum health and accept a male for mating.

10.3.2 Males

Mature males (around 7 years) being in optimal health is of high importance. Males need to have bright plumage and a suitable diet will provide necessary nutrients for this as well as give the energy needed to impress females and maintain their bowers.

10.4 Techniques Used to Control Breeding

Separating females from males is the easiest way to control breeding. However, if the pair in question have successfully bred previously and you would like to control the breeding without separating them, removing nesting material and possible nesting sites would be the next step.

10.5 Occurrence of Hybrids

A rare natural intergeneric hybrid between the *P. violaceus* and the Regent bowerbird is known as the Rawnsley's bowerbird. (Frith & Frith 2004)

Figure 9: A Rawnsley's bowerbird (photograph by Trevor Andersen)

10.6 Timing of Breeding

Nesting occurs from late August or during September through to January, with egg laying peaking during November to December. On average nesting lasts three and a half months each year, but this varies with location, altitude, weather, and food availability. (Frith & Frith 2004)

10.7 Age at First Breeding and Last Breeding

Female *P. violaceus* mature at two to three years but males do not reach maturity until seven or eight years when they have moulted completely into their characteristic blue-black adult plumage. No studies have been found relating to their age at which breeding continues to.

10.8 Ability to Breed Every Year

There is no guarantee of breeding every year due to their polygynous nature and the male's ability/inability to impress the female.

10.9 Ability to Breed More than Once Per Year

Replacement clutches are produced after the loss of the first, but true second broods within a season are exceptional. At Taronga Park Zoo, Sydney, a captive female laid a single clutch 41 days after the fledgling of her first brood of that season. (Frith & Frith 2004)

10.10 Nesting, Hollow or Other Requirements

The female *P. violaceus* builds the nest. This takes one to two weeks to build and mating can take place before or after nest building and over a month prior to egg laying. In the wild nests are built mostly in trees and bushes, but also in vine tangles about trees, in mistletoe clumps and 'suckering' tops of broken-off tree trunks. Nest height above ground averages around 15 metres, variation in nest site and height differs between habitats. Nests consists of a shallow saucer of sticks and twigs, with an eggcup lining of both green and dry leaves. (Frith & Frith 2004)
This can be replicated in captivity depending on the size and location of the enclosure. The enclosure should have sufficient native bushes for cover and privacy and keepers to provide nesting materials such as sticks and twigs of varying sizes and a mixture of green and dry leaves. For the building and maintenance of a male's bower, sticks and twigs are to be provided by keepers and spread around the ground of the enclosure. Blue decorations be that man made and/or natural to also be provided and spread across the ground of the enclosure for the male to choose from.

10.11 Breeding Diet

A *P. violaceus* diet consists of a wide variety of fruits, as well as some flower petals, stamens and nectar, leaves, seeds, and insects. The breeding diet will consist of its regular diet, however, upon breeding season their diet must be supplemented with a variety of insects. This can include mealworms, cockroaches, termites, maggots and grasshoppers.
The nestling diet is initially of invertebrates only, the overall nestling diet involving little fruit, and up to 90% insects. Fledglings are fed insects and fruits. (Frith & Frith 2004)

10.12 Incubation Period

The incubation period is 21 to 22 days and the nestling period 17 to 21 days. (Frith & Frith 2004)

10.13 Clutch Size

1 to 3 eggs are laid but most clutches are of 2 and eggs are laid on alternate days. (Frith & Frith 2004)

10.14 Age at Fledging

Fledgling age is 17 to 21 days.

Figure 10: *P. violaceus* nestling (photograph by Tixie Benbrook)

10.15 Age of Removal from Parents

Females have been recorded feeding offspring 59 days after they left the nest. Removal of the young when necessary should therefore be around 30 days, where they will still require human intervention for another 4 to 5 weeks.

10.16 Growth and Development

Individuals of both sexes have lived in excess of 20 to 30 years. Young males may begin to acquire their adult plumage in their fifth year and are not fully ‘attired’ until they are seven. *P. violaceus* are medium-sized birds. The adult male has striking glossy blue-black plumage, a pale bluish white bill and a violet-blue iris. Younger males and females are similar in colour to each other. They are olive-green above, off-white with dark scalloping below and have brown wings and tail. The bill in brown in colour.

11 Artificial Rearing

11.1 Incubator Type

Incubator type is up to the individual and their budget. However, a recommended leading brand in bird egg incubation is Brinsea. The octagon 20 eco has a capacity of 24 hen eggs, but is suitable for a wide range of egg sizes. The dividers are adjustable, it has fan assisted air circulation, fresh air is controlled with a vent slider and humidity is provided by water in two reservoirs in the base. The cabinet is insulated for low energy use and optimal temperature distribution.

Figure 11: Brinsea octagon 20 eco

11.2 Incubation Temperatures and Humidity

Recommended temperatures for a typical incubation period of 21 days, which the *P. violaceus* is, is 37.5 C, 99.5 F. The humidity necessary for correct incubation can be supplied by allowing dishes of distilled water to evaporate within the machine. Experience will quickly determine the best wet-bulb reading for a particular species. A good point to start at is 84 F (28.9 C) with a dry-bulb reading of 99.5 F (37.5 C) and RH 53%. (Vince 1996)

11.3 Desired % Egg Mass Loss

Regular weighing is essential throughout incubation to achieve the desired weight loss. *P. violaceus* eggs lose about 15% to 16% of their fresh laid weight during incubation, due to loss of water through the porous shell. (Vince 1996)

11.4 Hatching Temperature and Humidity

Once the chick has internally pipped, the egg no longer needs to be turned. Temperature should be 1-degree F lower than the incubation temperature, since warmth is generated during the hatch and the eggs may otherwise overheat. The hatching incubator should be at maximum humidity and can be a moving or still-air design (Vince 1996). Hatching humidity for all species is 65%.

11.5 Normal Pip to Hatch Interval

Internal pipping may occur a day or so before hatching, although the exact time is variable and must be monitored by candling. (Vince 1996)

11.6 Brooder Types/Design

Brooders can be self-made, for example any small container that is easy to clean and all requirements can be implemented, such as the temperature and humidity. The base needs substrate, for example a layer of very thin sticks, towelling or artificial fibre matting. Newly hatched chicks can have strong feet and benefit from something to grip on from day one. (Vince 1996)

11.7 Brooder Temperatures

Newly hatched chicks will need to be kept in a brooder at 35 – 37.2 degrees Celsius and at a humidity level similar to that used during incubation. (Vince 1996)
Below is a guide for most medium sized altricial chick species.
First 4-5 hours after hatching - 37.5 degrees Celsius
First 4-5 days after hatching - 36.5 degrees Celsius
From day 6 to day 10 - 35 degrees Celsius
From day 11 until chick has good coverage of down feathers - 34 degrees Celsius
The temperature can then be gradually reduced as the chick develops until it reaches room temperature (25-26 degrees Celsius). (Hickey 2010)

11.8 Diet and Feeding Routine

Within the first 24 hours, chicks are not to be fed. In doing so can interfere with the normal absorption of the yolk sac and can make the chick more vulnerable to egg peritonitis. (Vince 1996)

As an omnivorous species, day 1 to 6 approximately: 70 percent proprietary parrot rearing formula (Please see appendix 6 for formula details) premixed with water according to the manufacturer's instructions, plus 15 percent pureed apple, plus 15 percent pureed papaya and blended together. From day 6 approximately: thicken the food and begin offering sliced pinkie mice and small pieces of the adult diet. (Vince 1996)

The feed mixture can be delivered by using a syringe or eye dropper and progressing onto a larger syringe as the chick grows. Or a spoon with its edges bent upward to mimic an adult's mandibles. The temperature of the food must be between 37.8 and 41.1 degrees Celsius. If the food is too cold the chick is likely to refuse it, while food that is too hot can result in crop burn. Before feeding, it is important to elicit a normal feeding response, otherwise food can enter the windpipe instead and be inhaled. The food should be delivered over the tongue, and the bird given an opportunity to swallow. (Vince 1996)

It is essential never to overfeed the chick, monitoring of the crop during feeds is a good way to ensure this doesn't occur. Delivering a measured amount of food from a syringe or weighing the chick before and after feeds is a recommended practice. It is best to feed small amounts often and intervals of one to two hours for the first week, this should allow the food to be easily digested and easily clear the crop. The amount is recommended to be increased by approximately 10 percent each day. (Vince 1996)

Figure 12: One day old *P. violaceus* chick (photograph by Jonathan Bradley)

11.9 Specific Requirements

Growth is rapid and it is very important to provide suitable twigs and branches for the youngster to perch on, as it starts to explore its environment and while its feet are still developing. (Vince 1996) Safe handling techniques should be followed at all times and chicks handled only when absolutely necessary.

11.10 Pinioning Requirements

There is no requirement to remove the pinion joint of *P. violaceus*.

11.11 Monitoring health and data Recording

An excellent diet, clean drinking water and a stress-free and sanitary environment will lead to a healthy collection. However, you will encounter a sick bird and its prompt diagnosis and treatment are often vital for a recovery. If softbills are looked after by different people, simply noticing a sick bird can be a problem; but if they are cared for by the same person, small changes in their behaviour and appearance can be spotted. Any changes can be critical, since birds will do their best to mask signs of disease. (Vince 1996)

Growth and health records are an important part of hand rearing birds. Points to take note of include: (Sass, H 2017)

- Individual identifications
- Location of the animal
- Date and time egg begins incubation
- Weight of the egg or chick
- Temperatures of incubators or brooders
- Relative humidity of incubators or brooders
- Any movement of the chick or egg (i.e., from the incubator to the brooder)
- Date and time egg hatches
- Times of feeds
- Amount of food being consumed by each chick
- What food is being consumed

When a bird looks poorly it is often difficult to decide on the best course of action. If the subject looks only very slightly off-colour, leaving it alone, adding a probiotic treatment to its food and offering an infrared lamp is usually all the medicine it needs. If the condition persists for more than a day or so, seek immediate veterinary advice. Possible warning signs are bloodstained or loose droppings, appetite loss, half-open eyes, laboured breathing or deterioration of feather production/condition. (Vince 1996)
Problems that can arise during hand feeding include; refusal to feed/defecate, aspiration, sour crop, crop burn and deformed beaks.

11.12 Identification Methods

Leg bands are the most common method for identifying birds. There are two types available, the closed and opened band. Closed bands are used to denote a captive-bred bird, since they can only be fitted when the bird is a few days old. Open bands are either plastic or metal, they have a joint in them so they can be fitted on an adult bird's leg. (Vince 1996)

It is important to use a band of the correct size to avoid injury, or losing the band. A 08 – 09 stainless steel band is recommended for *P. violaceus*.

11.13 Hygiene

To avoid bacterial growth, it is important to disinfect the incubator every few weeks and especially at the beginning of the breeding season. Personal and utensil hygiene are also vital in keeping the chicks healthy. Washing hands thoroughly before and after doing work in the hand-rearing area, ensuring that feeding utensils are cleaned and disinfected in a solution such as Nolvasan or Avisafe (please see appendix 8 for Avisafe details). It is also important to soak the utensils for at least 15 minutes before they can be used (Vince 1996). Formulas and utensils should always be stored correctly to ensure the quality.

11.14 Behavioural Considerations

Always try to minimise any possible imprinting, time spent around the chicks should only be when necessary. Chicks will have to learn to forage for themselves, once they have fledged some small pieces of fruit can be left with them to discover.
P. violaceus are a secretive bird, taking eggs from a nest may adversely impact its ability to breed in the same enclosure again. In the wild replacement clutches are produced after the loss of the first, but true second broods within a season are exceptional. Because of this, it would be advised not to take a clutch in hope of a pair producing a second clutch in the same season.

11.15 Use of Foster Species

Other species of Bowerbirds could be attempted but there is little to no evidence supporting cross fostering within the Ptilinornhynchidae family, let alone with *P. violaceus*. The fostering of this species without prior knowledge could lead to the chicks being abandoned. (Good. A 2009)

11.16 Fledging

Weaning is not such a difficult task for *P. violaceus*. A dish of small pieces of fruit and mealworms and a dish of water, should be left in the young bird's cage and eventually food will be played with and eaten. It is advised to leave food and water in the cage from about one to two weeks after the normal fledging time, which is 17 to 21 days for *P. violaceus*.

Throughout the hand-rearing process, weighing the chick each day can provide an early warning of any problems. During the weaning period, a small, temporary decrease in weight is normal and is nature's way of encouraging the bird to feed itself. (Vince 1996)

11.17 Rehabilitation and Release to the Wild Procedures

P. violaceus due to be released into the wild need to be capable of collecting food for themselves and not associating humans as a food source. Once they are in the process of weaning, carers should not spend time with the birds except to place food in the enclosure. Carers should not feed the birds by hand once they know how to feed on their own. This will only encourage the association of food and humans. (Sass, H. 2017)

They will need to recognise their own species, birds due for release should have full capabilities of flying and moving freely (Sass, H. 2017). They should not have any issues with movement such as leg or wing issues. A soft release technique may be best for the release of *P. violaceus* into the wild.

12 Collection Management

12.1 Current Collection Census and Plan holdings

There is no current collection plan for *P. violaceus.*

12.2 IUCN Category

P. violaceus is listed as of least concern (LC) on the International Union for Conservation of Nature.

12.3 C.I.T.E.S. Appendix

P. violaceus is not listed under the Convention on International Trade in Endangered Species.

12.4 National Category

P. violaceus is not listed under the Environment Protection and Biodiversity Act 1999.

12.5 State or Territory Categories

P. violaceus is not listed under the Threatened Species Conservation Act 1995.

12.6 Wild Population Management

There are no recovery plans for *P. violaceus* as they are not a threatened species.

12.7 ASMP Category of management

P. violaceus are not listed in the ASMP management.

12.8 Key Personnel

Key personnel are not applicable to *P. violaceus.*

12.9 Captive Management details

There are no captive management details for *P. violaceus.*

12.10 Population Viability Assessment

A PVA/PHVA is not applicable to *P. violaceus* as they are not a threatened species.

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Steve Sass [personal communication]

Linda Sass [personal communication]

Holly Sass [personal communication]

15 Glossary

Pinioning – To cut off the pinion of bird to prevent flight

Scarify – Cut and remove debris with a scarifier

Nestling – A bird that is too young to leave its nest

Listlessness – Lacking energy or enthusiasm

Polygynous – A pattern of mating in which a male bird has more than one female mate

Bower – A structure made from sticks which the male bird constructs

Plumage – A birds feather collectively

Frugivore – A frugivore is any type of herbivore or omnivore where fruit is a preferred food type

Moult – Shed of feathers

Fledgling – A young bird that has just left the nest

Pipped – A bird cracking the shell when hatching

Imprinting – A form of learning in which a very young bird fixes its attention on the first object with which it has visual, auditory, or tactile experience and thereafter follows that object

Brooder – Apparatus used for chicks consisting of a box designed to maintain a constant temperature by the use of a thermostat

16 Appendices

16.1 Appendix 1 Products Mentioned in Text

Insect-a-stop (fluon).
Painted on smooth, clean, dry surfaces insects will not cross the barrier provided by INSECT-A-STOP. This material is PFOA free.

INSECT-A-STOP is brushed or wiped onto the inside top portion of the trap or container. The smoother the application the more effective. After it has dried, it forms a slick barrier that prevents arthropods from obtaining a foothold on the treated area. Sometimes sold as 'Fluon®' by other companies.

INSECT-A-STOP is a laboratory-grade product used by entomologists world-wide to prevent insects from escaping their container or habitat.

INSECT-A-STOP is compatible with any smooth surface such as glass, plastic, or polished metals.

Application is recommended by small paint brush or similar however the method of application and end use is strictly the responsibility of the end user.

This product is packaged in heat sealed plastic bottles, and is available in various sizes 50ml, 125ml, 250ml, 500ml, 1000ml

This product should not be shaken or subjected to freezing. Because it is a suspension, it should be turned every couple of weeks. Shaking and/or freezing causes clumping that is not reversible.

16.2 Appendix 2 MSDS (Material Safety Data Sheets).

F10 Disinfectant. MSDS sheets for the disinfectant F10 can be found via the link below:
https://www.vetnpetdirect.com.au/products/f10d
F10SC is a total spectrum disinfectant that, unlike other strong disinfectants on the market, has no adverse side effects on people, animals, or on equipment and surfaces. It is ecologically friendly and biodegradable, and carries a wide range of registrations and approvals from around the world.

In Australia, F10SC is registered by the APVMA for use in animal production and housing facilities, approved by AQIS for use in food export processing as a non-rinse disinfectant, and is also listed by the TGA as a Hospital Grade Disinfectant.

16.3 Appendix 3

Soft Bill Meat Mixture – Used at On the Perch.

Meat mixture: 1kg kangaroo mince
8 hard-boiled eggs, shelled and mashed
135g wet dog biscuits as a paste
635g chicken crumbles
1 1/3 cups insectivore
465g grated cheese
The mixture is thoroughly combined by hand, making sure all ingredients are as evenly spread as possible and the meat is broken up into small pieces.

Divide into airtight containers.
Store the mixture in the fridge for up to 2 days or the mixture can be frozen and defrosted in the fridge as needed. (DO NOT refreeze meat).

The mixture can be presented on a tray in the aviary, its best kept out of the sun to reduce how quick it will perish. The mixture should be replaced or removed after 24 hours.

16.4 Appendix 4

Details of the product Avitrol Plus used for worming *P. violaceus* routinely to treat/prevent every 3 months. (Vet-n-Pet Direct, 2017) This product can be purchased online in 25mL, 100mL, and bulk 2.5mL from:
https://www.vetnpetdirect.com.au/products/AVIT

COMPOSITION: Levamisole hydrochloride 10 mg/mL, Praziquantel 2 mg/mL.

INDICATIONS: Threadworm (Capillaria sp.), Caecal worm (Heterakis sp.), Roundworm (Ascaridia sp.), gape worm (Syngamus sp.), gizzard worm (Acuaria sp.) and Tapeworm (Raillietina sp.) in ornamental cage birds.

CONTRAINDICATIONS: Administration to species or strains of birds known to be sensitive to the effects of levamisole. Not recommended for use in Gouldian finches.

PRECAUTIONS: Parrots appear to be less tolerant than pigeons to levamisole. Do not dose in extremely hot, dry weather or treat stressed birds, or birds that are feeding young.

WITHHOLDING PERIODS: Meat: 7 Days

ADVERSE REACTIONS: Side effects include regurgitation (which is not considered to be harmful), incoordination, leg and wing paresis; atropine has been used as an antidote. Deaths of birds up to 2 days after dosing have been attributed to obstruction from massive roundworm infestation.

DOSAGE AND ADMINISTRATION:
Dose guide for crop administration
Type of bird; Weight of Bird; Dose (drops of undiluted syrup)

Finch 15g 1.5
Budgerigar 30g 3.0
Budgerigar 50g 5.0
Cockatiel 80g 8.0
Cockatoo 500g 50.0

Make up dose to 1 to 5 mL with water in a syringe.

Crop administration. A crop needle or tube placed directly into the crop can be used to administer Avitrol Plus syrup by syringe. Do not administer any liquid into the crop unless you are confident that the crop needle or tube is correctly placed.

Diluted in drinking water: 0.5mL (12 drops) to 20mL of water or 25mL/L. Use this as the sole source of drinking water for 24 hours and feed only seed, then replace with fresh clean water. Solution should be freshly made up before dosing. Repeat in 14 days with fresh solution, or as directed by a veterinary surgeon. This provides a dose of 40mg/kg bodyweight based on an average bodyweight of 30g and consumption of 5mL/day. In summer the dose should be reduced to account for increased water consumption, which may be double or more.

For threadworm, caecal worm, gape worm and roundworm a dose of 0.025mg/g (25mg/kg) bodyweight has been found adequate. For gizzard worm a dose of 0.05mg/g (50mg/kg) is necessary.

Good husbandry practices: Zone control is important in the management of these worm parasites. To prevent re-infestation, practise good hygiene and sanitation, and eliminate dampness. Ideally the birds should be moved into a clean cage 48 hours after initial treatment, and the old cage thoroughly scrubbed and disinfected. To prevent infection from the outside, prevent bird's access to intermediate hosts, e.g. grasshoppers, cockroaches and earthworms. Wild birds can infect the aviary with their droppings.

16.5 Appendix 5

Details on the product Baycox which can be used to routinely treat/prevent coccidiosis in *P. violaceus*. (Farm Advisor, 2014) This product can be bought online by the litre from: http://www.vetproductsdirect.com.au/baycox-solution-poultry1l?fee=8&fep=125&gclid=CjwKEAjwgZrJBRDS38GH1Kv_vGYSJAD8j4DfR_cT15EWOluS_ej316RxC8la5vxjLxGNV4QijWCu_hoCP3vw_wcB

Details: Baycox is added to the drinking water of chickens for the treatment and control of coccidiosis caused by Eimeria species including: Eimeria tenella, Eimeria necatrix, Eimeria acervulina and Eimeria maxima. Begin treatment with Baycox as soon as coccidiosis confirmed. Restraint: DO NOT treat replacement pullets more than twice.

Baycox is diluted at the rate of 3 litres per 1000 litres of drinking water (3:1000). It is administered on 2 consecutive days with an 8-hour treatment period on both days. Ensure full lighting conditions during treatment. Do not withhold feed during treatment. Add the required amount of Baycox to the amount of water consumed in an 8-hour period and stir thoroughly. Allow for varying water consumption during hot weather.

Treat the birds for 8 hours each day for 2 days (2x8 hour treatments). No other source of drinking water should be available to birds during the 8-hour treatment period. If required, treatment may be repeated after 5 days.

Withholding Periods MEAT: DO NOT USE less than 14 days before slaughter for human consumption EGGS: DO NOT USE in laying hens. DO NOT USE in replacement pullets within 8 weeks of laying onset, where eggs are to be used or processed for human consumption. Eggs laid during the withholding period MUST NOT BE USED or processed for human consumption.

16.6 Appendix 6

Vetafarm Neocare hand rearing formula. This product can be bought online from: https://vetafarm.com/product/neocare/

Ingredients:
Whole grains (corn, wheat & soybean), Vegetable oils and Natural organic acids, Amino acids (lysine and methionine), probiotics and predigestives. Vitamins (A, B1, B2, B3, B5, B6, B9, B12, C, D3, E, H & K), Minerals (calcium, cobalt, copper, iodine, iron, magnesium, manganese, phosphorus, potassium, selenium, sodium, sulphur & zinc).

Guaranteed Analysis:
Min. Crude Protein 21.0%
Min. Crude Fat 15.0%
Max. Fibre 4.0%
Max. Salt 0.5%
Calcium 1.0%

Expiry:
2 years from date of manufacture.

Storage:
Store in a dry area below 30°C

16.7 Appendix 7

Breeding Gentles or Blowfly Maggots for Feeding to Birds.

1. Bran is a popular and clean medium to use for breeding maggots. Ice cream containers can be used to add two cups of bran, mix with enough water so the consistency is crumbly, add a teaspoon of milk powder and lightly mix through.
2. These containers can be stored in an old medium sized fridge custom made into a fly box. Each day the containers are to be lightly stirred, with a new batch made. The cycle takes around four days for maggots to reach appropriate size to feed out.
3. Feed the fly box with a small container of raw sugar and provide water which can be via a bird drinker to avoid flies from drowning.
4. Fly pupae can be purchased online from such companies as https://www.piscesenterprises.com/fly-pupae-care.html.

16.8 Appendix 8

Avisafe is concentrated disinfectant for use on bird equipment. This product can be bought online from: https://www.northernparrots.com/avisafe-concentrated-disinfectant-3-sizes-prod6170a/

Effective against bacteria, viruses, fungi and yeasts, yet is non-corrosive, pleasant smelling and biodegradable. Avisafe Disinfectant can be used on food and water containers, incubators, brooders, perches, hand rearing implements and nest boxes.

Defra approved disinfectants should be on your list of "keep in the cupboard" products. Avisafe is one of the products on that very list. We all know what a disinfectant is supposed to do, but did you know that different types of disinfectants kill different bugs? Did you also know that disinfectants can also be adversely affected by the materials which they are cleaning?

Avisafe is available in both a concentrate and pre-diluted form, when diluted, stays active for an amazing six months. Avisafe kills yeasts, fungi, viruses and bacteria therefore you can be assured that you are providing your birds with the highest level of hygiene. Avisafe is non-corrosive, easy to use but most importantly does not give off any toxic fumes or smells. Avisafe can be used in the presence of birds so long as there are no puddles of disinfectant left. The product is extremely cost effective and the dilution rates for the concentrate version is as follows:

1-part Avisafe to 100 parts water for cages, food and water containers, incubators, brooders and perches. 1:100 - 5 mls Avisafe (1 teaspoon) to 500 mls (1 pint) water.
1-part Avisafe to 50 parts water for hand-rearing implements, nest boxes and heavily soiled areas. 1:50 - 10 mls Avisafe (2 teaspoons) to 500 mls (1 pint) water. 50mls of Avisafe to 500mls of water.

Effective against Avian Flu when used at a strength of 1-part Avisafe to 10 parts water.
Effective against Coronavirus at a 1:50 dilution rate (i.e. 20mls of Avisafe to 1 litre of water).

16.9 Appendix 9

Vetafarm spark is a liquid concentrate for birds. This product can be bought online from: https://www.vetsupply.com.au/dietary-and-nutrition/vetafarm-spark-liquid-concentrate-for-birds/p2090.aspx

Vetafarm Spark Liquid Concentrate is a fine blend of body salts and readily absorbed energy in a liquid form. The liquid energy and electrolyte supplement is ideal for use in times of stress, high temperatures, illness or transport. The water-soluble supplement provides sustained energy and keeps birds healthy during extreme situations.

Vetafarm Spark Liquid is recommended for use in aviary birds, drinking water in times of extreme temperature or as a first aid supplement for sick, stressed or injured birds. Also aids the birds during transportation. The Spark Liquid is an added benefit for a bird keeper's first aid kit, along with Poly Aid Plus and Avian Crittacare.

Dosage: Drinking water dose is 5 mL per 250 mL.
Crop Needle dose is 5 mL in 50mLs of water and then give 1 mL per 100 grams body weight.