

# **Management and breeding of Birds of Paradise (family *Paradisaeidae*) at the Al Wabra Wildlife Preservation.**

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## **Introduction to Birds of Paradise in the Wild**

### **Taxonomy**

The family *Paradisaeidae* is in the order *Passeriformes*. In the past decade since the publication of Frith and Beehler (1998), the taxonomy of the family *Paradisaeidae* has been re-evaluated considerably. Frith and Beehler (1998) listed 42 species in 17 genera. However, the monotypic genus *Macgregoria* (MacGregor's Bird of Paradise) has been re-classified in the family *Meliphagidae* (Honeyeaters). Similarly, 3 species in 2 genera (*Cnemophilus* and *Loboparadisea*) – formerly described as the “Wide-gaped Birds of Paradise” – have been re-classified as members of the family *Melanocharitidae* (Berrypeckers and Longbills) (Cracraft and Feinstein 2000). Additionally the two genera of Sicklebills (*Epimachus* and *Drepanornis*) are now considered to be combined as the one genus *Epimachus*. These changes reduce the total number of genera in the family *Paradisaeidae* to 13.

However, despite the elimination of the 4 species mentioned above, 3 species have been newly described – Berlepsch's Parotia (*P. berlepschi*), Eastern or Helen's Parotia (*P. helenae*) and the Eastern or Growling Riflebird (*P. intercedens*).

The Berlepsch's Parotia was once considered to be a subspecies of the Carola's Parotia. It was previously known only from four female specimens, discovered in 1985. It was rediscovered during a Conservation International expedition in 2005 and was photographed for the first time. The Eastern Parotia, also known as Helena's Parotia, is sometimes considered to be a subspecies of Lawes's Parotia, but differs in the male's frontal crest and the female's dorsal plumage colours. The Eastern or Growling Riflebird is sometimes considered to be a subspecies of the Magnificent Riflebird, but differs in plumage as well as the male's distinctive growling song.

The recent changes in the taxonomy of the family *Paradisaeidae* now result in 41 species in 13 genera. These 41 species are listed in Table 1.

### **Distribution, Habitat and Conservation Status**

The family *Paradisaeidae* is mostly distributed throughout the island of New Guinea and its surrounding islands, including the Aru Islands, Misool and Salawati Islands and Yapen Island. (The island of New Guinea itself is split into two halves – the western half is Irian Jaya, governed by Indonesia; the eastern half is the independent state of Papua New Guinea.) Additionally there are two species native to islands in the Moluccas and there are four species whose range includes (either partially or entirely) north-eastern Australia.

In general, Birds of Paradise are residents of humid, tropical rainforest, either lowland or montane. Fortunately, New Guinea is currently one of the few locations where such tropical forest still occurs in relative abundance. Consequently many of the species are not under serious threat of extinction, even those with relatively limited distributions. The threat status of the 41 species, according to BirdLife International (2008), is also listed in Table 1.

Table 1: List of species in the family Paradisaeidae, including their status of threat and broad distribution.

Genus	Species	Common Name	Status	Distribution
<i>Lycocorax</i>	<i>L. pyrrhopterus</i>	Paradise Crow	LC	Moluccas
<i>Manucodia</i>	<i>M. atra</i>	Glossy-mantled Manucode	LC	NG
	<i>M. jobiensis</i>	Jobi Manucode	LC	NG
	<i>M. chalybata</i>	Crinkle-collared Manucode	LC	NG
	<i>M. comrii</i>	Curl-crested Manucode	LC	Kiriwina & D'Entrecasteaux Islands (NG)
	<i>M. keraudrenii</i>	Trumpet Manucode	LC	NG & NE Australia
<i>Paradigalla</i>	<i>P. carunculata</i>	Long-tailed Paradigalla	NT	NG
	<i>P. brevicauda</i>	Short-tailed Paradigalla	LC	NG
<i>Astrapia</i>	<i>A. nigra</i>	Arfak Astrapia	LC	NG
	<i>A. splendidissima</i>	Splendid Astrapia	LC	NG
	<i>A. mayeri</i>	Ribbon-tailed Astrapia	NT	NG
	<i>A. stephaniae</i>	Stephanie's Astrapia	LC	NG
	<i>A. rothschildi</i>	Huon Astrapia	LC	NG
<i>Parotia</i>	<i>P. sefilata</i>	Western Parotia	LC	NG
	<i>P. carolae</i>	Carola's Parotia	LC	NG
	<i>P. berlepschi</i>	Berlepsch's Parotia	DD	NG
	<i>P. lawesii</i>	Lawes's Parotia	LC	NG
	<i>P. helenae</i>	Eastern / Helen's Parotia	LC	NG
	<i>P. wahnesi</i>	Wahnes's Parotia	VU	NG
<i>Pteridophora</i>	<i>P. alberti</i>	King of Saxony BOP	LC	NG
<i>Lophorina</i>	<i>L. superba</i>	Superb BOP	LC	NG
<i>Ptiloris</i>	<i>P. magnificus</i>	Magnificent Riflebird	LC	NG & Cape York Pen (Aus)
	<i>P. intercedens</i>	Eastern / Growling Riflebird	LC	NG
	<i>P. paradiseus</i>	Paradise Riflebird	LC	NSW & Queensland (Aus)
	<i>P. victoriae</i>	Victoria's Riflebird	LC	NE Queensland (Aus)
<i>Epimachus</i> (including <i>Drepanornis</i> )	<i>E. fastuosus</i>	Black Sicklebill	VU	NG
	<i>E. meyeri</i>	Brown Sicklebill	LC	NG
	<i>E. albertisi</i>	Black-bill / Buff-tail Sicklebill	LC	NG
	<i>E. bruijnii</i>	Pale-billed Sicklebill	NT	NG
<i>Cicinnurus</i>	<i>C. regius</i>	King BOP	LC	NG
	<i>C. magnificus</i>	Magnificent BOP	LC	NG
	<i>C. respublica</i>	Wilson's BOP	NT	Waigeo & Batanta Islands (NG)
<i>Semioptera</i>	<i>S. wallacii</i>	Wallace's Standardwing	LC	Moluccas
<i>Seleucidis</i>	<i>S. melanoleuca</i>	Twelve-wire BOP	LC	NG
<i>Paradisaea</i>	<i>P. apoda</i>	Greater BOP	LC	NG (including Aru Islands).
	<i>P. minor</i>	Lesser BOP	LC	NG
	<i>P. raggiana</i>	Raggiana BOP	LC	NG
	<i>P. decora</i>	Goldie's	NT	D'Entrecasteaux Islands (NG)
	<i>P. rubra</i>	Red BOP	NT	Waigeo & Batanta Islands (NG)
	<i>P. guilielmi</i>	Emperor BOP	NT	NG
	<i>P. rudolphi</i>	Blue / Prince Rudolph's BOP	VU	NG
LC = Least concern NT = Near-threatened VU = Vulnerable DD = Data deficient		NG = New Guinea (including surrounding islands) Aus = Australia NSW = New South Wales		

Table 2: Species previously or arguably considered to be Birds of Paradise, with their re-assigned family.

Genus	Species	Common Name	Actual Family
<i>Melampitta</i>	<i>M. gigantea</i>	Greater Melampitta	Orthonychidae (Logrunners)
	<i>M. lugubris</i>	Lesser Melampitta	
<i>Cnemophilus</i>	<i>C. loriae</i>	Velvet Satinbird (formerly "Loria's BOP")	Melanocharitidae (Berrypeckers and longbills). "Wide-gaped BOPs"
	<i>C. macgregorii</i>	Antenna or Crested Satinbird (formerly "Crested BOP")	
<i>Loboparadisea</i>	<i>L. sericea</i>	Silken Satinbird (formerly "Yellow-breasted BOP")	
<i>Macgregoria</i>	<i>M. pulchra</i>	Macgregor's Giant Honeyeater (formerly "Macgregor's BOP")	Meliphagidae (Honey-eaters)

### Feeding ecology and foraging behaviour

In the wild, Birds of Paradise are known to feed mostly on both fruit and arthropods. Some of the larger species may target vertebrate prey such as small reptiles and may also be considered nest predators of other birds.

When searching for arthropods, Birds of Paradise employ three main techniques:

1. Gleaning bark.
2. Gleaning twigs, vines and foliage.
3. Probing and tearing at dead wood and foliage.

Although Birds of Paradise in general are not gregarious (except in some cases at courtship leks), individuals may join large, mixed species, foraging flocks which move noisily through the canopy. For example, *C. regius* may be observed associating with *P. minor* whilst foraging.

### Reproductive behaviour and ecology

The majority of Birds of Paradise species are polygynous, where males are promiscuous and their only contribution is courtship and copulation; whereas females do all the nest-building, incubation and chick-rearing. The courtship behaviour of Birds of Paradise can be divided into two major groups – leks or courts.

Lekking species have a specific communal location where multiple males congregate to display to females. The females select a mate from the group of males, presumably according to a number of characteristics – plumage quality, dancing display technique, fitness and even the dominant position of a display perch.

Species which hold courts feature an individual male who maintains his own display site, sometimes making lots of effort into ensuring the site allows the best possible display – the male may remove live leaves from the understory or leaf litter from the forest floor in order to create an arena or allow sunlight to permeate. Each male's court is distinct from the neighbouring male and the females travel through the forest evaluating each male individually. In the case of *C. regius*, the average distance between neighbouring males is 70m.

## Management of Birds of Paradise in captivity at Al Wabra Wildlife Preservation

### Al Wabra Wildlife Preservation

The Al Wabra Wildlife Preservation (AWWP) is the private breeding centre of His Excellency Sheikh Saoud Bin Mohd. Bin Ali Al-Thani. AWWP is an associate member of the European Association of Zoos and Aquaria (EAZA); the facility is non-commercial and not open to the public.

The two major foci of the bird collection are Birds of Paradise and threatened parrots – 53 species of bird are currently maintained, including 6 species (7 taxa) of the family Paradisaeidae and 17 species of the order Psittaciformes.

Table 3: Overview of the Bird of Paradise collection at AWWP (16<sup>th</sup> September 2008).

Scientific Name	English name	Number	Successful breeding at AWWP?
<i>Paradisaea apoda apoda</i>	Aru Island Greater BOP	15.9.0	Yes
<i>Paradisaea apoda novaeguineae</i>	Mainland Greater BOP	4.6.1	Yes
<i>Paradisaea apoda</i> hybrid	Hybrid Greater BOP	2.0.0	No
<i>Paradisaea minor</i>	Lesser BOP	2.3.0	Yes
<i>Paradisaea rubra</i>	Red BOP	2.3.0	Yes
<i>Seleucidis melanoleuca</i>	Twelve-wire BOP	7.1.1	Yes
<i>Cicinnurus regius</i>	King BOP	13.10.0	Yes
<i>Cicinnurus magnificus</i>	Magnificent BOP	1.0.0	No
<b>Total taxa</b>		<b>7</b>	
<b>Total birds</b>		<b>80</b>	

### Status of Birds of Paradise in captivity

The family Paradisaeidae is famously difficult to maintain and breed in captivity. Consequently the numbers of Birds of Paradise in captivity and the numbers of facilities holding them are limited. As a result, institutions are collaborating in international breeding programs in order keep the gene pool as diverse as possible.

Since it received its associate membership of the European Association of Zoos and Aquaria (EAZA) in 2007, AWWP is beginning to collaborate with other European zoos (and American ones) in cooperative breeding programs, with great mutual benefit for the gene pool. As a first step, AWWP sent two male *C. regius* on breeding loan to Vogelpark Walsrode, Germany, in January 2008; this resulted in the successful fledging of a chick in October 2008. Additionally, an EAZA European Studbook for *C. regius* was approved and initiated in 2008.

Table 4: Status of Birds of Paradise in European EAZA zoos

Species	EAZA partner institutions	Number of birds in EAZA zoos	Cooperative breeding programs
<i>P. apoda apoda</i>	AWWP	15.9.0	
<i>P. apoda novaeguineae</i>	AWWP	4.6.1	
<i>P. minor</i>	AWWP	2.3.0	
<i>P. rubra</i>	Chester, AWWP	5.2.1	PMP.
<i>S. melanoleuca</i>	Walsrode, AWWP	8.2.1	
<i>C. regius</i>	Walsrode, Wuppertal, AWWP.	19.12.1	ESB. 2.0 AWWP birds on breeding loan at Walsrode.
<i>C. magnificus</i>	AWWP	1.0.0	PMP.

PMP = (North American) Association of Zoos and Aquariums (AZA) international Population Management Plan  
 ESB = European Association of Zoos and Aquaria (EAZA) European Studbook

### Aviary Management at AWWP

The majority of Birds of Paradise at AWWP are maintained in two different sizes of aviary units. Each unit comprises a larger outdoor aviary and a smaller indoor, climate controlled aviary. The dimensions of the aviary units are listed in Table 5. In general, the larger aviaries are assigned to the highest priority breeding birds (e.g. *P. rubra* and *S. melanoleuca*) or the largest taxa (e.g. *P. apoda apoda*).

Table 5: Dimensions of Bird of Paradise breeding aviaries at AWWP.

Aviary type	Outdoor aviary			Indoor / climate controlled aviary		
	Length	Width	Height	Length	Width	Height
Larger	7.2m	3.6m	3.6m	3.0m	2.1m	2.7m
Smaller	5.4m	2.7m	3.6m	2.1m	2.1m	2.7m

Due to the essentially solitary nature and potentially aggressive behaviour of Birds of Paradise, whenever possible each bird is allocated its own individual aviary unit – this is strongly recommended. Similarly, due to nutritional concerns, particularly with regard to Haemosiderosis (iron storage disease), it is strongly recommended that they are kept in single species aviaries, even though they may be compatible with many other cage-mates.

The outdoor aviary has several key features devoted to its major functions:

1. **Many perches at all heights** to provide multiple opportunities to find comfort and seclusion in the aviary. Smaller species such as *C. regius* are very agile and benefit from a wide variety of branches, including the upright trunks of trees and shrubs. Additionally, logs are also happily utilized by Birds of Paradise – they actively forage for arthropods by breaking away bark or rotting wood. However, caution should be taken not to encourage too much foraging for invertebrates due to concerns of them acting as intermediate hosts for endoparasites.
2. **Large numbers of live plants** to mimic the rainforest canopy and provide shelter, seclusion, visual barriers and roosting locations. Live plants enable the bird to undertake natural foraging behaviours, particularly gleaning leaves and bark for arthropods. At AWWP, many species of Bird of Paradise have also been observed eating the fruits of the Mulberry *Morus* sp. additionally, many species incorporate fresh foliage in their nests.
3. **Water sprinklers and shade-cloth on the roof** elevate humidity, reduce the temperature, providing a suitable environment for the birds and ensure the plants survive. Being rainforest species, the birds appreciate frequent sprinkling for bathing and preening.
4. **Pop-hole and sliding hatch door** to allow (and prevent) access between the indoor and outdoor aviaries.
5. **Hatches or tunnel systems** link adjoining cages, thereby facilitating separations and socializations, but allow visual and auditory contact. We have successfully used a tunnel system with multiple access holes to socialise a single male *P. apoda novaeguineae* with up to four separate females within a breeding season.

Similarly, the indoor aviary has several key features devoted to its major functions:

1. **Climate control.** Birds of Paradise are sensitive to the high temperatures experienced during the Qatari summer (up to 50° Celsius). Consequently, our birds spend significant amounts of the summer in their indoor, air-conditioned aviary. For incubation to be successful during summer months, nesting attempts must be made in the cool indoor aviary. Most Birds of Paradise are quite capable of withstanding the cold nights of the Qatari winter, with temperatures below 10° Celsius, without the need for heating. However, *C. regius*, the smallest species and an inhabitant of lowland forests, is provided with heating during the winter months in an attempt to keep the temperatures above a minimum of 10° Celsius. Obviously, heating in aviaries for Birds of Paradise kept in temperate climates is a more serious consideration.
2. **Feeding station.** All the birds are provided with food and water in the indoor aviary. High temperatures quickly spoil food. Birds of Paradise are also messy eaters, which frequently scatter food.
3. **Small numbers of solid perches.** The smaller indoor aviary is most suited to capturing the birds for veterinary treatment, weight monitoring, and routine procedures (e.g. toe-nail

trimming). Therefore there are limited perches in the indoor aviary, to facilitate the capture of birds.

4. **Concrete floor.** Concrete floors facilitate the cleaning of the indoor aviary, particularly around the feeding station. Additionally concrete floors facilitate the collection of fecal samples for analysis of endoparasites.

### **Nutrition and Iron Storage Disease**

Nutrition is arguably the most important consideration in the management of Birds of Paradise in captivity. Failure to adhere to strict diet regimes for Birds of Paradise has notably resulted in disastrous consequences. Birds of Paradise in captivity are particularly susceptible to Haemosiderosis (Iron Storage Disease). It is hypothesized that the soil of tropical rainforests is low in certain nutrients, most relevantly iron; consequently fruits are also low in iron. In order to compensate for these low iron levels, frugivores from tropical rainforest have adapted by developing highly efficient metabolic processes for harnessing iron from their wild diet. If these tropical frugivores, such as Birds of Paradise, are not provided with low iron diets in captivity, then they assimilate excessive levels of iron, which in turn is stored in the liver. Excessive iron storage can impact hepatocytes and impair the function of the liver and sometimes other organs, to the extent where mortality may result.

AWWP has conducted research into the prevalence of Haemosiderosis in dead Birds of Paradise (6 species, plus Flame Bowerbirds *Sericulus aureus ardens*). By analyzing pathology samples, it was possible to assess the level of iron in the liver of dead birds. It appears that birds which died of trauma, only 33% (n = 4 from 12) showed evidence of excessive iron storage. In contrast, birds which suffered longer-term clinical illness such as nephropathy, respiratory, bacterial infection or parasite infestation, 83% (n = 48 from 58) showed evidence excessive iron storage (Hammer et al., 2008). This suggests that excessive iron storage is exacerbated by disease, or alternatively that fatal diseases may be more prevalent in birds compromised by excessive iron storage. However, the precise cause and effect relationship has not been proven.

At AWWP we are careful to limit the iron composition in the diet. Soft fruits such as papaya, pear, apple and mango make up the major component of the diet. It is important to limit fruits which contain high levels of vitamin C (e.g. orange), since this nutrient can exacerbate Haemosiderosis.

At AWWP, we limit the amount of insects we feed to our Birds of Paradise. Although we do provide mealworms or *Zophorba* ("jumbo mealworms") once per week as part of the routine diet, mealworms are mostly restricted for use as rewards / bribes for transferring birds between aviaries, for females rearing chicks and for encouraging birds into breeding condition,. It is worth remembering that caution should be used when gut-loading and sprinkling nutritional supplements on insect food, since these products may contain additional sources of iron – up to 1000ppm.

Low iron softbill pellets (such as Witte Molen Beo pellets or Zeigler Bird of Paradise Pellets) also make a significant contribution in the diet. For a softbill pellet to be considered "Low iron", we consider that the iron content must be below 70 parts per million. Unfortunately it is possible that individual batches produced by feed companies may be variable in their iron content. Therefore it is highly recommended that each batch of pellets is analysed by an independent lab for iron content. Universal / insectivorous mix is generally not suitable for Birds of Paradise, unless it is confirmed to have an iron content of less than 70ppm.

A number of vitamin and mineral supplements are added to the diet on a weekly basis – the use of a variety of products is a non-scientific attempt to cover all potential nutritional deficiencies. To date we have not experienced significant trends of mortalities caused by nutritional deficiencies.

The diets currently used at AWWP for all 7 taxa of Birds of Paradise are shown in Table 6.

At AWWP the birds are fed twice a day - we find it necessary to replace the morning food dish in the early afternoon to avoid issues of fruit spoiling with unwanted bacteria. We have found that

morning food consumption is greater than the afternoon's, so we alter the food provision accordingly.

Table 6: Diet for Birds of Paradise at AWWP

Amount of food per 1 Bird of Paradise	A.M.				P.M.			
	<i>C. regius</i> <i>C. magnificus</i>	<i>P. rubra</i> <i>P. minor</i> <i>S. melanoleuca</i>	<i>P. a.</i> <i>novaeguineae</i>	<i>P. a. apoda</i>	<i>C. regius</i> <i>C. magnificus</i>	<i>P. rubra</i> <i>P. minor</i> <i>S. melanoleuca</i>	<i>P. a.</i> <i>novaeguineae</i>	<i>P. a. apoda</i>
	Papaya	30g	60g	90g	120g	30g	60g	60g
Pear	30g	60g	60g	60g				
Mango		10g						
Apple					10g	30g	30g	30g
Seasonal fruit					10g	30g	30g	30g
Zeigler BOP pellets: – Breeding season	½ t-sp	1 t-sp	1½ t-sp	1½ t-sp				
– Non-breeding	¼ t-sp	½ t-sp	1 t-sp	1 t-sp				
Witte Molen Beo: – Breeding season					½ t-sp	1 t-sp	1½ t-sp	1½ t-sp
– Non-breeding					¼ t-sp	½ t-sp	1 t-sp	1 t-sp
<b>Extra food items – on weekly rotation.</b>								
Grape (Saturday)	5g	10g	10g	15g				
Mango (Sunday & Tuesday)	10g		30g	30g				
Red Bell Pepper (Sunday)	5g	10g	10g	10g				
Banana (Monday)	15g	30g	30g	30g				
Mealworms (Wednesday)	3 MW	5 MW	3 Zophorba	3 Zophorba				
Orange (Thursday)	5g	10g	10g	10g				
Mixed vegetables (Friday)	10g	30g	30g	30g				
<b>Supplements</b>								
Nekton S (Saturday)	Sprinkle							
Nekton Tonic F (Monday)								
Nekton MSA (Wednesday)								



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## Veterinary considerations

As well as the issue of Haemosiderosis, AWWP has noted that the prevalence of endoparasites is a key factor in the management of Birds of Paradise in captivity. Of 70 mortalities (adults and juveniles) between 2001-2006, parasites were responsible for mortality in 17% (n = 12) of cases.

In an attempt to combat the impact of endoparasites, routine fecal screening for endoparasites is carried out once per month on all Birds of Paradise. Less than 20% of birds have never shown a positive result for endoparasites. The main findings are *Raillietina spp*, *Coccidia spp*, *Capillaria spp*, and various other nematodes. (Schulz et al. 2004)

Birds with a positive result are treated with Fenbendazole or Mebendazol, Ivermectin, Clazuril or Praziquantel, according to the susceptibility of the parasite. One major problem in the adjustment of the anti-parasite treatment is the uncertainty whether a positive faecal sample after a period of medication denotes a persistent infestation or a new infestation from the enclosure environment. Unfortunately aviary design conducive to breeding features a sandy soil substrate, which in turn allows the development of parasitic stages in intermediate hosts (earthworms, ants, beetles) which then might be ingested by the birds. (Schulz et al. 2004)

## Reproduction and breeding management

In Qatar, where all the birds have access to both indoor and outdoor aviaries all year, we have found that the start of the breeding season is dependent upon the species and may even vary between individuals of the same species.

All breeding females are provided with a number of artificial nest sites – in most cases these are a square, plastic plant baskets; in the case of *C. regius*, these are nest boxes. During the summer months, artificial nest sites are only placed in the indoor aviary, since excessive outdoor ambient temperatures prohibit successful incubation. However this does not stop some females attempting to make natural nest outdoors.

Nest-building females are closely monitored. At the later stages of the nest-building phase, the females are regularly socialized with the relevant males through hatches or tunnels between aviaries. In some cases, socialisations must be closely observed to ensure that the male does not destroy or interfere with the female's nest. In the case of *C. regius* pairs can be socialized long-term without interference from the male at the nest. Whenever possible we try to emulate the lekking or courting behaviour of the males in the way we undertake breeding socialisations. However, usually this is not possible due to the limitations of aviary building design and genetic management of the population.

Since the male's only contribution to reproduction is copulation (obviously, other than the courtship), once the female has laid her egg(s), socialisations are discontinued. Of the AWWP species, *P. apoda*, *P. minor* and *S. melanoleuca* lay 1 egg per clutch; *P. rubra*, *C. regius* and *C. magnificus* lay 2 eggs per clutch. (No *C. magnificus* eggs have been laid at AWWP.)

Birds of Paradise are particularly susceptible to disturbance on the nest. During nest inspections we do not access the nest by climbing a ladder, since this gives the females an impression that the nest is being depredated. Instead, each nest basket is mounted on a long pole which allows for the nest to be detached from the mesh and lowered for inspection – this fools the female into thinking that the nest site has not been disturbed.

The female alone is responsible for incubation and chick-rearing. During the chick-rearing stage, females are provided with additional animal protein five times per day, in order to fuel chick growth and development. White/soft-skinned mealworms and chopped 1-day-old mice are the main

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source of protein, although chopped 1-day-old rats and 1-week-old mice are given in the later stages of chick development. We take care to remove the milk-filled stomachs and guts of the baby rodents.

Birds of Paradise fledge surprisingly early and in a relatively premature state of development. In the case of *P. rubra*, fledging occurs at around 19 days; in *C. regius*, fledging occurs at around 16 days. The recent fledglings are relatively helpless, with almost total inability to fly. Post-fledging feeding dependency may last several months in the larger species, such as *P. apoda* and *S. melanoleuca*.

## Artificial Propagation

A significant number of Birds of Paradise have been successfully hand-reared at AWWP. It is thought that AWWP achieved the first successful hand-rearing attempts for both *P. apoda* and *C. regius* (Jensen and Hammer 2004). The hand-rearing diet is typical for a large omnivorous passerine, with white/soft-skinned mealworms, 1-day-old mice, soft fruit such as papaya and mango, scrambled egg and soaked softbill pellets being significant components of the hand-rearing diet. In the early stages of chick development, chicks are fed at a frequency of 1 hour, up to 17 times per day; particular attention must be paid to the hydration of the chick. Prior to fledge, chicks are fed every two hours, up to 8 times per day. Feedings became progressively less frequent as the chick learns to feed independently. During the nestling phase it is important to provide a suitable substrate in the nest for the toes to grab on to, in order to prevent splayed legs – at AWWP we use plastic mesh mats cut from pond filtration material.

Due to their intelligence, Birds of Paradise can become easily imprinted on humans. This problem is further compounded by the fact that the different species lay clutches of only one or two eggs, so that youngsters are often raised alone, prohibiting the opportunity for nestlings to develop their own species identify. In many of the larger species (e.g. *P. apoda*), being raised with a nest-mate is totally unnatural and anecdotal evidence suggests that nestlings fail to thrive in the companionship of other chicks, apparently due to stress (Dean Tugade pers. comm.)

Although considerable success has been achieved at AWWP in hand-rearing, it is advised to parent-rear whenever possible, in order to produce well-adjusted breeding birds for the future.

## Conclusion

Birds of Paradise present significant challenges for aviculturists, with diet, housing and behavioral observation being key issues. However, our experiences at AWWP have shown that it is possible to maintain a variety of species in captivity long-term, with successful breeding being achieved.

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