

KINGFISHERS

By Glen Holland & Liz Romer

Introduction: The kingfishers belong to the order Coraciiformes and include three families, the Alcedinidae, the Halcyonidae, and the Cerylidae. More than ninety species are distributed widely throughout the world. For this section I have concentrated on two African kingfisher species, one representing the fish eaters which are associated with, and dependent upon, aquatic habitats, and one representing the woodland kingfishers which feed largely on invertebrates and small vertebrates, and often live away from aquatic habitats. I have chosen two species with which I have had extensive experience to demonstrate the two different management techniques for this group of fascinating birds. The third group, described by Liz Romer of Currumbin Sanctuary, are the kookaburras. All the

MALACHITE KINGFISHER

Introduction: The malachite kingfisher *Alcedo cristata* is widespread in Africa. Few species can match or beat the beauty of these little jewels. They are true fishers and are found in pairs or perched singly on vegetation along riverbanks and lakes. Their call is a soft, high-pitched "tseep" made in flight.

Management: Sexes are alike and surgical sexing is advised to ensure true pairs. These beautiful little kingfishers deserve an aviary to themselves featuring a small flowing stream which can be regularly stocked with fish, allowing visitors the opportunity to watch them fish. When a separate aviary cannot be provided, they are compatible with small seedeaters, sunbirds, and softbills such as white-eyes. Cyprus and other reeds should be planted along the edges of the water. In addition, a few exposed dead branches over the stream will provide ideal hunting perches. Habitat F will suit these tiny kingfishers. Aviaries do not have to be large and a 6 m (20 ft.) x 2 m (6½ ft.) x 2 m (6½ ft.) flight will suffice. Do not use glass on displays housing kingfishers, as these birds are prone to killing themselves by flying into it. Due to territorial aggression, only one pair should be kept per aviary. Although they are able to withstand

overnight temperatures down to freezing, they require daytime temperatures in excess of 12 °C (53.5 °F). In countries where severe climates persist for extended periods, they are best housed indoors with some additional warmth during the winter months.

Diet: Ideally, about 50 minnows should be stocked into the aviary stream once a week. In addition to live fish, they are fed on small dead minnows, which can be stored frozen, strips of fish and heart. A multivitamin is added to the food twice weekly.

Breeding: To encourage breeding, a sandbank should be provided, preferably with a pool of water in front of it. Starting a tunnel will encourage the birds to excavate a nest. Alternatively, a pipe of 5 cm (2 in.) diameter and about 30 cm (12 in.) long can be built into the mound to serve as an access tunnel to the nest chamber. The pair shares incubation for 14 days. Adults indicate clearly when chicks have hatched; instead of turning the fish headfirst into the beak, the fish are carried by the tail section with the head pointing forward.

Fledglings are generally duller than the adults and have a slightly shorter beak, which is black, as are the legs. One breeder reported thirteen chicks raised in captivity from a single pair, which reared four clutches in quick succession. The aviary became crowded and the entrance pipe to the nest was blocked to stop further breeding! As the young birds started to mature they were attacked by the adult male and had to be removed.

Hand Rearing: Hand rearing is much the same as described below for the brown-hooded. When the chicks are still very small they are best fed on small minnows which are broken in half and slightly crushed. Initially, only one food item is taken, but when half grown they begin to take two, and later three food items per feeding. As quills start to appear, ox heart strips are introduced. I lost one chick from a brood because initially I fed them on flying ants, which were too coarse, causing compaction. As soon as the ants were replaced with minnows, the chicks progressed well.

The food is fed with a forceps. Is necessary to hold the food at the fore-end and push it into the throat. This prevents the excited chicks from knocking the food out of the tweezer. Care must be

taken to avoid injury to the chicks from the tip of the tweezer as they lunge forward to swallow the food. As the chicks reach maturity they will not take food unless it is placed well back in the throat, triggering this forward lunge. By the time the chicks are well covered in quills, minnows of about 30 mm (1.18 in.) can be fed whole, alternated with ox heart strips. When minnows were not available, thin strips of fresh fish were substituted.

A moistened rearing food and a multivitamin and calcium supplement are added to the moistened ox heart once per day. The chicks make a rapid "chirr-chirr-chirr" call while being fed. The larger chicks seem to be slightly aggressive and dominant over the smaller ones. It is best to place each chick in an adjacent separate compartment. After fledging, the chicks make a short "chik-chik-chik" call when hungry, and while being fed they flap their wings rapidly. This wing flapping appears to be a form of exercise and often continues beyond feeding. Within five days of fledging, the birds instinctively begin to bash food against the perch. They do not take food well at this stage, but knock it about with the beak open. Small fish or strips of ox heart should be offered with the forceps, then dropped onto a plate containing shallow water, prompting the chicks to fly down to fetch it. Soon live minnows in shallow water will also stimulate the natural feeding behavior. A strong perch should be situated beside and above the source of food.

Ring Size: 2.5 mm

Species requiring similar management are:

Giant kingfisher
Belted kingfisher
Common kingfisher
Pied kingfisher
British kingfisher

The larger species should not be mixed with birds smaller than themselves. As predators they may learn to feed on small birds.

BROWN-HOODED KINGFISHER

Introduction: Brown-hooded kingfishers *Halycon albiventris* is usually found in pairs inhabiting riverine vegetation, but may also be found some distance away from water in open woodland and in gardens. Their call consists of a melodious "choo, choo, choo, choo, choo," often in the form of a duet and accompanied by the birds flitting their wings. The call is repeated rapidly when disturbed. Members of a mated pair also make soft twittering contact calls when not in sight of each other. Males are brighter in color than females.

Management: Their aviary should be landscaped as described for Habitat B in the chapter on landscape, and should include a pool of water into which they can dive. A few dead branches and upright tree stumps will provide ideal hunting perches. As they naturally occur in warm climates, adequate shelter must be provided in countries where temperatures remain below 10°C (50°F) for extended periods, particularly if cold and wet. In temperatures near freezing, an additional source of heat should be provided. Brown-hooded are woodland birds and are not fishers. They will sit motionless on an exposed branch for long periods, interrupted only by the occasional bob of the head as they watch for prey below. The prey is caught in a straight glide from the perch.

They are extremely aggressive when breeding and I have had a bee-eater knocked off my hand and killed instantly by this species. I have, however, kept them with pied kingfishers *Ceryle rudis* with no problems. This was due in part to the different food sources used by the two species, and because the pied were too young to compete for nest sites. Brown-hooded and other woodland kingfishers are best housed with birds of the same or a larger size than themselves, such as *Tockus* hornbills, shrikes, starlings and weavers.

Diet: They should be fed on 40 % ox heart strips and 30 % chicken strips with a multivitamin powder added once per day, and 30 % live food such as mealworms, winged termites, grasshoppers, locusts, praying mantises, millipedes, crickets, and pinkie mice. If a small fish is stuck in very shallow water they will take it. They will also take small dead fish fed by hand, but will not dive into deep water after fish.

Breeding: Unfortunately, these kingfishers become rather aggressive during the breeding season and should be carefully monitored to prevent picking on other birds. A brown-hooded pair will excavate their own nest into a sandbank. For additional information on building sandbanks, read the section on BEE-EATERS. The tunnel is approximately 70–90 cm (2–3 ft.) long, built 1–3 m (3–10 ft.) above the ground, with a nest chamber at the end. Both sexes incubate the 4–6 eggs for fourteen days. Removing a clutch of young will stimulate the pair to produce a second clutch. Hand-raised chicks must never be reintroduced into the parent's aviary, as they will be attacked immediately. Should successful breeding occur, the chicks must be removed when independent.

Hand Rearing: All species of woodland kingfishers can be hand-raised on 50 % ox heart strips dipped in commercial rearing food, with a multivitamin and calcium supplement added once a day. The remainder of the diet should consist of insects, pinkie mice, and rats which have been cut in pieces. Small lizards are a real treat for the chicks and are devoured whole. Initially, chicks should be fed hourly and provided with an artificial source of heat. Newly hatched chicks are kept at 36°C (96.8°F) and this is reduced by 1°C (1.8°F) per day until an ambient temperature of 24–26°C (75.2–78.8°F) is reached. By this time the chicks will be half-feathered, and feeding every two hours will suffice. All food is fed with forceps, and chicks will usually take three food items per feeding.

The chicks are able to swallow quite large pieces of food. While their eyes are still closed, the food is touched on the side of the gape, and will immediately be seized. Chicks become agitated and aggressive when food is presented, but I have not found it necessary to separate them. They are extremely vocal when hungry. The chicks are kept on sawdust. Due to their pungent droppings and regurgitated pellets, this bedding must be changed daily.

Ring Size: 4.5 mm

Species requiring similar management:

Woodland kingfisher

Striped kingfisher

White-breasted kingfisher

Rollers

Bee-eaters

MICRONESIAN KINGFISHER

This section is quoted directly from the extensive: MICRONESIAN KINGFISHER (*Halcyon cinnamomina cinnamomina*) SPECIES SURVIVAL PLAN HUSBANDRY MANUAL 1998. Edited by Beth Bahner, Aliza Baltz and Ed Diebold

The adult female resembles the male except that the upper breast is paler, as are the chin and the throat, with the rest of the underparts and underwing coverts white. The recommended minimum enclosure size for breeding pairs of kingfishers is 10 ft x 8 ft (3 m x 2.4 m) with a height of 10 ft (3 m). Although pairs have bred in enclosures as small as 6 ft x 8 ft x 8 ft (1.8 m x 2.4 m x 2.4 m), problems with pair compatibility may be exacerbated by these small enclosure sizes. Pairs should be provided with the opportunity to put some distance between themselves when not breeding. Birds have escaped from enclosures that use piano wire barriers; therefore, this type of barrier should not be used with this species. There have been several cases in which kingfishers have attacked their images reflected in glass cage fronts. Birds housed in glass-fronted enclosures should be monitored carefully to assure that this does not occur and cause injury to the bird. As a forest bird, the Micronesian kingfisher has a natural shyness and needs adequate cover. Marshall (1989) found that kingfisher nest cavities were found in areas with approximately 80% canopy cover. Kingfishers must be provided with water dishes that are large enough to permit bathing, a minimum dish size of 5 in (12.7 cm) deep and with a diameter of 18 in (45.7 cm) is recommended with a water depth of 2-3 in (5.1-7.6 cm). The water dish should be elevated approximately 1 foot off of the floor for easier access by the birds.

Aggression can be problematic and at the Philadelphia Zoo a Micronesian kingfisher killed a superb fruit dove (*Ptilinopus superbus*) and, over a two-year period, the Pittsburgh Aviary lost one silver-eared mesia (*Leothrix argentauris*), three shama thrush (*Copsychus malabaricus*), one dhyal thrush (*Copsychus s. saularis*), and two fairy bluebirds (*Irena puella*) to kingfisher aggression. Given the current state of the captive population, it would be inappropriate to risk housing this species with any other potentially aggressive species, leaving single-species maintenance the best option for the Micronesian kingfisher. Birds should also be monitored to assure that neighboring species are not causing a disruption as well. Another concern about mixed species exhibits is the difficulty of monitoring and controlling food intake. Given the weight control problems, incidence of hemosiderosis and other nutritional concerns, kingfishers are best housed alone. Because of their propensity for intra-specific aggression, adult Micronesian kingfishers should be held either in breeding pairs or as singletons. Young birds can often be housed together if monitored carefully for aggression. While adults have occasionally been held in same-sex groups without incident, this practice is not recommended. In addition, because several pairs have failed to breed until neighboring pairs or singletons were removed from sight, it is recommended that all breeding pairs be visually isolated from

conspecifics.

Feeding: Food dishes should be shallow and open to allow birds to feed on the wing. It is preferable to place feed dishes above ground level in a central location to facilitate feeding.

Pairs should be provided with more than one food dish in different locations, to minimize the potential for aggression over food. It is also recommended that birds be fed twice daily.

Observations have shown that kingfishers prefer to feed early in the morning and in the evening.

Food cups which attach to the side of the cage (as used for psittacines) should not be used.

Micronesian kingfisher Nutrition Survey 1994, 1996 significant intake results

<u>Items offered</u>	<u>1994</u>		<u>1996</u>	
	<u>Intake rating</u>	<u>Offered by (# inst)</u>	<u>Intake rating</u>	<u>Offered by (# inst)</u>
<u>Mice (pink or fuzzy)</u>	<u>Good (>80% of offered)</u>	<u>13</u>	<u>Good (76.7 – 100 % of offered)</u>	<u>5</u>
<u>Insects (mealworms, crickets, waxworms)</u>	<u>Good (>80% of offered)</u>	<u>13</u>	<u>Good (>80% of offered)</u>	<u>6</u>
<u>Green anoles</u>	<u>Excellent (100%)</u>	<u>2</u>	<u>Excellent (100% of offered)</u>	<u>4</u>
<u>Complete foods (Dog food, Bird of Prey)</u>	<u>Poor (<40% of offered)</u>	<u>5</u>	<u>Poor (<40% of offered)</u>	<u>4</u>

Breeding: The following protocol for introducing birds to each other is recommended in an attempt to decrease the potential for aggression. Prior to placing the birds in the same enclosure, the prospective pair should be placed in adjacent cages for two weeks of acclimation and observation prior to introduction. If the pair appear compatible, to minimize problems that could arise from territorial defense, when possible potential mates should be introduced into a neutral enclosure. All pairs should have nest logs available at the time of introduction. Several successful pairs have begun striking at the nest within 1 hour of introduction. This may be 1) important to initiate the pairing process and 2) a good early indicator of the potential for success. All pairs should be observed for at least 1 hour after introduction

In captivity pairs produce multiple clutches in a year and there have been females that lay eggs almost continuously throughout the year. Because of potential problems with eggshell thinning, more than 4 clutches per year are not recommended. For pairs that do not stop breeding on their

own, removal of nest log(s) may be necessary. Removal should occur in the “non-breeding” season, approximately August through November. Several observers have suggested that the process of excavating a nest cavity plays a substantial role in pair formation or the maintenance of pair bonds. Micronesian kingfishers excavate a nest cavity by “...alternating thrusts of the beak at the chosen site in flights initiated from a nearby perch. Not having the foot structure necessary for perching on the vertical trunk, a bird flaps its wings vigorously (and awkwardly) as it attempts to deliver more than one blow per flight. Usually a bird is restricted to only one or two blows and returns to the perch after each attempt. A call is given upon leaving the perch with each new attempt.” Although the Micronesian kingfisher does not appear to have an elaborate courtship display the male does courtship feed his mate. Courtship feedings occur coincident with successful pair copulations and have not been observed during the early stages of pair formation, incubation or care of the young. The male may offer the female a variety of food items but the female does not always accept what he offers.

Most copulations and attempts occur within 3 weeks of egg laying and mounting frequency peaks during the week preceding oviposition. Mountings have been observed during brooding for the pair observed by Marshall on Guam and have been noted to occur in captivity as well. Clutch size ranges from 1-3 eggs. Incubation begins with the laying of the first egg, and both sexes participate in incubation duties. Eggs should be candled at least 1 week after egg laying. During the first week of incubation, eggs can be quite fragile and easily punctured or broken. Although it is possible to determine egg fertility earlier than 7 days, candling the eggs before this time is not recommended because of the potential risk to the developing chick.

Table 3. Age of egg production.

	<u>minimum</u>	<u>minimum fertile</u>	<u>average</u>	<u>maximum (as of 6/97)</u>
<u>Females</u>	<u>0.67 years</u>	<u>0.75 years</u>	<u>2.12+1.03</u> <u>years</u>	<u>10.83 years</u>
<u>Males</u>	<u>0.83 years</u>	<u>0.92 years</u>	<u>2.33+1.08</u> <u>years</u>	<u>> 13 years*</u>

Clutch size ranges from 1 to 3 eggs; 64% of clutches consist of 2 eggs, 32% are 1 egg clutches and only 4% are 3 egg clutches. Out of 631 eggs produced, 254 (40%) were fertile and 194

(76% of fertile eggs) hatched with 116 (60.56) viable offspring produced. Of the 116 viable offspring (i.e., lived > 30 days) 96 (47.49) lived to reproductive age. In captivity, pairs have not been very successful at fledging offspring from the nest. As of 31 December 1995, 69% of parent-reared chicks have been lost in the nest. Of those chicks that are lost prior to fledging, 75% disappear from the nest and the cause of death is unknown although cannibalism has been suspected, 90% are lost within the first 10 days. Hand-rearing has been more successful with only 19% lost before 30 days of age; 76% of those are lost within the first 10 days. As a result, hand-rearing is recommended. In light of aggression by parent birds, it is recommended that all parent-reared chicks be removed from the enclosure in which they are reared within two weeks of the time they fledge. In the interim period the chick(s) should be monitored closely for signs of parental aggression.

Artificial Incubation and Rearing: The recommended protocol for pulling eggs for hatching and hand-rearing is to remove the eggs approximately 20 days after laying. Eggs left with non-experienced pairs should be candled to determine fertility at least 1 week after laying of the last egg and removed from the nest approximately 2 days prior to hatching, preferably after the chick has penetrated the air sac. The egg(s) should be placed in the hatcher set at a wet bulb temperature of 88-90° F (31.1-32.2° C) and dry bulb of 100° F (37.8° C) with a relative humidity of 64%. After hatching, follow the protocol outlined in Appendix E. High humidity appears to be very important to successful hatching. In cases where the egg is removed prior to penetration of the air sac, set the wet bulb at 86-88° F (30-31.1° C) for a humidity of 58% and adjust after air sac penetration. The egg should be turned approximately 3 times/day in the hatcher until the air sac is penetrated. Care should be taken to avoid removing the egg more than 4 days prior to hatching.

Artificial incubation parameters used at selected institutions.

<u>Institution</u>	<u>Temp. (°F)</u>	<u>% Weight Loss</u>	<u># Egg Turnings/Day</u>
<u>Houston</u>	<u>100/84-86</u>	<u>14-16% loss</u>	<u>12 (auto)</u>

<u>San Diego</u>	<u>99.5/86.0</u>	<u>13% loss</u> <u>(ave.)</u>	<u>5 or 12 (auto)</u>
<u>St. Louis</u>	<u>99.5/85</u>		<u>5 or 12 (hand & auto)</u>
<u>Cincinnati</u>	<u>99.5/86</u>		<u>4 (auto)</u>
<u>Audubon</u>	<u>99.5/87</u>	<u>9-10% loss</u>	<u>4 (hand)</u>

The San Diego Zoo rearing protocol describes changes in diet for each developmental stage and provides a description of a diverse diet recommended for Micronesian kingfisher chicks. The San Diego Zoo uses a Micronesian kingfisher hand puppet for hand-rearing and chicks are isolated from all human contact once eye slits open. Not all institutions take steps to minimize contact with humans

Because the chicks are naked at hatching, they require a brooder/isolette temperature of 96 degrees F (35.5° C). Temperature can gradually be decreased as the chick gets larger and the feathers begin to develop. Chicks are typically housed in a bowl (nest cup) lined with a non-slip substrate, such as toilet paper, paper towel or washcloth. These are quickly soiled and should be replaced regularly. Clutch-mates can be housed in the same brooder/isolette but should not be placed in the same nest cup since aggression has been observed between siblings. As the chicks get older and more mobile, birds that are housed within the same brooder should be monitored to assure that no aggressive interactions occur. When chicks begin perching at approximately 21 days of age, they can be moved to larger quarters. At approximately 30 days of age, chicks will begin to attempt flying but are not yet completely independent and self-feeding. Fledging occurs for parent-reared chicks at 33±2.74 days after hatching (N=18 parent-reared birds).

Begin chicks on chopped pinkies (whole pinkies or eviscerated) and chopped anoles. To minimize problems with dehydration, pinkies are dipped in dextrose or Pedialyte. The typical signs of dehydration are dry, baggy skin and dry fecals. A well-hydrated chick is pink with the skin fitting well on the body. Calcium carbonate and vitamin supplements can also be added to the pinkie diet. Additional diet items are added as the chicks grow, beginning as early as one

week of age at some facilities. Additional food items can include cricket abdomens, chopped whole crickets, mealworms, and waxworms. As the chick grows, diet items can also increase in size and whole insects can be fed. Analysis of pellets cast by young chicks revealed that they do not digest many of the components of soft food.

Chicks should be weighed in the morning before the first feeding. Normal hatch weight is in the range of 4.4 to 7.1 grams. Chicks should be fed 6-8 times per day initially, beginning first thing in the morning and continuing approximately every 1 1/2 to 2 hours throughout the day. After 7-10 days, additional feedings are dropped until the chick reaches independence. The frequency of feedings should be adjusted to assure that the chick follows the expected weight curve. For young chicks, small food items are offered by touching them to the side of the chick's beak. They quickly learn to respond to the touch and gape or lunge for the food item. Blunt-ended toothpicks work well to feed young chicks until tweezers or forceps become practical. Chicks begin to refuse food after reaching a weight of 60 to 70 grams (20-25 days). Force feeding is not necessary as long as the chicks remain on the typical weight curve. Hand feedings can be reduced to 3-4 per day and food items can be left with the chick between feedings. Chicks typically decrease in weight at this time down to as little as 50 to 55 grams. By day 26, the chick can often be encouraged to pick up food on its own by moving it with forceps. Birds are capable of self-feeding at 32-35 days and, generally, they can be weaned by 40-55 days of age.

KOOKABURRA

by Liz Romer

Introduction: In Australia there are two species of kookaburra. The laughing kookaburra *Dacelo*

novaeguineae, the world's largest kingfisher, is native to eastern Australia and has been introduced to Tasmania and southwestern Australia (Forshaw 1992). It is a clever and persistent predator, usually preying, from a strategic perch, upon creatures on the forest floor. The laughing kookaburra is found in a variety of habitats including open eucalyptus forest, open rainforest, parks, suburban gardens, fenced paddocks, and sugar cane fields with telegraph poles, all providing adequate perches for foraging opportunities (Shields 1994). It is particularly able to exploit habitats altered by European development. Anyone conducting an outside barbecue soon discovers that the laughing kookaburra is prepared to add steak, chops and sausages to its diet (Shields 1994). The normal diet includes insects and their larvae, earthworms, snails, snakes, lizards, frogs, freshwater crayfish, small birds, and fish.

Laughing kookaburras are extremely sedentary, residing in delineated territories, which may contain a mated pair or a family group comprising the adult pair with one or more offspring from previous years acting as helpers at the nest. They have been known to live for up to twenty years (Shields 1994). The sexes are similar, but females are slightly larger than males. The laughing kookaburra is well known for its famous laughing song.

Across northern Australia the smaller, more colorful blue-winged kookaburra *D. leachii* replaces the laughing kookaburra. It is more distinctive than its more common relative with brighter colors, more exotic habitat requirements, and a more spectacular song. It generally prefers moister habitats than the laughing kookaburra, being found mostly in gallery forests, mangroves and along inland streams. It is more wary than its close relative, frequently flying away when approached, in contrast to the laughing kookaburra, which in some instances will even seek out human contact (Shields 1994). Female blue-winged kookaburras are similar to males with the exception of the tail. The tail of the male is dark blue, while that of the female is rufous evenly barred with blue-black.

Management: Kookaburras are not commonly kept in aviculture in their native land. Some Australian zoos display and breed kookaburras, with the blue-winged kookaburra probably being the more commonly bred species. Laughing kookaburras often come to zoos as juveniles to be hand-reared and rehabilitated back to the wild, but are seldom kept for display. Outside of

Australia this situation is reversed. The blue-winged kookaburra is relative rare in European and North American zoos and private collections, while the laughing kookaburra is well-established, having been captive bred for many generations. Kookaburras are best kept in pairs in captivity. They have been maintained in aviaries 2 m (6½ ft.) x 4 m (13 ft.) x 2 m (6½ ft.) high, but generally prefer a bit more space. At Currumbin Sanctuary we have bred blue-winged kookaburras in aviaries 4 m (13 ft.) x 6 m (20 ft.) x 3 m (10ft.) and 7 m (23 ft.) x 10 m (33 ft.) x 6 m (20 ft.). In both cases they have been housed with other species, including Australian kestrels *Falco cenchroides*, Pacific bazas *Aviceda subcristata*, and bush stone-curlews *Burhinus grallarius*. Due to their predatory nature, they should not be housed with smaller species. The aviaries are best landscaped with natural perches of various thicknesses. Kookaburras also like to bathe, and a reasonably sized water dish is recommended.

Diet: In captivity they are primarily fed a meat based diet. The Currumbin Sanctuary meat mix for kookaburras is listed below.

Coarse Meat Mix Ingredients:

- 2 kg lean mince/ pieces
- 1 cup of Wombaroo Insectivore mix
- 2 cups wholemeal bread
- 1 cup Dog Chow
- 6 teaspoons Calcium
- 3 teaspoons Vitamin E
- 2 grated carrots

Preparation: Blend the wholemeal loaf and dog chow, and then thoroughly mix in the other ingredients.

This mixture is supplemented with mice and mouse pinkies, chopped day old chicks, mealworms and whitebait.

Breeding: In the wild, laughing kookaburras normally nest in hollow logs or termite nests, while

blue-winged kookaburras nest in hollowed out termite nests or bottle trees. In captivity, we have been successful in breeding blue-winged kookaburras in both hollowed out logs and nest boxes measuring approximately 30 cm (1 ft.) square. The opening is in the front, with a lower lip preventing the eggs from accidentally rolling out. Laughing kookaburras have been consistently bred using natural logs or nest boxes of a similar size. Some breeders provide a nest box that is more rectangular, perhaps 30 cm (1 ft.) x 40 cm (1 ft. 4 in.) x 30 cm (1 ft.) high, such as a wood duck *Aix sponsa* nest box turned on its side. Birdworld Bird Park has successfully used a box with a sloped shape measuring 90 cm (3 ft.) in length and 35 cm (14 in.) in both height and width, with a 15 cm (6 in.) diameter entrance hole, with a perch below, located near the top of the front panel (Sweeney 1995). While we have found the blue-winged kookaburra tolerant of nest inspection, Shepard (1989) reports that laughing kookaburras are intolerant of nest inspection during incubation.

Spring is the usual breeding season for kookaburras. Blue-winged kookaburras commonly lay a clutch of 2–4 eggs, while Sweeney (1995) reports that the most common clutch size for laughing kookaburras in captivity is 2 or 3 eggs. In both species, both parents share the incubation duties. Blue-winged kookaburra eggs weigh approximately 22–23 grams. The incubation period for both species is 24–26 days. Blue-winged kookaburras have fledged at approximately 38 days of age, while Widman and Vorous (1961) reported that laughing kookaburras at the National Zoological Park in Washington, D.C., first left the nest at 30 days of age.

During breeding, fresh food is offered up to three times a day. The primary diet when the chicks are very young is pinkies and coarse meat mix, well combined. As the chicks grow older, larger food items are offered, including cut up day old chicks and gutted and portioned mice. Mealworms are also offered. Young are only removed when required as surplus stock for exchange as no aggression has been seen between the parents and offspring. In 1998, following the successful fledging of a chick, our blue-winged kookaburras nested a second time. This is the first instance of double clutching in one season recorded for this species.

Artificial Incubation and Hand-Rearing: We have artificially incubated wild laughing kookaburra eggs brought to Currumbin Sanctuary. Two chicks hatched in October 1998 and were

successfully reared.. They were incubated at 37.2°C (99° F) with a wet bulb reading of 29°C (84°F). The chicks were kept in a brooder with an initial temperature of 35°C (95°F). The temperature was lowered 0.6°C (1°F) every second day after pin feathers were observed emerging. By the time the feathers were breaking out, the chicks were kept at room temperature. Eyes were fully open at 18 days. Fledging occurred at 35 days.

The chicks were fed eight times per day for the first week, seven for the second week, five for the third week, and then four times per day until they were self-feeding. The diet consisted of small pieces of lean meat, ox heart, day old chicken, and mouse, dipped in Wombaroo Insectivore mix and water mixed to a slurry. At one feeding each day one pinch of Enzyplex enzyme complex was added to the feed. Balanced Cal was also added to the feed once daily..

Nos. 1 & 2, Laughing kookaburra
 Incubator hatched wild eggs, hand raised 1998.
 No.3, Blue-winged kookaburra
 Naturally incubated and raised 1994.

Day	No. 1	No. 2	No. 3
1	21.3 g	20 g	
2	27.1 g		
3			33.42 g
4		47.5 g	
5	61.8 g	56.5 g	
6	69.7 g	77.5 g	
7	88.8 g	89.9 g	
8	105.2 g	107.4 g	
9	121.7 g		
10			103.88 g
11		158.5 g	
12	170.7 g	172.5 g	

13	185.5 g	188.3 g	
14	196.6 g	196.8 g	
15	207.7 g	Eyes ½ open	
16	219.5 g	232.4 g	
17	245.4 g	252.3 g	
18	257.4 g	Eyes fully open	
20		295.3 g First laugh heard	212.37 g
21	292.2 g	302.8 g	
22	305.7 g		
25		315.7 g	
26	327.2 g	321.5 g	
27		310.6 g	259.47 g
28		313.9 g	
29		313.4 g	
32		312 g	
33	317.6 g	306.04 g	
34	303.3 g	292.6 g	267.37 g
35	290.5 g	Fledged	Fledge day 38

Ring Size: 9 mm

Liz Romer - Wildlife Conservation Officer

Currumbin Sanctuary, Gold Coast

Australia

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