

# Breeding biology of Oriental Dwarf Kingfisher *Ceyx erythaca*

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Palkar, S. B., Katdare, V. D., Lovalekar, R. J., Mone, R. V. & Joshi, V. V. 2009. Breeding biology of Oriental Dwarf Kingfisher *Ceyx erythaca*. *Indian Birds* 4 (3): 98–103 (2008).

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Ms received on: 16th September 2007.

## Introduction

The Oriental Dwarf Kingfisher *Ceyx erythaca* is a resident bird that disperses widely with the onset of the south-west monsoon. It is mostly found in Nepal, northern West Bengal, Sikkim, Bhutan, Assam, Nagaland, Manipur, Mizo Hills, Bangladesh and the Western Ghats. Shady jungle, streamlets, moist deciduous and evergreen forests are its most favored haunts (Ali & Ripley 2001). It is one of six species of kingfishers (Alcedinidae) found in and around Chiplun city (17°31'N 73°31'E) in Ratnagiri district (Maharashtra, India). It is a breeding visitor to the area in June–September, thereafter not being present during October–May. Here we present observations on the breeding biology of the Oriental Dwarf Kingfisher.

## Study area

Chiplun town is surrounded by the foothills of the Western Ghats and is 50 km away from Arabian Sea. Here, in 2003, we studied the breeding biology of the Oriental Dwarf Kingfisher, close to the house of one of the authors (SBP), which is located in an urban area, along the Mumbai–Goa highway. This nest was behind a cowshed, and was situated in a 2.4 m vertical land cutting. The nest was at a height of 2 m from the ground and 5 m away from the cowshed.

Between 2005 and 2007 we closely observed another nest of this species, in a small nullah, near the Vindhyawasini temple—a well-known locality of Chiplun. This area has semi-evergreen vegetation and a plantation of mango *Mangifera indica* and teak *Tectona grandis* trees. The Oriental Dwarf Kingfisher has been known to breed here since 1999.

We observed a third nest of this kingfisher at Matewadi, a small area situated between SBP's house and Vindhyawasini temple.

## Methodology

We studied the breeding biology of Oriental Dwarf Kingfisher by using a closed-circuit television (CCTV) camera and a camera stick. We measured the internal and external temperature of the nest with a digital thermometer, which had a 2 m sensor. We also made video recordings with the CCTV camera.

Every day we switched on the camera and the fluorescent tube for a brief period of 10–15 min. Then we switched off the equipment for 45–55 min. This procedure was followed till the evening. The birds were not disturbed when we operated the fluorescent tube and the camera.

**Nest 1:** To observe the action inside the nest located behind SBP's house, we fixed a 12-volt CCTV camera and a 6-volt fluorescent tube on the upper side of the nest chamber (Fig. 1). The camera was fixed inside a 23 cm long waterproof PVC pipe of 10 cm diameter. The fluorescent tube was fixed in a 23 cm long waterproof PVC pipe having a 5 cm diameter. This was done late in the evening when the chamber was about 90% complete. We dug approximately for one meter parallel to the nest to the left and 1.5 meters away from the nest entrance. Then we started digging from the upper side towards the chamber.

When the chamber was visible we fixed the pipes containing camera and the tube, at the upper side of the chamber. Then we filled it up using wet mud and leveled it. A small piece of plastic was spread over the pipes to prevent leakage of water through the pipes. Dry leaves and soil were spread over that plastic. This effectively camouflaged all the damage done while digging. We connected the wires. Now everything inside the chamber was clearly visible on the TV monitor. We completed this work in two hours.

Next day was very important, as we were not sure whether the birds would accept our arrangement. We were relieved to observe the birds enter the nest as usual. They were not disturbed or confused, and it seemed that they didn't notice the changes in the chamber.

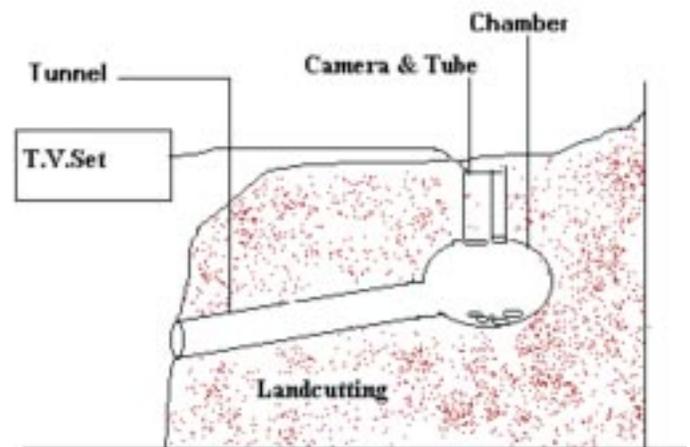


Fig. 1. The nest behind Sachin Palkar's house.

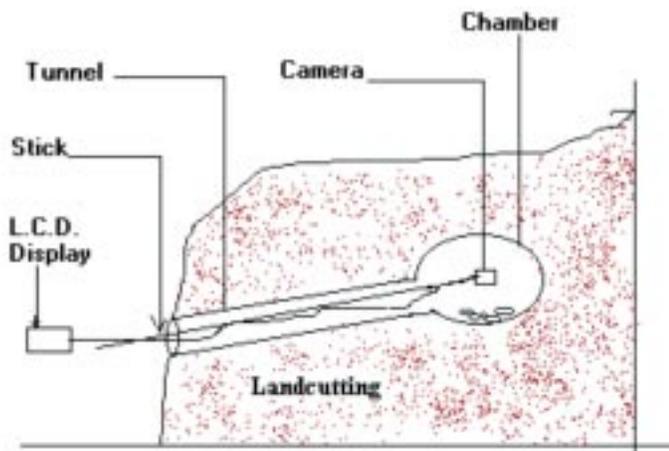


Fig. 2. Nest at Vindhyawasini temple.

**Nest 2:** At the Vindhyawasini temple we used a 2 cm diameter CCTV camera. It was fixed to one end of a metal rod. A 3-volt bulb was fixed to one side of this camera and attached to a battery, through which it operated a 6-volt LCD display.

We inserted the camera stick into the nest, when bird left, and made all necessary connections. Everything inside the nest was clearly visible on the LCD display.

### Temperature

We checked the change in temperature inside the chamber, when the light was turned on. When the incubent departed we inserted the sensor of the thermometer into the chamber so that it was easily visible on the monitor—and read the temperature. After that we turned on the light and the camera for up to 30 min and took a reading again. There was no change in the temperature. During the study, temperatures outside the nest ranged from 23.6°C to 31.1°C while inside it ranged from 27.5°C to 29.1°C.

### Rainfall

In 2003 the rains started on 11th June 2003 and up to 30th September 2003, 3,154 mm had fallen. While in 2005 rainfall commenced on 1st June 2005 and up to 30th September 2005, 4,780 mm had fallen.

### Notes on breeding biology

In the Chiplun area, breeding activities of the Oriental Dwarf Kingfisher start with the onset of the south-west monsoon, i.e., in June and ended in September.

### Nest & nest construction

The nest is a horizontal tunnel up to a meter in length and 4 cm



Niranjan Sant

Oriental Dwarf Kingfisher: Male



Niranjan Sarti

Oriental Dwarf Kingfisher: Female

in diameter, which ends in a wider egg chamber—in a vertical earthen bank, or in a land cutting near a small nullah (Ali & Ripley 2001). The tunnel and egg chamber are inclined upwards. This perhaps prevents entry of water inside the chamber. It also helps the flow of waste material outside the nest. The egg chamber is unlined.

From 2004 to 2007 a pair of kingfishers was observed with the onset of monsoon. Twice they were seen entering the same nest (in site No. 1). They were busy in nest-site selection, but nest excavation process was incomplete and they left the place.

In 2005 we ringed the pair at Vindhya wasini. Next year, in 2006, the same pair used the same nest for their nesting, but the birds removed the eggs after completion of the clutch, perhaps because of the low rainfall. The same pair was again observed in 2007, when they started building a new nest on 30th August, but later abandoned it, presumably because of poor rainfall.

#### **Nest 1—SBP's house:**

From 21st June 2003 a pair was observed calling and chasing each other in this area. Nest excavation started on 26th June 2003.

The process of nest excavation: Both the birds sat on a dead *Artocarpus heterophyllus* tree in front of their chosen nest site, under a horizontal root of a teak *Tectona grandis*. One of the birds flew like a projectile at the land cutting and hit the

nest spot with its bill. It immediately flew back towards the perch, which was 2.5 m away from the bank. The other bird repeated the same process. Both excavated alternatively. They made a 4.5 cm hole and prepared a tunnel entrance. Then sitting on the edge of the nest entrance, and pecking with the tips of their beaks they excavated a 4 cm wide (diameter) and 15 cm long tunnel. Excavation activity slowed down in the evening.

When we fixed the camera on 29th June 2003, about 90% of the egg-chamber had been completed. Then both the birds finished the wall of the chamber. No more changes inside the chamber were observed after the camera had been fixed.

During this period courtship feeding was observed. Once the male was seen presenting a centipede to the female. The nest was completed in ten days, on 5th July 2003.

#### **Nest 2—Vindhya wasini**

In 2005 rains commenced on 10th June. During 14th–26th June 2005 the pair changed the sites of nest excavation six times, due to unsuitability of the selected sites. They finally selected a new site on 26th June 2005. As usual, both the birds started excavating a nest. Its location was under a horizontal root of a mango *Mangifera indica* tree in a 1 m earth bank, and the nest was completed on 4th July 2005. Egg laying commenced on 4th July 2005, and incubation started after the last egg was laid. From 25th to 27th July there was a heavy downpour (856 mm).

**Table 1. Dimensions of nests (in cm)**

Location	Dia. of entrance	Tunnel	Chamber
SBP's house	5	61	10
Vindhya wasini	5	56	11.5
Matewadi	7.5	64	20.5

**Table 2. Morphometric details**

	Male	Female
Weight	14.83gm	18.03gm
Beak	31mm	32mm
Tarsus	8mm	9mm
Tail	24mm	27mm
Wing	53mm	57mm

There was no incubation during this period (due to heavy rain?). On the morning of 27th July 2005 the birds removed all the eggs. This might be the first record of a pair removing all infertile eggs from their nest.

### Nest 3—Matewadi

In 2005 we observed an unusual nesting situation of this species in Matewadi. A pair used an existing nest-hole of a White-breasted Kingfisher *Halcyon smyrnensis*, which had been excavated in 2004. It was at a height of 1.5 m from the ground in an 11.5 m vertical land cutting.

A pair of Oriental Dwarf Kingfishers was seen from 26th June 2005 trying to excavate a nest in the same land cutting but soon abandoned it because of hardness of the earth. On 30th June 2005 we saw the male Oriental Dwarf Kingfisher entering the White-breasted Kingfisher's unused nest. Subsequently we observed five eggs inside this nest by using camera stick.

All five eggs hatched on the morning of 17th July 2005. There was heavy rainfall (700 mm) during 26th–28th July 2005, which caused a landslide and all the five chicks perished. The adults were seen in the vicinity for the next two days after which they disappeared.

This might be the first record of an Oriental Dwarf Kingfisher using another kingfisher's nest for nesting.

### First brood

A clutch of glossy white eggs varies between 4–5 and sometimes 6–7. Ali & Ripley (2001), quoting Baker, give the average size of 30 eggs as 18.9 × 15.6 mm.

We observed that one egg was laid per day in the morning—immediately after which the hen left the nest. Incubation started only after the last egg was laid. Only the hen incubated at night while the cock shared incubation duties during the day.

Incubation period is considered to be the period from the laying of the last egg of a clutch to the hatching of the last nestling (Skutch 1945).

**Nest 1:** Incubation period lasted for 17 days. During incubation, both birds would cover all eggs with their belly feathers. Not an egg remained outside. Sometimes they hammered on the walls of the nest chamber with their beaks during incubation. Houseflies, centipedes, millipedes, spiders, mosquitoes, red- and black-coloured ants, snails and other invertebrates were regularly observed in the nest during the incubation period. The walls of the nest were wet.

The birds regurgitated undigested food in the form of a pellet during incubation—which they later removed. While changing incubation duties, the relieving bird would arrive and sit on a regular perch near the nest, and utter a shrill call. Before leaving, the incubating bird stands over the clutch, flutters its wings for a second and then leaves the nest, flying out quickly and silently.

When the relieving bird enters the tunnel it utters an unfamiliar note, 'tronk-tronk', which has not been described earlier. Before settling down for incubation, it touches every egg with the tip of its bill and then begins incubation. After about 20–30 minutes the bird changes its position, and rotates the eggs.

On 12th July 2003 female started incubation at 1850 hrs and left the nest on 13th July 2003 at 0610 hrs.

On 20th July 2003 we recorded incubation details over a period of 12 hours during the day (Table 4).

Once, the male incubated continuously for a period of 184 min. The eggs were left unattended for a maximum period of 17 min.

### Hatching

**Nest 1:** On 27th July 2003 the first egg hatched at 0606 hrs, the last at 1052 hrs. The attending bird removed the eggshells. Chicks were naked and pink and called continuous—'chick-chick'. On entering the nest chamber, an adult touched each nestling with the tip of its bill, after which it gathered all the chicks under its abdomen and commenced brooding.

### Feeding

**Nest 1:** Feeding commenced at 0729 hrs, even before the entire clutch of eggs had hatched. Both the birds fed the chicks. When both parents brought food simultaneously only one of them entered the nest while the other waited outside. Also they uttered a particular call to each other. Feeding activity was carried on throughout the day. While feeding a chick, the food—lizard, fish, gecko, etc—was presented head first into its gape. Frequently the items being fed were half alive. At this time too they gave the 'tronk-tronk' calls. Food was at times much larger than their body length. Sometimes the tail of a food item

**Table 3. Nesting record**

Nest	Y	P	B	Laying dates					Hatching dates					F
				1	2	3	4	5	1	2	3	4	5	
1	2003	S	1st	6/7	7/7	8/7	9/7	10/7	27/7	27/7	27/7	27/7	27/7	16/8
	2003	S	2nd	4/9	5/9	6/9	7/9	—	25/9	25/9	25/9	25/9	—	D
2	2005	V	1st	5/7	6/7	7/7	8/7	9/7	I	I	I	I	I	—
	2005	V	2nd	2/8	3/8	4/8	5/8	6/8	24/8	24/8	24/8	24/8	24/8	12/9

**Abbreviations:** B=Brood; D=Dead chick; F=Fledging dates; I=Infertile egg; P=Place; S=SBP's house; V=Vindhya wasini temple; Y=Year.

**Table 4. Incubation details over 12 hrs**

	Minutes	% share
Female	232	32.22%
Male	437	60.70%
Unattended	051	07.08%
Total	720	—

protruded outside its bill—one chick took 17 min to swallow a full-grown common skink *Mabuya carinata*.

We observed the birds feeding chicks 19 times on the first day. The male fed them 13 times and the female six times. Fish was the commonest item that day, being brought 14 times; frogs were brought four times and a snail once.

From the fourth day onwards parents brought geckos, frogs, mantids and water striders to the nest; from the sixth—lizards.

Once the female brought a frog in its beak. The male was busy brooding. She extended it towards the chicks but they didn't accept it. This went on for five minutes. Then she offered it to the male. During this time they uttered the 'trunk-trunk' call. Finally she dropped the frog in front of the chicks and went out. The male followed her immediately. After about 20 min, the male brought a snail and fed it to the chicks and started brooding. Then after 25 min the male picked up the frog and went outside the nest.

The adults did not remove undigested food material but on three instances we observed that food that had been dropped while being brought to the chicks, was removed by the incubating bird.

Due to the high humidity inside the chamber, its floor becomes dirty with droppings, undigested food and waste material, and after a while a number of white maggots were visible. Mosquitoes, millipedes and centipedes were also observed moving freely in the nest chamber. One day we observed two mosquitoes biting chicks.

After 6–7 days parents fed the chicks from the entrance of the chamber, as they couldn't enter it. The chicks jostled each other to get the food they brought, which included geckos, crabs, spiders, field crickets, dragonflies, lizards, grasshoppers (mantis), snails, mole crickets, frogs, common skinks, etc.

For about six to seven days, most of the parents' time was spent in brooding the chicks and after that, in standing guard. Thereafter only chicks were observed in the chamber. The female guarded and brooded the chicks up to the night of 2nd August 2003.

On 15th August 2003 we observed only four chicks inside the nest. One lay dead outside.

### Fledging

All the chicks fledged out in the morning. Fledging period is considered, as defined by Skutch (1945), to be the period from the hatching of the last egg of a clutch to the fledging of the last chick.

**Nest 1:** All the four chicks fledged out one by one after 20 days, on 16th August 2003 from 0800–0830 hrs. Feeding was observed throughout the day in this area. The nest chamber was full of maggots.

### Second brood

Both pairs raised a second brood, each commencing 19 and 23 days after the fledging / failure of the first brood.

**Nest 1:** Though the chicks fledged on 16th August 2003, we continued our daily observations, despite the heavy rain. Roots had begun to grow inside the nest chamber. Houseflies, mosquitoes and black coloured beetles were regularly observed in the chamber. From 18th August 2003 onwards, fewer white maggots were not observed but base of the chamber was muddy. Small bones remained in the chamber.

From 27th August 2003 a pair of Oriental Dwarf kingfishers was seen chasing each other in the vicinity and then entering this nest.

Both the birds entered the nest and made some alterations. They widened the egg chamber as well as dug up the floor of the chamber and removed all the roots growing inside the chamber.

**Nest 2:** Birds were regularly observed in the area, as well as entering in the nest.

### Egg laying

**Nest 1:** Egg laying started on 4th September 2003. Four eggs were laid, one per day, between 0630 and 0729 hrs. Incubation, as in the first brood, started from the last egg. In this brood, houseflies, beetles, millipedes, centipedes, etc., were fewer than in the first brood.

**Nest 2:** Egg laying commenced on 2nd August 2005. Five eggs were laid between 0632 and 0711 hrs. The clutch was completed on 6th August 2005.

**Table 5. Nestling development in Nest 1**

Age in days	Remarks
0–2	All the chicks were naked, pink in colour, with black colour eyeball prominent and eyes closed. The newly hatched chicks were able to raise their necks but were unable to stand and called continuously 'cheek-cheek'.
2–4	Primaries and secondaries appeared on the third day. Chicks had rough body surface appearance. At the base of the upper beak near nostril, black colour developed.
4–8	Black colour primaries and secondaries.
8–12	On 9th day eyes of the chicks opened. On 11th day chick had colour feathers and feathers on the back, rump and tail.
12–16	On 14th day chicks had blue colour on the back and rump feathers. Colour of the bill tip was orange-yellow. Colour of the chicks looked much brighter. Also had white colour patch and beside that deep blue colour feathered patch developed on each side of the head. They fluttered their wings. From 15th day primaries and secondaries developed fan shaped (webs) and blackish in colour. Tail feathers developed pinkish colour.
16–20	From 16th day chicks had fully colour feathers. They push each other to get food from the parents. They were getting ready for fledging.

Table 6. Total rainfall (mm) in the study period

Brood		2003	2005
First	Construction	701	920
	Incubation	959	1520
	Brooding	649	—
	Total rainfall	2309	2440
Second	Up to the 1st egg	261	475
	Incubation	175	726
	Brooding	18	408
	Total rainfall	454	1609

### Hatching

**Nest 1:** All the eggs hatched on the morning of 25th September 2003 and eggshell removal started at 0543 hrs by the attending bird. From this day the male was not observed in this area.

On 24th September 2003 one adult kingfisher was observed dead on the road. It was 18–20 m away from the nesting site. The bird had succumbed after being hit by a fast-moving vehicle.

**Nest 2:** All the eggs hatched on the morning of 24th August 2005—the eggshells being removed immediately by the attending bird. Incubation period lasted for 18 days.

### Feeding

**Nest 1:** First feeding was observed at 1009 hrs. Up to 4th October 2003 the female guarded the chicks at night. As the female had to feed the entire brood alone, gradually the feeding frequency decreased. All chicks looked hungry and eventually died due to starvation. On 12th October 2003, one chick died inside the nest chamber. The female did not remove it and soon maggots were observed in the dead chick. Next day another chick was found dead at 0645 hrs. Then one by one the remaining chicks died. The female was last observed in the area at 1930 hrs after which she was not seen.

### Fledging

**Nest 2:** All five chicks fledged successfully on 12th September 2005 in between 0700 to 0730 hrs. Fledging period was 18 days.

### Sexual dimorphism

Ali & Ripley (2001) note that the sexes of this species are alike while Rasmussen & Anderton (2005) say that the 'female typically has rufous crown, lacking strong lilac sheen; mantle mostly black with dark glossy blue spotting (less blue than on male).'

Over the last five years we observed that the sexes differed in colouration, at all nesting sites. To determine their sex, we watched the pairs during the egg laying process and subsequently by ringing them.

We found that the female was duller and the male was brighter in colour—a fact that is visible in the photographs. Both male and female have white coloured and deep bright blue coloured patch on the nape. Male has deep bright blue coloured lesser and median coverts. Female has brownish coloured lesser and median coverts. Male has lilac coloured forehead and crown. Female has faint rufous-coloured forehead and crown.

The female was also larger than the male.

On 13th September 2005 we mist-netted and measured the pair at Nest 2.

### Conclusions

Difficulties that the species faces during breeding in the study area include:

1. Birds excavated the nest in loose land cutting—the earth caved in easily during the onset of heavy rainfall.
2. Nesting near a busy road may result in birds being hit by speeding vehicles.
3. Unhealthy chicks cannot fly easily. Sometimes they fall into the water and die.
4. As chicks grew and their hunger increased, they moved towards the entrance in anticipation of returning parents and in their enthusiasm to get at the food, sometimes fell out of the nest and perished.
5. Starvation is one of the main causes affecting breeding success.
6. The amount of rainfall is an important factor on which successful breeding depends.

Incubation period of the Oriental Dwarf Kingfisher is presented for the first time in this paper. Both the birds share all nesting duties. The female is larger in size and has duller coloured plumage than a male. Eggs are laid at an interval of 24 hours, in the morning. Normal clutch size is five eggs. Incubation begins after the last egg is laid. Female takes a larger part in incubation being the one to incubate at night. Incubation period is 17–18 days and fledging period is 18–20 days. In two of the three observed nests two broods were raised but only one was successful. Out of the total 24 eggs that were laid, five were infertile, nine chicks fledged and the remaining ten died—four out of starvation, one by falling out of the nest, and five due to collapse of the nest chamber. Nest re-use is recorded for the first time.

### Acknowledgments

We thank Niranjan Sant (Belgaum) for the photographs and P. B. Sagonkar for his valuable support in the preparation of this report.

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