Breeding biology of the Common Kingfisher *Alcedo atthis* from Chiplun, Maharashtra, India

Sachin B. Palkar & Pranav Gokhale

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Sachin B. Palkar, House No. 100, Sathyabhama Sadan, Near D. B. J. College Gymkhana, Mumbai–Goa HW, Chiplun, Ratnagiri 415605, Maharashtra, India. E-mail: sachinbpalkar82@gmail.com
Pranav Gokhale, School of Biological Sciences, Georgia Institute of Technology, Atlanta, Georgia, USA 30332. Email: pranavgokhale1@gmail.com [Corresponding author]
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Introduction

Common Kingfisher *Alcedo atthis* is a small green-blue coloured bird with rufous underparts and a long bill (Ali & Ripley 2001). The sexes are similar in plumage, except for the male, which has a mostly black bill, while the female has an orange-red lower mandible with a black tip. It is often observed around water bodies and feeds mainly on fishes than on arthropods (Woodall 2020). It is one of the most widely distributed kingfishers, with a range spanning from western Europe and northern Africa to Papua New Guinea in Southeast Asia. There are seven recognised subspecies distributed across three continents, three of which occur in India. In India, the distributions of the three subspecies are as follows: *A. a. atthis* occurs in northwestern India, *A. a. bengalensis* is distributed from central to eastern India, and *A. a. taprobana* is found south of the River Godavari in Peninsular India (Woodall 2020). Kingfishers are burrow nesters, and a nest hole is made either in natural or artificial banks or in trees. Thus, their breeding biology is often difficult or challenging to observe and hence poorly studied globally.

The breeding biology of Common Kingfisher has been studied in some parts of its breeding range, which is summarised by Woodall (2020). Each subspecies may experience distinct environmental and climatic conditions; therefore, fine-scale information on the life-history traits of each subspecies is essential. Life-history traits such as the number of broods per season, clutch size, incubation period, fledging period, and breeding success are highly variable and therefore difficult to generalise for such widely distributed species. For example, breeding success is reported to be 80% in Britain, 54% in Switzerland, and 58% in Germany (Woodall 2020).

We studied the breeding biology of *A. a. taprobana* from Chiplun, Maharashtra, where it occurs sympatrically with the Blue-eared Kingfisher *A. meninting* (Palkar 2016) and Oriental Dwarf Kingfisher *Ceyx erithaca* (Palkar et al. 2009a). It is a resident species in the region and is often found near the lower reaches of rivers, ponds, swamps and canals during the non-breeding season and is scattered during the breeding season. We follow the same method to observe the inside of nests by using a close circuit camera attached to a stick, which we previously used to study other kingfisher species (Palkar et al. 2009a; Palkar et al. 2009b; Palkar & Joshi 2009; Palkar 2016). We monitored 22 nests between 2004 and 2021 and collected systematic data about the breeding biology of *A. a. taprobana*. We also provide a detailed account of chick development from the hatching to fledging stages, supplemented with photographs, which are being documented for the first time.

Study site

We conducted this study in Datar Behere Joshi (D. B. J) college campus and around the villages Dhamandevi, Dhamanvane and Valope, Chiplun Taluka (17.52°N, 73.52°E; 20 m asl), Ratnagiri district, Maharashtra, India. The study area is characterised by undulating foothills of the Western Ghats interspersed with streams and rivers that flow into the Arabian Sea. It is located on the banks of the River Vashishthi, one of the largest rivers in the Konkan region of Maharashtra. The river and surrounding areas have abundant water throughout the year because of its proximity to the Koyna electric power generation plant. The main rainy season, which lasts from June to September, is during the period of active south-west monsoon. All nests were in the semi-evergreen forests in close proximity to human settlements.

Methodology

We surveyed the study area opportunistically to find as many nests during the breeding season, which starts with the onset of the south-west monsoon. The nest search included surveying known nesting sites as well as opportunistic visits to nearby villages. We visited as many vertical land cuttings with nest holes as we could along roads and streams and around playgrounds, construction sites, and houses. However, it was difficult to observe the inside of the nests since the eggs were laid in a chamber at the end of a narrow burrow with a small entrance hole. Therefore, to make our observations possible and easier, a small close-circuit television camera was attached to one end of a stick that was inserted into the nest burrow until it reached the chamber. The diameter of the camera was 2.5 cm, and the camera was easily inserted into the burrow without touching the nest. The camera was operated on a 12-volt battery and connected to a battery-operated MP4 display. Two LEDs were added to the sides of a camera to illuminate the inside of the nest chamber; these LEDs were operated on a 3-volt battery. The camera was placed inside a nest when the birds were either not present inside and not in sight around the nest-site. The camera was inserted into the chamber, after which the entire circuit was turned on, including the LEDs (Fig. 1). We documented our observations and videographed the chicks at various phases of development. Although 70% of the nests were studied prior to the publication of the *Indian BIRDS* nesting biology guidelines (Barve et al. (2020b), we closely reviewed the protocol and found our methods to largely conform to the recommended practices for studying hole-nesting birds. In fact, the nesting biology best practices paper (Barve et al. 2020a) refers to our prior studies on other kingfishers that followed similar methods.

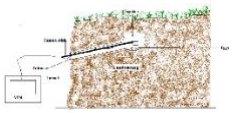


Figure 1. Diagrammatic representation of the nest of the Common Kingfisher

The nests were observed opportunistically twice a day—early in the morning (0600–1000 h) and late in the evening (1600–1800 h). We chose these time frames for making observations, as the nesting activity was apparently high during early mornings and late evenings. We observed nests until the clutch was completed (i.e., the last egg laid) and then monitored nests once all the eggs hatched (i.e., the 18th day after clutch completion). We measured nest characteristics by using a standard measuring tape after the completion of the breeding season. We measured the length of the tunnel, the width of the chamber, and the diameter of the entry hole by attaching the tape to the camera stick and inserting it into the nest. We switched on the camera to guide the tape through the tunnel up to the entrance of the chamber and measured the length of the tunnel. We measured the width of the chamber by pushing the apparatus further up to the rear wall of the chamber. The diameter of the entrance hole was measured from the outside. We used 7x50 binoculars to observe the birds when not monitoring the insides of the nests.

The incubation period is the time from laying the last egg in a clutch to hatching of the last chick, and the fledging period is the time from hatching of the last chick to the last hatchling leaving the nest (Skutch 1945). We calculated hatching, fledging, and overall breeding success by using the following formulae:

Hatching success (%) = (Total no. of eggs hatched / Total no. of eggs laid) * 100.
Fledging success (%) = (Total no. of chicks fledged / Total no. chicks hatched) * 100.
Overall breeding success (%) = (Total no. of chicks fledged/ Total no. eggs laid) * 100.

Results

The breeding season of the species starts in early June, when the south-west monsoon begins to show signs of revival. After raising one or two broods, the nesting season often ends with the commencement of the dry season in late October. From 2004 to 2023, we examined 40 clutches from 26 nests (Appendices 1 & 2), including 14 nests with both first and second broods and 12 nests with either first or second broods for cases that could not be confirmed. Chicks fledged from 32 of the 40 clutches, with the remaining eight failing due to egg infertility, predation, and premature mortality, for e.g., mortality caused by chicks falling out of the nests.

Nest and nest construction

The nests consisted of a horizontal tunnel excavated in a vertical land-cutting area that led to an enlarged egg chamber. The nest-chamber is situated slightly higher, creating a downward slope inside the tunnel; this might help prevent water from flowing into the chamber and allow easy passage for the excreta and other waste as the chicks grow. Before nest construction, both sexes wandered around inspecting locations for suitable nesting sites, which was often accompanied by establishing territories and chasing out intruders. If the nest of the previous season was in good condition, the birds cleaned the nest or modified it by digging deeper and then reusing it. Once the suitable site was located, both birds participated in the nest-digging process. They usually chose a nearby perch from where they executed the digging activities. They would alternatively fly from one perch and strike the spot with their bills to dig the hole. This process was repeated until the excavation of the nest entrance was completed. The diameter of the entrance ranged from 4.8 to 6.5 cm [(mean = 5.45), (Fig. 2)]. After the initial part of the tunnel (5–6 cm) was ready, both birds alternatively perched on the edge of the entrance and started digging inside the tunnel to extend it. The length of the tunnel varied from 20–55 cm [(mean = 31.86 cm), (Fig. 2)]. After excavating the tunnel, they extended it further into a widened, deeper chamber with a width ranging from 11.8 to 13 cm [(mean = 12.79), (Fig. 2)]. When the birds would come across an obstacle or an obstruction during the nest digging process, such as stones, roots, or hardened soil that was difficult to penetrate, they discontinued the digging process, and the pair eventually abandoned the site. They chose a new location and restarted the process until the chamber was completed. There was no lining inside the egg-laying chamber that we could observe (Appendix 2).

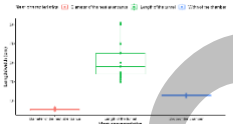


Figure 2. Nest characteristics

We found an uncommon nest in 2004 at Muradpur, near Chiplun. We stumbled upon a large *Ficus* sp. tree that had fallen owing to strong rain and storms [height = 25 m, Girth at Breast Height (GBH) = 4 m]. A large amount of soil was stuck to the bottom of the tree between the roots, where the species had built its nest. This large lump of earth resembled a 3 m area of land-cutting, and the birds appeared to have used it to build a nest within. In 2004 and 2005, the birds successfully raised two broods at this site. However, we were unable to observe nesting activity because the nest was at a height of 2 m above the ground.

Courtship-feeding and mating

Courtship-feeding rituals began soon after the territory was established. This ritual became more prevalent after the nest-digging process was completed. Females became relatively idle at this time and were frequently observed perched near the vicinity of the nest site. Females seldom hunt on their own and prefer to wait for a male to provide food, for example, a fish. A male would approach a female with a fish and offer it to her. Females would only accept certain fish, while others were rejected. If a female accepted the fish, the male would try to mate with her after some time had passed. Both birds

vocalise and call to each other, and the male flies to the female, hovering and circling around her before mating. During mating, the male mounts the female and pecks her head and crown feathers. Mating usually lasted between 5–10 sec.

Eggs and egg-laying

Forty clutches from 26 nests resulted in 263 eggs (Fig. 3). The clutch normally consisted of 6 to 7 eggs; the colour of the eggs was white and glossy in appearance [1]. The eggs were always laid in the morning, and multiple mating events were observed on the day before egg-laying. The process was repeated for the next 5 to 6 days. Shortly after egg-laying, the female was observed leaving the nest. A paired t-test showed that the number of eggs in the first brood was significantly greater than that in the second brood (Table 1; $t_{13} = 2.1213$, $p = 0.05$), with a mean number of eggs in the first brood as 6.85 (n = 14), and in the second brood as 6.42 (n = 14).

Table 1: Hatching, fledging and overall breeding success of the nests.

Total number of nests	Total number of clutches (both broods)	Mean number of eggs	Hatching success (%)	Fledging success (%)	Overall breeding success (%)	
26	40	6.58	94	84	79	
Nests with both broods						
Brood	Number of nests	Number of clutches	Mean number of eggs	Mean hatching success (%)	Mean fledging success (%)	Mean overall breeding success (%)
1	14	14	6.85	91	92	91
2	14	14	6.42	90	71	69
			$T_{13} = 2.12$	$T_{13} = 0.09$	$T_{13} = 1.38$	$T_{13} = 1.50$
			p = 0.05*	p = 0.92	p = 0.18	p = 0.15

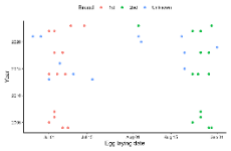


Figure 3: Egg laying dates

[1] Eggs (Clutch ID 30). Photo: CCTV Camera

Incubation

After the last egg was laid, the incubation process commenced. The birds incubated only for a short time during the day until the last egg in a clutch was laid, and they did not incubate at night. After the last egg was laid in a clutch, regular incubation commenced, and night incubation was also observed, albeit solely by the female. Both birds, however, would incubate the eggs during the day. The incubation period varied between 18–20 days. While one bird would sit on the eggs and incubated, the other stayed near the nest, perhaps to guard the nest. When interchanging incubating duties, one bird would appear near the nest, perch on its regular perch, and call out to the incubating bird; the incubating bird would then leave the nest, handing over incubation duties to the other bird. Undigested food material was found within the nest during the incubation period in the form of pellets and droppings, as well as mosquitoes, houseflies, millipedes, and snails.

Hatching

The process of hatching occurred at irregular intervals (Fig. 4). Out of a total of 263 eggs, 246 chicks successfully hatched (Hatching success = 94%), and the remaining 16 eggs did not hatch (11 infertile; 6 predated). Once the eggs hatched, the eggshells were removed from the attending bird. For the first 5–6 days, we saw only females guarding the chicks at night. The parents did not appear to be removing undigested food material or other waste in the form of pellets or droppings, which would make the interior of the nests to appear dirty. A large number of maggots were found in the chamber due to the relatively high humidity inside the nests and the accumulated waste material **[2]**. The excess waste material naturally flowed to the exterior of the nests since the chamber was situated at a high angle.

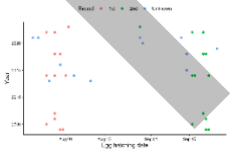


Figure 4: Egg hatching dates

[2] White-coloured maggots on the 14th day after hatching (Clutch ID 30). Photo: CCTV Camera

Feeding

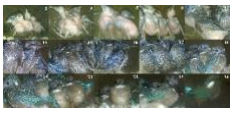
Both birds assisted in the feeding of the chicks. Feeding began as soon as the first egg hatched. Only fish, as prey items, were offered to the chicks, which were half-alive when they were brought by their parents. When both parents bring food at the same time, only one bird will enter the nest at a time, while the other will wait outside.

Nestling development

Nestling development is detailed in Table 2 and illustrated with photographs **[3]**.

Table 2: Nestling development during the fledging period

Age in days	Remarks
0–2	Chicks were naked, smooth and fleshy-pink in colour with a small pale-coloured beak. Eyes were closed, dark in colour and bulging outwards.
2–4	Primary and secondary feathers started to appear, dark blue in colour.
4–8	Bill became darker. Primary and secondary feathers in brush-like appearance. Throat became darker with appearance of tiny blue feathers.
8–12	Eyes opened, more elongated bill with distinct tail becomes visible. Primary and secondary feathers grew substantially, body covered with long hair-like feathers. Forehead and crown covered with feathers.
12–16	Eyes completely opened, like adults. Distinct white patch on throat became visible. Body covered with thick layer of hair-like feathers. Bluish and orange feathers visible on the ventral side. Bill entirely black in colour.
16–20	Body covered with smooth layer of feathers, bluish dorsally and orange ventrally with orange-ear patch began to appear. Light blue upper tail coverts.
20–24	Bluish-green dorsal and bright orange ventral feathers. Completely grown primary and secondary feathers. Birds resemble more like adults.



[3] Nestling plumage development (day 1 to day 24; day 1 is considered the hatching day, clutch ID 30)

Fledging

Out of the 246 chicks that hatched, 209 successfully fledged (Fledging success = 85%), and 37 chicks died (either predated or found dead outside nests) (Fig. 5). Chicks always fledged in the morning, and the fledging period was found to last 19–23 days.

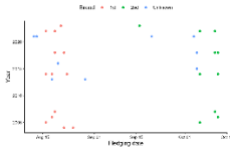


Figure 5. Fledging dates

Post-fledging

The chicks stayed in close proximity to the nests and continued to beg for food from the parents for approximately one week after fledging.

Second brood

After the first brood had fledged, the second brood began 5–8 days later. Fourteen of the 26 nests had a second brood. Birds often clean their nests and, if necessary, dig more to repair or modify the nest. The overall time taken for the second brood, from egg laying, incubation, brooding, and feeding, was similar to that of the first brood.

Predation

We monitored one opportunistic nest by deploying a CCTV camera in front of the nest in the D. B. J. College campus. We did not find this nest at the beginning of the breeding season and could not study any data related to egg laying or hatching. However, we videographed and documented a predation event by an Indian Rat Snake *Ptyas mucosa*. On 22 September 2018, at 1100 h, the snake entered the nest and preyed on the chicks **[4]**.

[4] An Indian Rat Snake entering a nest. Photo: Sachin B. Palkar

Breeding success

Of the 263 eggs from 26 nests, 246 successfully hatched into chicks (hatching success = 94%), while the remaining 16 did not hatch (11 infertile; 6 predated) (Table 1). However, 209 of the 246 chicks fledged (fledging success = 84%), and 37 chicks died (either they were predated or found dead outside nests). The overall breeding success is 79%. For the nests with two broods (n = 14), a paired t-test showed that the mean hatching success did not change significantly between the first and second broods ($t_{13} = 0.09$, $p = 0.92$). However, the mean fledging success ($t_{13} = 1.38$, $p = 0.18$) and the mean overall breeding success ($t_{13} = 1.50$, $p = 0.15$) decreased (but statistically not significant) in the second brood.

Discussion

We studied the breeding biology of the Common Kingfisher *A. a. taprobana* by monitoring 40 clutches from 26 nests in Chiplun, Maharashtra, India, from 2004 to 2023. Our findings suggest that the breeding season commences in June with the onset of the southwest monsoon and concludes with the dry season in October, especially in the case of raising two broods (Fig. 6). However, this finding contradicts the previously recorded breeding season of February to September, or chiefly March to April (Ali & Ripley 2001; Woodall 2020). We report no single nesting observation prior to June at our study site. It is also noteworthy that the breeding season at our study site extends into October, which is also well past the previously recorded breeding season of the species.

The nest dimensions also varied across the different nests we studied. Tunnel length varied greatly between 20–55 cm, with a mean of 31.86 cm. Our measurements fall well within the previously recorded tunnel length range of 25–100 cm (Ali & Ripley 2001); however, these findings contradict the measurements (50–90 cm) provided by Woodall (2020). The width of the chamber and diameter at the entrance are similar to those of previously recorded measurements (Ali & Ripley 2001; Woodall 2020).

Our study revealed a larger clutch size of 6–7 eggs than the previously recorded clutch size of 5 for *A. a. taprobana* (Ali & Ripley 2001); however, Woodall (2020) reported a clutch size of 6–7 eggs for this species in general. An incubation period of 19–21 days was reported by Ali & Ripley (2001) for the European subspecies *A. a. ispida*; however, we also found a similar incubation period of 18–20 days for the subspecies *A. a. taprobana*. The fledging period was not reported by Ali & Ripley (2001). Woodall (2020) reported the fledging period to be 23–27 days; however, this contradicts the fledging period reported in our study (19–23 days).

The hatching success of all nests at our study site was greater than the fledging success (Table 1). Interestingly, for the nests with two broods, the fledging success and the overall breeding success declined in the second brood; however, the hatching success remained the same (Table 1). We conjecture that as the dry season approaches the end of the second brood, there might be less availability of fish in streams, resulting in starvation of some chicks, likely affecting their survival rates.

Our study reports breeding success (79%) for the first time in India and highlights that the breeding success rate is highly variable across the range of the species and time of the year; breeding success is reported to be 80% in Britain, 54% in Switzerland, and 58% in Germany (Woodall 2020).

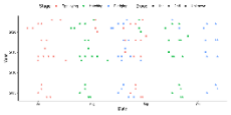


Figure 4. Summary of the breeding times

Conclusion

We investigated the ecology and breeding biology of Common Kingfisher in Chiplun, Maharashtra, India. Our study provided a detailed account of various aspects of the breeding behaviour of the species, such as nest construction, courtship feeding, and chick development, which were supplemented with photographic documentation. We also discussed the incubation period, fledging period, and breeding success of the subspecies *A. a. taprobana*. Similar research conducted elsewhere in India and across the range of Common Kingfisher would be productive to better understand the breeding behaviour of the species.

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Appendix 1: Summary of Common Kingfisher nests from 2004 till 2023.
D1-Dhamanavane; D2-Dhamanavane Bag; D.M.-Dhamndevi Morewadi; D.P.-Dhamandevi Pankarwadi; D.R.-Dhamandevi Rohidaswadi; C.C.-D.B.J.College Campus; V. – Valope; CF-Chicks felled Out

Year	Clutch ID	Location	Brood	Egg laying dates							Egg hatching dates							Fledging date
				1	2	3	4	5	6	7	1	2	3	4	5	6	7	
2004	1	C.C.	1	06-Jul	07-Jul	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	31-Jul	22-Aug
2004	2	C.C.	2	29-Aug	30-Aug	31-Aug	01-Sep	02-Sep	03-Sep	-	21-Sep	21-Sep	21-Sep	21-Sep	22-Sep	22-Sep	-	Dead
2004	3	V.	1	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	31-Jul	01-Aug	01-Aug	02-Aug	02-Aug	02-Aug	02-Aug	25-Aug
2004	4	V.	2	30-Aug	31-Aug	01-Sep	02-Sep	03-Sep	04-Sep	-	22-Sep	22-Sep	22-Sep	23-Sep	23-Sep	23-Sep	-	Dead
2005	5	C.C.	1	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	16-Aug
2005	6	C.C.	2	23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	06-Oct
2006	7	C.C.	1	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul	09-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	18-Aug
2006	8	C.C.	2	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	01-Sep	21-Sep	21-Sep	21-Sep	21-Sep	21-Sep	21-Sep	21-Sep	12-Oct
2007	9	C.C.	1	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul	09-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	19-Aug
2007	10	C.C.	2	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	01-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	11-Oct
2013	11	D2	-	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	-	26-Jul	26-Jul	26-Jul	26-Jul	26-Jul	Infertile	-	18-Aug
2013	12	D1	-	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	-	10-Aug	10-Aug	10-Aug	10-Aug	10-Aug	Infertile	-	29-Aug
2014	13	D2	1	07-Jul	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	01-Aug	01-Aug	01-Aug	01-Aug	01-Aug	01-Aug	01-Aug	23-Aug
2014	14	D2	2	29-Aug	30-Aug	31-Aug	01-Sep	02-Sep	03-Sep	-	22-Sep	22-Sep	22-Sep	22-Sep	22-Sep	22-Sep	-	12-Oct
2014	15	D1	1	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul	09-Jul	10-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	Infertile	18-Aug
2014	15	D1	2	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	-	17-Sep	17-Sep	18-Sep	18-Sep	18-Sep	18-Sep	-	Dead
2014	17	C.C.	1	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	16-Aug
2014	18	C.C.	2	23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	Infertile	06-Oct
2014	19	C.C.	-	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	04-Aug	04-Aug	04-Aug	04-Aug	04-Aug	04-Aug	04-Aug	6 Aug CF
2015	20	D.M.	-	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	25-Aug		14-Sep	14-Sep	14-Sep	14-Sep	14-Sep	14-Sep	-	05-Oct
2016	21	D.P.	-	05-Jul	06-Jul	07-Jul	08-Jul	09-Jul	10-Jul	11-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	Infertile	20-Aug
2018	22	D.R.	1	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul	09-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	19-Aug
2018	23	D.R.	2	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	01-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	Infertile	11-Oct
2018	24	D.P.	1	06-Jul	07-Jul	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	31-Jul	22-Aug
2018	25	D.P.	2	29-Aug	30-Aug	31-Aug	01-Sep	02-Sep	03-Sep	-	21-Sep	21-Sep	21-Sep	21-Sep	22-Sep	22-Sep	-	12-Oct
2018	26	D.M.	-	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	25-Aug	-	14-Sep	14-Sep	14-Sep	14-Sep	14-Sep	14-Sep	-	05-Oct
2019	27	D.M.	-	01-Sep	02-Sep	03-Sep	04-Sep	05-Sep	06-Sep	-	25-Sep	25-Sep	25-Sep	25-Sep	25-Sep	25-Sep	-	1 Oct CF
2020	28	D.P.	-	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug	09-Aug	10-Aug	29-Aug	29-Aug	29-Aug	29-Aug	29-Aug	29-Aug	Infertile	4 Sep CF
2021	29	D.R.	-	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	20-Jul	20-Jul	20-Jul	20-Jul	20-Jul	20-Jul	20-Jul	13-Aug

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2021	30	D.R.	-	19-Aug	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	-	12-Sep	12-Sep	12-Sep	12-Sep	12-Sep	12-Sep	-	04-Oct
2021	31	D.M.	-	03-Aug	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug	09-Aug	28-Aug	28-Aug	28-Aug	28-Aug	28-Aug	28-Aug	28-Aug	20-Sep
2021	32	D.P.	-	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	-	22-Jul	22-Jul	22-Jul	22-Jul	22-Jul	22-Jul	-	12-Aug
2022	33	D.M.	1	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	25-Jul	16-Aug
2022	34	D.M.	2	23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	16-Sep	06-Oct
2022	35	D.R.	1	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul	09-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	19-Aug
2022	36	D.R.	2	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	01-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	20-Sep	11-Oct
2023	37	D.R.	1	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	-	02-Aug	02-Aug	03-Aug	03-Aug	03-Aug	03-Aug	03-Aug	21-Aug
2023	38	D.R.	2	30-Aug	31-Aug	01-Sep	02-Sep	-	-	-	Infertile	Infertile	Infertile	Infertile	-	-	-	-
2023	39	D.D.	1	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	-	Predation	Predation	Predation	Predation	Predation	Predation	-	-
2023	40	D.D.	2	03-Aug	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug	09-Aug	28-Aug	28-Aug	29-Aug	29-Aug	29-Aug	29-Aug	29-Aug	16-Sep

Appendix 2: Nest dimensions of the Common Kingfisher from 2004 to 2023
D1-Dhamanavane; D2-Dhamanavane Bag; D.M.-Dhamndevi Morewadi; D.P.-Dhamandevi Pankarwadi; D.R.-Dhamandevi Rohidaswadi; C.C.-D.B.J.College Campus; V. – Valope; CF-Chicks felled Out

Clutch number(s)	Year	Location	Diameter of the nest entrance (cm)	Length of the tunnel (cm)	Width of the chamber (cm)
1, 2	2004	C.C.	5	51	13
3, 4	2004	V	6.5	50	13
5, 6	2005	C.C.	6	50	13
7, 8	2006	C.C.	6	24	12
9, 10	2007	C.C.	5.5	30	13.5
11	2013	D2	4.8	35	12
12	2013	D1	6.2	50	13
13, 14	2014	D2	5	40	13
15, 16	2014	D1	5	23	12.8
17, 18	2014	C.C.	4.8	22	11.8
19	2014	C.C.	5	25	12
20	2015	D.M.	5.5	21	12.5
21	2016	D.P.	5	35	13
22, 23	2018	D.R.	5.8	28	13
24, 25	2018	D.P.	5.8	25	13.5
26	2018	D.M.	5.5	35	13
27	2019	D.M.	5	30	13
28	2020	D.P.	6	24	12.5
29	2021	D.R.	5.5	30	13
30	2021	D.R.	5	25	13
31	2021	D.M.	5	28	12.8
32	2021	D.P.	6	20	13

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33, 34	2022	D.M.	5	28	12.8
35, 36	2022	D.R.	4.8	25	12.5
37, 38	2023	D.R.	5	25	12.5
39, 40	2023	D.D.	5.5	22	11.8