Supplementary material to the study named

 **“Killing behaviour of adult brood parasites”**

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**A1. Material and methods**

*A1.1. Reed warbler study site in the Czech Republic*

This study site is located in two adjacent fishpond areas between Hodonín (48°51′ N, 17°07′ E) and Mutěnice (48°54′ N, 17°02′ E) in South Moravia, Czech Republic. Here, approximately 80 pairs of the great reed warbler *Acrocephlus arundinaceus* and 300 pairs of the reed warbler *Acrocephlus scirpaceus* nest each year. Both species are parasitized by the common cuckoo *Cuculus canorus* at relatively high rates; average parasitism rate was 69% (421 of 612 nests parasitized, data from 2013–2019) for the great reed warbler (hereafter GRW) and 10% (86 of 844 nests parasitized, data from 2010–2015) for the reed warbler (hereafter RW).

We continuously video-recorded 75 RW nests containing cuckoo chicks during June and July in 2016-2019. The video-recording system comprised either a rear-view camera Carmedien STO-IR (Carmedien, Tschernitz, Germany) with IR illumination or custom HD cameras with inbuilt recorders without IR illumination and miniature digital videorecorder Mini DVR CH-HD0065 (Shenzhen Chu-Tech, China) placed in a water-resistant box. All equipment was powered by 12 V/100 Ah gel batteries with the capacity to record for about 7 days. All equipment was camouflaged. Batteries were placed on the bank far from the nests. Water resistant boxes with recorders were hung on reeds and covered by masked cloths two to five metres from nests. Cameras were placed on thin aluminium poles camouflaged by cut reed stems and leaves fastened together by jute string. The distance between cameras and nest varied from 20 cm to two meters depending on the density of the reed bed. Filmed nests were visited every three days to check the nest content, adjust equipment and download the data (change the memory card). We set up our video-cameras at the nests mostly when the cuckoo was ten days old (but sometimes earlier) and collected them when the cuckoo disappeared from the host nest. The causes of chick disappearance were as follows: chick fledged and left the nest (*N*=46), chick fell out of the nest (*N*=16), chick was depredated, (*N*=10), or it was ejected by the adult cuckoo (*N*=2, see Videos 1 and 2). One cuckoo died in the nest.

To test some specific predictions concerning nest size and cuckoo chick survival, we exchanged approximately half (*N*=33) of the RW nests for GRW nests on the day when the video-camera was installed. These nests were attached to the reed *Phragmites australis* stems at the same place as the original RW nests by jute strings and cuckoo chicks were moved from the original nest to these ones. The other half of nests remained intact. Two recorded infanticides took place at both the natural RW (Video 1) and the exchanged GRW nests (Video 2).

*A1.2. Great reed warbler study site in Poland*

The study site is located in the fishpond area around Ruda Sułowska (51°31′ N, 17°07′ E) in the Milicz region, Poland. In the fishponds selected for the study, approximately 86 pairs of the GRW nest. The species is parasitized by the common cuckoo; average parasitism rates were − 10.7% (*N*=56 nests) in 2015; 6.1% (*N*=49 nests) in 2016; 19.6% (*N*=46 nests) in 2017; 25.6% (*N*=43 nests) in 2018; 10.1% (*N*=89 nests) in 2019. Predation rate of the GRW nests was 12.8% (*N* = 94 nests) in 2019.

We set up trap cameras on 36 GRW nests containing eggs or nestlings from 19 May to 2 August in 2019. The trap cameras (ScoutGuard SG520-W, Bushnell BN-119740, Denver WCT-8010) were placed on a tripod approximately 1–2 m from the nest depending on the surrounding of the nest. The cameras were set to take two or three photos, triggered by motion, and between trigger events they would enter sleep mode for 5 or 10 s. The nests were visited every three or four days to change the batteries and memory cards. Most of the cameras were placed at the nests containing only GRW eggs/nestlings. One camera was set up at the nest containing a cuckoo egg and 3 host eggs. The cameras were collected when the nestlings disappeared from the nest. The fate of video-recorded nests was as follows: nestlings fledged and left the nest (*N*=31), nestlings were predated (N=3) and nestlings in one nest died from the parasitism by blowflies (Calliphoridae). The cuckoo chick was eventually ejected by the adult cuckoo (see Figure 1 in the main text). Other cuckoo chicks from unmonitored nests (N=5) fledged and left the nest.

*A1.3. European robin study site in Poland*

The study site is located in the Białowieża Forest (51°31′ N, 17°07′ E) in the Podlasie region, Poland. The approximate mean densities of the European robin *Erithacus rubecula* (hereafter robin) range from between 8.5–10 pairs/10 ha ((Wesołowski et al. 2006), unpubl. data). Research was carried out from 20 March to the end of June in the years 2016–2019. As part of the surveys, robinnests were searched and then regularly inspected. Common cuckoo parasitism in this species is extremely rare in Białowieża National Park. There was only 1 parasitized nest for all 115 robin nests found.

Camera traps were set up at some nests in 2017 (*N*=21), and in all nests found in 2018 (*N*=43) and 2019 (*N*=51), to identify the predators attacking broods. We set up camera traps at the robins’ nests at the egg or the nestling stages from 11 April 2017, 20 April 2018 and 25 April 2019 to the end of June in each year. Camera traps were installed ca. 2–3 m from the robin’s nest. To set up the cameras we used natural structures of the forest (tree trunks, branches or in case of the ground nest we set it up on the ground). A NatureView 14MP HD, Live View Green model (Bushnell, Overland Park, KS, USA; dimensions 15.0 × 11.5 × 7.0) of camera trap was used. Cameras were programmed for 1 s trigger interval, motion-detection and 30 s videos. Cameras were visited twice during the recording time to replace the battery and memory card. When host nestlings disappeared from the nests, camera traps were collected. The causes of host nestling’s disappearance from the recorded robin nests were as follows: nestlings fledged and left the nest (*N*=48), nestlings were depredated (*N*=66), or it was ejected by the adult cuckoo (*N*=1, see Video 3).

*A1.4. Wood warbler study site in Poland*

The study was conducted in the Białowieża Forest (the coordinates of the Białowieża village 52°42′ N, 23°52′ E) in the Podlasie region, Poland. Here, the numbers of the breeding wood warblers *Phylloscopus sibilatrix* (hereafter WW) fluctuate strongly, with mean bird densities ranging between 0.1 and 6.7 pairs/10 ha in oak-lime-hornbeam *Tilio-Carpinetum* and mixed coniferous *Quercoroboris-Pinetum* stands (Wesołowski et al., 2006, 2015, unpubl. data). This species is hardly ever parasitized by the common cuckoo; only four of 176 WW nests contained a cuckoo egg in 2015–2016 (Maziarz et al., 2019) and one of 119 nests in 2019.

We set up camera traps at 85 WW nests at the egg or the nestling stages, from 9 May to 2 July in 2015–2016. Two of the camera-monitored nests were parasitized by the common cuckoo during the egg-laying and the beginning of the egg incubation. In both cases the nests were deserted by host birds by the following day. We used PC900 HyperFire ProfessionalHigh Output Covert camera traps (dimensions: 14 × 11 × 8 cm; Reconyx, Holmen, WI, USA). The details of the camera installation are given in (Maziarz et al., 2019). Additionally, the fate of one WW nest was monitored in oak-lime-hornbeam stands in 2019. We used a Maginon WK1 camera trap (dimensions: 13.1 × 8.5 × 4.5 cm; supraFoto-Elektronik, Kaiserslautern, Germany). The camera was installed ca. 2 m from a nest with chicks and ca. 1 m above the ground, on medium-sized spruce. It was programmed to capture a continuous series of 30 s videos when triggered. The camera was removed after six days from installation at the WW nest. Altogether we recorded predation events at 37 of all 86 camera-monitored nests and one case when the WW nestlings were ejected out from the host nest by the adult cuckoo.

**A2. Detailed description of the nestling ejections by cuckoos**

*A2.1. Cuckoo chick ejection in the reed warbler*

The first ejection of a cuckoo chick by the adult cuckoo happened at 6:59 on 28 June 2016 (Video 1). The age of the cuckoo chick was exactly 7 days (it hatched on 21 June) and the adult cuckoo was a grey morph of unknown age and sex. The sex of the cuckoo chick was determined as male through genetic analysis.

The second ejection took place at 17:08 on 27 June 2019 (Video 2). The cuckoo chick was moved into the GRW nest at the age of 10 days. At the day of ejection, the cuckoo chick was exactly 13 days old. The adult cuckoo was a second-year (according to the colour difference in its primaries, secondaries and coverts) grey morph female (according to the breast coloration). For details of aging and sexing, please see (Baker, 1993).

In both cases, the whole action (from landing on the host nest to leaving it) took less than 20 s. First, the adult cuckoos immediately ejected the chick out of the nest by grasping it. Afterwards, the cuckoos displayed searching behaviour for about 10 s in the empty nests and then left. The hosts did not directly attack the intruder. Both host females after ejection deserted their empty nests. Unfortunately, we do not know whether these RW females re-nested.

*A2.2. Cuckoo chick ejection in the great reed warbler*

The ejection in Poland happened at 12:43 on 6 July 2019 (Figure 1 in the main text). The adult cuckoo was a rufous female (rufous adult cuckoos are always females; Payne, 1967; Koleček et al., 2019) of unknown age. The age of the cuckoo chick was exactly 6 days (it hatched on 1 July). After ejection the host female abandoned the nest and did not re-nest.

*A2.3. Host nestling ejection in the European robin*

The ejection of the robin nestling by the adult cuckoo happened at 17:03 on 21 May 2018 (Video 3). The adult cuckoo was a rufous female of unknown age and the age of the robin nestling was exactly 8 days (it hatched on 14 May). In this case the cuckoo female visited the robin’s nest 2 min before the ejection event but was attacked by the host male parent so harshly that it left the nest. However, two minutes afterwards probably the same cuckoo female (they look the same on the videos) came back and despite continuous attacking by the host parent, ejected one of 8 nestlings present in the nest. Both cuckoo visits lasted 23 s. After ejection, both host parents continued feeding of alive nestlings. On 25 May 7 fledged chicks left the nest. The female from the same pair after just a few days, on 27 May laid the first egg in newly built nest, c. 60 m away from the first one. This time, both robins’ parents successfully raised all from 6 nestlings and no cuckoo visit was recorded.

*A2.3. Host nestling ejection in the wood warbler*

The adult cuckoo visited the WW nest 30 May 2019 at 12:50 and 18:49 (Video 4), when the seven WW chicks were four days old (hatching date 26 May). During these visits, the cuckoo was heavily attacked by host parents and left the nest without ejecting any nestlings. Probably the same cuckoo individual, in both cases a grey morph of unknown age and sex, arrived on the next day at 18:13, but this time ejected the three WW nestlings within 15 s (Video 4). It is possible that the cuckoo was disturbed during this event because the adult host suddenly appeared on the camera and started to chase the parasite (Video 4). Although the three chicks were removed from the nest by cuckoo, host parents did not abandon the nest and continued feeding young that remained in the nest. Two days later the nest was predated by a pine marten *Martes martes*, but it is unknown if the WW pair repeated the breeding attempt.

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