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Female's nursery wallows as a 'kindergarten' for *Crocodylus porosus* Schneider, 1801 hatchlings in Australia

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Female crocodilians of several species, including *Alligator mississippiensis*, *Crocodylus morletii*, *C. porosus*, and *C. siamensis*, are known to excavate a water-filled wallow near their nests, often by deepening an existing swamp or wet depression (Webb et al., 1977; Magnusson and Taylor, 1982; Webb et al., 1983; Gopi et al., 2007; Rainwater et al., 2024; Platt et al., 2024). These wallows, used primarily for the female to submerge and conceal herself while tending the nest, are variously termed attendance lodgings, refuges, guard wallows, or body pits (Magnusson and Taylor, 1982; Webb et al., 1983; Gopi et al., 2007; Murray et al., 2020; Platt et al., 2024). In *C. porosus*, the number of wallows associated with a nest increases with distance from permanent water (Gopi et al., 2007). Here we document wallowing behaviour by a female *C. porosus* that appears unrelated to nest attendance, specifically the use of a wallow to protect hatchlings from potential predation.

Between 2006 and 2025, we monitored a female *C. porosus* from hatching (ca. 0.3 m total length in 2006) in an ~ 800 m tidal tributary of the Daintree River, Queensland, Australia (16.2630° S, 145.3780° E), approximately 10 km upstream from the river mouth. The site is characterised by brackish water and a low density of non-hatchling crocodiles (1.44 km^{-1}; Taplin et al., 2022). Observations were made from a 7.3 m electric motor vessel (48 V, 5 kW) used for daily ecotourism cruises (≈ 8 h/day, 7 days/week).

On 30 November 2020, the 14yearold female (~ 2.4 m) constructed the first nest on the tidal stretch of the river, approximately 500 m from her natal site, near the upper hightide mark. On 18 and 21 December 2020 and 15 February 2021, she was guarding the nest and excavating a small wallow (~ 2 × 2 m, 0.5 m deep at high tide, dry at low tide) on the sandy and muddy bank approximately 5 m from the mound nest, using both forelimbs and hindlimbs to scoop sand and mud. On 8 March 2021, 24 hatchlings emerged from the nest. The female assisted with hatching and continued to maintain the wallow. On 19–23 and 25 March and 1 and 17 April 2021, the female was in the wallow with hatchlings inside. She frequently positioned her body across its entrance (Fig. 1A, 1B), while the hatchlings were swimming or resting within the wallow both day (Fig. 1C) and night (Fig. 1D). The wallow remained in active use for about five weeks (until 17 April), and hatchlings persisted in nearby crèche areas with the female until mid-May. Some hatchlings remained in the vicinity until 8 August 2021 before dispersing.

The wallow constructed before and after hatching differed from typical guard wallows in three ways: (1) the wallow was excavated as a tributary of the main stream which was already in a close proximity to the nest, while the female could have hidden in the river channel for guarding the nest during incubation; (2) the wallow primarily sheltered hatchlings posthatching; and (3) she maintained it for at least five weeks after hatching.

The likely purpose of this nursery wallow was to protect hatchlings from strong tidal flow, as young hatchlings are poor swimmers, and aquatic predators. Barramundi (*Lates calcarifer*), Queensland Giant Grouper (*Epinephelus lanceolatus*), and Bull Sharks (*Carcharhinus leucas*) are abundant in the river and are known to prey on *C. porosus* hatchlings (Webb and Messel, 1977; Somaweera et al., 2013). Activity of these fish species was frequently observed around the crèche site. Whether the wallow also reduced avian predation (e.g., herons, raptors) is unknown, though fish predation likely posed the greater risk because fish can remove multiple hatchlings simultaneously. In this river, hatchlings are commonly found on branches above the

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water (Fig. 2), which may reflect not only basking for thermoregulation but also reducing exposure to fish predation.

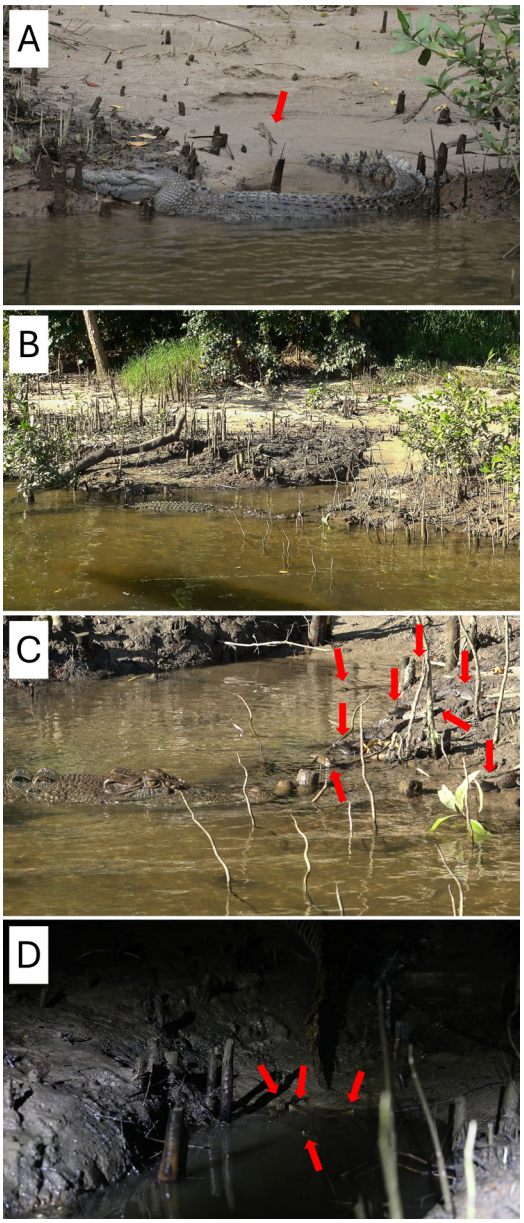

Figure 1. (A) A 2.4-m female *Crocodylus porosus* positioned across the entrance to a wallow adjacent to her nest in a tributary of the Daintree River, Australia, with a hatchling (red arrow), at middle tide; (B) the same position at low tide; (C) hatchlings (red arrows) swimming within the wallow during the day; and (D) nocturnal use of the wallow by the female and hatchlings (red arrows). Photos by David White.

After the first nesting in 2020, the same female did not nest again until November 2024. In this second event, the female built the nest on the opposite riverbank, 2–3 m above the water level, probably to avoid flooding, and attended it from a creek below without excavating a wallow, as the bank consisted of hard clay and was difficult to dig. After hatching, the deep creek provided initial refuge for hatchlings; however, most (17 of 20) disappeared overnight, probably due to fish predation, as large Barramundi and Queensland Gropers were observed feeding there at night (Day 18 posthatching). This rapid loss contrasts with the more gradual attrition observed during the first nesting event, when hatchlings used the wallow as a refuge.

Another *C. porosus* female, approximately 2.4 m in length and of unknown age, excavated a wallow on the sandy and muddy riverbank within 5 m of her previous nest after 28 eggs successfully hatched on 28 February 2009. These hatchlings spent the first five days in the wallow before the female moved the creche about 30 m to a more obscure location beneath mangrove branches. In later years (2010–2013, 2015, 2017–

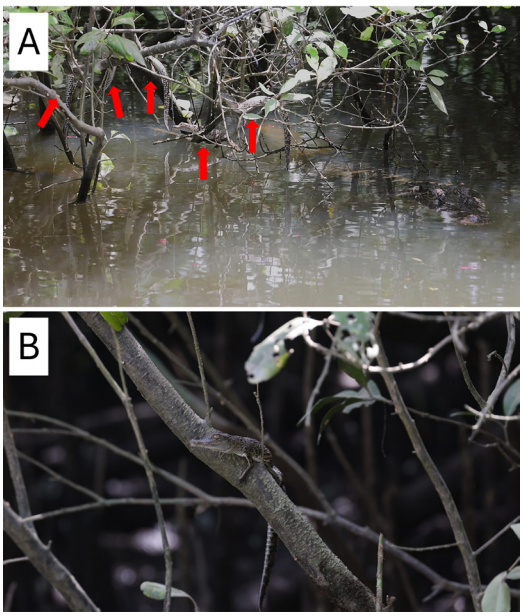

Figure 2. (A) *Crocodylus porosus* hatchlings (indicated by red arrows) on Spotted Mangrove (*Rhizophora stylosa*) branches with a female in the water under the trees in a tidal tributary of the Daintree River, Australia. (B) A close-up shot of a hatchling resting on a branch approximately 0.5 m above the water. Photos by David White.

2021), this individual nested within these mangroves, where hatchlings remained for several weeks among submerged roots and branches that likely provided effective refuge from piscine predators.

Taken together, these observations suggest that *C. porosus* females construct at least two functionally distinct wallow types: (1) nest-attendance wallows used during incubation, and (2) post-hatchling nursery wallows that protect hatchlings from current and aquatic predation. Similarly, other crocodilian species, such as *A. mississippiensis* (Rootes and Chabreck, 1993) and *C. moreltii* (Platt, 2000), are known to construct tunnel-like structures called dens or burrows that serve as refuges for adults and neonates and likely often protect young from predators.

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