A new case of communal egg-laying by iguanas and American crocodiles (*Crocodylus acutus Cuvier*, 1807) from a Caribbean atoll of Mexico

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Communal egg-laying in oviparous animals occurs when two or more conspecific females deposit their eggs in the same nest cavity (Espinoza & Lobo 1996). Although this behavior appears to be more widespread among reptiles than initially thought (Doody *et al.* 2009), interspecific communal egg-laying, which involves different reptile species, has been reported less frequently in the literature (Alfonso *et al.* 2012, Escobedo-Galván *et al.* 2019). Recently, Escobedo-Galván *et al.* (2019) published a review of reptile species that have been observed depositing their eggs in crocodile nests. In addition, Platt *et al.* (2021) provide more information on some reptile species nesting in *Crocodylus moreleti*i and hybrid (*C. moreletii* x *C. acutus*) nests in Belize. These studies revealed that interspecific communal egg-laying has been documented for eight (33.3%) of the 24 crocodilian species recognized by the IUCN crocodile specialist group (http://www.iucncsg.org/pages/Crocodilian-Species.html). Among these eight species, three are from the family Alligatoridae (*Alligator mississippiensis*, *Caiman latirostris*, and *Melanosuchus niger*) and five are from the family Crocodylidae (*Crocodylus acutus*, *C. intermedius*, *C. moreletii*, *C. novaeguineae*, and *C. rhombifer*) (Escobedo-Galván *et al.* 2019). There also exist cases of interspecific communal egg-laying in nests of *C. acutus* x *C. moreletii* hybrids in Belize (Platt *et al.* 2021). Twenty-five reptile species have been recorded to deposit their eggs in these crocodile nests: 15 turtles, six lizards, and four snakes (Escobedo-Galván *et al.* 2019, Platt *et al.* 2021). Here we report a new case of interspecific communal egg-laying between *Crocodylus acutus* and iguanas on Cayo Centro, Banco Chinchorro Atoll, Quintana Roo, Mexico.

Banco Chinchorro Atoll is a Biosphere Reserve located off the southeastern coast of the Mexican state of Quintana Roo, on the Yucatan Peninsula (see description in Charruau 2021). Cayo Centro is by far the largest cay of the atoll (541 ha) and is located in the center of the reef lagoon (Charruau 2021). Since 2006, we have been monitoring (annually) the reproduction of a recovering population of American crocodiles (*Crocodylus acutus*) present on this cay (Charruau *et al.* 2005, 2010, 2013, 2022, Charruau & Hénaut 2012, Charruau 2012). On May 17, 2021, during our annual survey, we found a crocodile nest (18.57°N, -87.33°W) containing 16 iguana eggs beneath 17 *C. acutus* eggs (Fig. 1). The crocodile nest was a mound (140 cm wide x 150 cm long x 36 cm high) and the substrate consisted mainly of sand with some leaf litter and a black nylon rope (Fig. 2). Crocodile eggs (n = 17) had a mean length of 66.1 ± 2.2 mm (range: 63.2–71.7 mm), mean width of 42.3 ± 0.7 mm (range: 41.2–43.7 mm), and mean mass of 71.5 ± 4.5 g (range: 66.3–84.1 g). Iguana eggs (n = 15) had a mean width of 22.2 ± 0.6 mm (range: 21–23 mm), mean length of 32.1 ± 0.5 mm (range: 31–33 mm), and mean mass of 9.0 ± 0.6 g (range: 7.7–9.9 g). Unfortunately, it was not possible to determine the iguana species based on external egg characteristics. Two species of iguanids are present on the island, the green iguana (*Iguana iguana*) and the black iguana (*Ctenosaura similis*) (Charruau *et al.* 2015, 2020). The clutch and egg characteristics we obtained were within the range of measurements reported previously for these two species (Fitch & Henderson 1978, van Marken Lichtenbelt & Albers 1993, Alvarado *et al.* 1995, Muñoz *et al.* 2003, Campos & Desbiez 2013, Avery *et al.* 2014). *Iguana iguana* is already known

Figure 1. American crocodile and iguana clutches found together in the same cavity at Cayo Centro, Banco Chinchorro Atoll, Mexico. Photo by Pierre Charruau.

to nest communally with crocodilians, including *C. acutus* (Dugan *et al.* 1981, Bock & Rand 1989, Platt *et al.* 2010, 2021), and we already observed that this species uses the same nesting areas as *C. acutus* at Banco Chinchorro, sometimes digging up crocodile eggs as observed in Panama (Bock & Rand 1989, Charruau & Hénaut 2012). We have also observed *Ctenosaura similis* on nests of *Crocodylus acutus* in Banco Chinchorro (Charruau & Hénaut 2012). However, out of 204 crocodile nests found to date on Cayo Centro since 2006, this is the first time (0.5%) that we found an iguana clutch in the same cavity as a crocodile clutch. Although *I. iguana* is the most likely species that deposited the eggs along with those of the crocodile, we cannot exclude the possibility that *Ctenosaura similis* is as well. Future research on reproductive ecology of the green and black iguanas at Banco Chinchorro should be conducted to provide elements to differentiate the clutches of these species.

Other species of reptiles, birds, mammals, and arthropods have been observed at crocodile nesting sites at Banco Chinchorro (Charruau & Hénaut 2012, Gagnon *et al.* 2018). However, none of them have been observed nesting in crocodile nests. In addition, black rats (*Rattus rattus*) and feral cats (*Felis catus*) have been eradicated and are no longer present on the atoll (Charruau 2021). It is likely that birds use these sites to sunbathe, forage for nest building material, forage for food, or scavenge crocodile eggs (Charruau & Hénaut 2012, Platt *et al.* 2014, P. Charruau, personal observation). Blue land crabs (*Cardisoma guanhumi)* and Caribbean hermit crabs (*Coenobita clypeatus*) have been observed passing on crocodile nests, and on one occasion we observed a red crab (*Gecarcinus lateralis*) digging up a crocodile egg from a nest as it built its tunnel (Charruau *et al.* 2012, P. Charruau, personal observation). The other reptiles observed at crocodile nests the Cuban blue anones (*Anolis allisoni*), Cuban brown anoles (*Anolis sagrei*), and Maslin's whiptails (*Aspidoscelis maslini*), only appear to pass on the nest without showing other types of interaction (Charruau & Hénaut 2012). Among other animals observed at crocodile nesting sites was one centipede (*Scolopendra viridis*) collected from a crocodile nest's substrate (Gagnon *et al.* 2018).

Multiple hypotheses have been proposed to explain intra- and interspecific communal egg-laying in reptiles (Doody *et al.* 2009, Escobedo-Galván *et al.* 2019). One possible explanation for the occurrence of this life trait between iguanas and crocodiles is that iguana clutches receive protection from the female crocodile that aggres-

Figure 2. The American crocodile mound nest where interspecific communal egg-laying between crocodile and iguana was observed. Photo by Pierre Charruau.

sively guards her nest, improving the survival of the iguana clutch, although this may also cause the death of some female iguanas and the loss of clutches, predated and dug up by crocodiles respectively (Bock & Rand 1989, Dugan *et al.* 1981, Platt *et al.* 2010, 2021, Escobedo-Galván *et al.* 2019). However, there are no predators of crocodile clutches at Cayo Centro, and the protective behavior of female crocodiles seems to be reduced in the reserve compared to other sites with a higher presence of predators (Charruau & Hénaut 2012). Thus, this would not support this hypothesis. In addition, the iguana's clutch was below that of the crocodile, suggesting that the iguana laid its eggs first without knowing if a crocodile would nest in this location.

In our case the reduced nesting areas available on the island for iguanas and crocodiles are probably the main reason for the occurrence of interspecific communal egg-laying. *Crocodylus acutus*, *Iguana iguana*, and *Ctenosaura similis* are known to nest communally or gregariously with conspecifics sometimes (Bock & Rand 1989, Lee 2000, Alonso-Tabet *et al.* 2014), show similar requirements for nest site selection, and nest at the same time of the year at Banco Chinchorro. All of them select elevated and open sandy areas that avoid flooding and allow them to receive a good amount of solar radiation, providing adequate conditions for optimal embryo development (Bock & Rand 1989, Charruau *et al.* 2010, Campos & Desbiez 2013, Lee 2000). These areas are limited in Cayo Centro and this may lead to interspecific competition for these sites as has been observed in Panama (Dugan *et al.* 1981, Bock & Rand 1989, Charruau *et al.* 2022).

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