BULLETIN

OF THE

TEXAS ORNITHOLOGICAL SOCIETY

Vol. 47 No. 1–2 December 2014

Published by the
Texas Ornithological Society
www.texasbirds.org

SCAVENGING OF CROCODILE EGGS BY VULTURES (*CATHARTES AURA* AND *CORAGYPS ATRATUS*) IN QUINTANA ROO, MEXICO

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Black Vultures (*Coragyps atratus*) and Turkey Vultures (*Cathartes aura*) are soaring obligate scavengers (Ruxton and Houston 2004) common throughout Mexico and Central America (Kirk and Mossman 1998, Buckley 1999). In general, Black Vultures prefer larger carrion, while Turkey Vultures appear more specialized for detecting and consuming smaller carcasses; however, both species are opportunistic foragers known to consume a wide range of foods, including carrion from wild and domestic animals (fish, amphibians, reptiles, birds, and mammals), terrestrial and aquatic invertebrates, carrion-dwelling insects (e.g., maggots and beetle larvae), animal dung, household garbage, and on occasion fresh and rotting fruits (Kirk and Mossman 1998, Saul Sánchez and Ortiz 1998, Buckley 1999, Platt and Rainwater 2009).

Despite an extensive literature on the dietary habitats of Black and Turkey Vultures, there are few published observations of either species scavenging or predating the eggs and neonates of crocodilians. Ross (1997) attributed the loss of several captive juvenile Cuban crocodiles (*Crocodylus rhombifer*) to predation by Turkey Vultures, which have also been observed opening the nest of an American crocodile (*Crocodylus acutus*), extracting eggs, and consuming embryos (Rodriguez-Soberón et al. 2002). Somaweera et al. (2013) stated that both Black and Turkey Vultures scavenged American crocodile eggs after raccoons (*Procyon lotor*) had opened nests, but provided no further information. We herein report on Black and Turkey Vultures scavenging eggs, eggshell membranes, and dead neonates from an American crocodile nest. Unlike previous accounts, we include detailed observations of this behavior based on sequential photographs and video taken by an automatic wildlife camera placed at the crocodile nest site.

Our observation occurred in the Punta Sur Ecological Park (PSEP) as part of a larger study on nest attendance and parental care among wild *C. acutus* in Quintana Roo, Mexico (Charruau and Hénaut 2012). PSEP (54° 17' N; 86° 26' W) is a protected area located at the southern end of Cozumel Island encompassing 1,110 ha of coastal dunes, open beaches, shallow hypersaline lagoon systems (>1.5 m deep), and mangrove forests (González-Cortés 2007). PSEP harbors a robust population of *C. acutus* which nests on elevated beach ridges during March-April (Charruau et al. 2011, Charruau and Hénaut 2012). *Crocodylus acutus* is classified as a "hole-nesting" crocodilian, i.e., females deposit clutches of 20-60 eggs in holes (ca. 20-30 cm deep) excavated in a porous substrate, usually deep sand (Thorbjarnarson 1989).

During a survey of PSEP in May 2009, one of us (PC) located a recently constructed *C. acutus* nest containing 27 eggs, 11 of which were infertile. A Moultrie® I-60 Digital Infrared Game Camera was installed about 2 m away from the nest to monitor activity of the attending female crocodile and record predation events. This camera (optical field of view = 52° with an approximate detection range of 12 ± 1.5 m) was programmed to take a single high resolution digital photograph with accompanying video (30 sec duration during daylight; 5 sec after

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dark) at 60 second intervals whenever motion was detected by infrared sensors; the date and time were automatically recorded on each photograph. PC returned to the nest site on 5 July 2009, recovered the camera, and later downloaded the digital images and video.

Our examination of the photographs and video taken at the nest site indicates the clutch hatched on the night of 29-30 June; beginning at 2130 hr the attending female crocodile is seen making repeated visits to the nest, excavating the overlying sand, and transporting what are inferred to be neonates to a nearby mangrove lagoon. A subsequent series of 35 photographs (with accompanying video) taken from 2-5 July at the excavated nest shows Black and Turkey Vultures scavenging unhatched eggs (infertile eggs and those containing dead neonates) and eggshell membranes. Black Vultures (1-4) are present in most photograph-video combinations, two photograph-videos each show a single Turkey Vulture in company with 1-4 Black Vultures, and three photograph-videos reveal a single Turkey Vulture, but no Black Vultures. Because we were unable to distinguish individuals, and additional birds could have been present beyond the optical field of view, the number of vultures at the crocodile nest might well have been greater.

To briefly summarize the images in our series of photograph-videos, at 1642 hr on 2 July a single Turkey Vulture arrives at the nest, followed three minutes later by a single Black Vulture (1645 hr). Within two minutes additional Black Vultures begin to arrive and by 1649 hr, four Black Vultures are present together with the single Turkey Vulture. During this period (1642-1654 hr) the vultures can be seen walking around the nest site, investigating the nest cavity, and removing and consuming unhatched eggs and eggshell membranes (Figure 1). The Black Vultures also appear to be harassing the Turkey Vulture, which moves onto a downed snag and then departs at 1654 hr. From 1656-1725 hr, 1-4 Black Vultures continue searching the nest site and consuming unhatched eggs and eggshell membranes, which can be seen strewn about the nest site. A single spiny-tailed iguana (*Ctenosaura similis*) comes into view at 1718 hr and remains visible through the last photograph-video sequence taken at 1725 hr. Although often in close proximity to scavenging Black Vultures, no interactions between the two species are observed. Neither does the iguana appear to be scavenging at the nest, despite it being a likely predator of crocodile eggs and hatchlings (Charruau and Hénaut 2012). A lone Turkey Vulture returns to the nest site on 3 July (1628-1633 hr) and again on 5 July (1134 hr). During both visits, the Turkey Vulture briefly searched the nest site and then departed, presumably because the supply of eggs was exhausted by the initial group of feeding vultures. PC recovered the camera on 5 July, 73 minutes after the Turkey Vulture departed.

Our photographs and video suggest the crocodile nest was first detected by a Turkey Vulture, most likely by olfactory cues emanating from decomposing eggs, some of which contained dead neonates. Turkey Vultures possess a well-developed sense of smell and controlled experiments have demonstrated their ability to locate carrion solely by olfaction (Owre and Northington 1961, Stager 1964). Similarly, odors lingering at the nest site may have prompted brief visits by a lone Turkey Vulture on 3 and 5 July. We attribute the two-day lag between neonate emergence and arrival of the vultures to the fact that the decomposition of dead neonates had to be well underway before discernible odors were produced (Houston 1986). Turkey Vultures are also known to detect and exhume buried carrion (Smith et al. 2002, Platt and Rainwater, unpubl. data), an ability that no doubt aids in exploiting crocodile nests. Additionally, unearthed eggs and eggshell membranes left by the attending female crocodile may have provided visual cues that abetted vultures in detecting the nest.

The arrival sequence of Turkey and Black Vultures at the crocodile nest is best explained by their respective foraging strategies. Because Black Vultures have a poorly developed sense of smell and largely rely on visual cues when foraging, they generally fly higher than Turkey Vultures and follow them to carrion (Rabenold 1987, Buckley 1999). Although Turkey Vultures typically precede Black Vultures to a food source, the latter usually arrive quickly thereafter and in greater numbers (Rabenold 1987, Kirk and Mossman 1998, Buckley 1999), a sequence consistent with our photographs and video taken at the nest site. Once at a food source, continuous squabbling and frenzied feeding among Black Vultures often causes Turkey Vultures to leave the site (Kirk and Houston 1995, Buckley 1996). For these reasons, Black Vultures are regarded as the chief competitor of Turkey Vultures for carrion (Kirk and Mossman 1998, Buckley 1999).

Figure 1. Black Vulture (left) and Turkey Vulture (right) photographed with an automatic wildlife camera scavenging eggs from an American crocodile nest on Cozumel Island, Quintana Roo, Mexico. The nest is located in the shallow depression to the immediate right of the Black Vulture. Note eggshells and eggshell membranes scattered about the nest site.

Our observations appear to constitute one of the few reports of oophagy among Black and Turkey Vultures. In addition to crocodile eggs (Ross 1997; Rodriguez-Soberón et al. 2002, Somaweera et al. 2013; our study), Black and Turkey Vultures have been observed consuming the eggs of green turtles (*Chelonia mydas*) (Fowler 1979), and Turkey Vultures reportedly feed on eggs at pelagic seabird colonies (Kirk and Mossman 1998). The fact that oophagy has been so infrequently observed among vultures is somewhat surprising because eggs are a rich source of calcium, lipids, proteins, and water (Manolis et al. 1987; Congdon and Gibbons 1990; Noble 1991). Given these potential nutritional rewards, we consider it likely that oophagy has simply escaped notice by previous workers and is actually more widespread than the few published observations would suggest.

In conclusion, our observations of Black and Turkey Vultures scavenging American crocodile eggs at PSEP are noteworthy for several reasons. First, our observations complement previous accounts of vultures scavenging crocodilian eggs and neonates, and provide additional details on this under-reported behavior. Second, our findings are yet another example of how vultures can adjust foraging behaviors to best exploit available carrion resources. Indeed, this adaptability has probably contributed to the continuing northward range expansion of both species of vultures in North America (Rabenold 1989, Kelly et al. 2007). Finally, our study further highlights the utility of automated wildlife cameras for investigating poorly known aspects of vulture biology (see also Rollack et al. 2013).

This project was made possible through the generous support of the Fundación de Parques and Museos de Cozumel. Support for SGP was provided by Wildlife Conservation Society. We thank Deb Levinson and other library staff at

Wildlife Conservation Society for assisting us with obtaining literature. Comments by Lewis Medlock improved an early draft of this manuscript. The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

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