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Crocodilians use tools for hunting

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Using objects as hunting lures is very rare in nature, having been observed in just a handful of species. We report the use of twigs and sticks as bird lures by two crocodilian species. At least one of them uses this method predominantly during the nest-building season of its prey. This is the first known case of a predator not just using objects as lures, but also taking into account the seasonality of prey behavior. It provides a surprising insight into previously unrecognized complexity of archosaurian behavior.

KEY WORDS: crocodile, alligator, *Crocodylus palustris, Alligator mississippiensis,* tool use, lures, egret.

INTRODUCTION

Use of objects as hunting lures is very rare among animals, being known to date only in captive capuchin monkeys, a few bird species and one insect (SHUMAKER et al. 2011). There are a few anecdotal records of saltwater crocodiles (*Crocodylus porosus*) using fish prey leftovers as bait for birds, but in these cases it is unclear if baiting was intentional or accidental (SHUMAKER et al. 2011). Here we report the use of small twigs and sticks as bird lures by two species of crocodilians (crocodiles and alligators).

Non-systematic observations

It is common for some bird species to preferentially nest in trees growing in ponds with large numbers of crocodiles or alligators, apparently using the crocodilians as protection against tree-climbing nest predators such as snakes, monkeys and raccoons. This behavior is well documented in one species of songbird (HUDGENS 1997), but can be more easily observed in wading birds, particularly egrets (POOLEY 1967). The birds have to "pay" for the protection, as chicks accidentally falling in the water are

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usually snatched by waiting crocodilians. But the protection seems to be worth the cost: almost any crocodile farm or alligator park with appropriate trees will sooner or later become the location of an egret rookery.

One such rookery, dominated by little egrets (*Egretta garzetta*), has formed on the grounds of Madras Crocodile Bank, a reptile zoo and herpetology research station located near Chennai (Tamil Nadu, India). In January 2007, while studying the behavior of mugger crocodiles (C. palustris) in large ponds where the rookery trees were standing, V. Dinets repeatedly observed large muggers as they lay in shallow water along the edge of the pond with small sticks or twigs positioned across their snouts (Fig. 1). The crocodiles remained perfectly still for hours, and if they did move to change position, they did it in such a way that the sticks remained balanced on their snouts. On one occasion, an intermediate egret (E. intermedia) approached one of the crocodiles and stretched its neck towards the stick; the crocodile lunged at the bird, but narrowly missed it. In this case, it was unclear if crocodiles intentionally positioned the sticks on their snouts, or just happened to either surface underneath the floating sticks or have them accidentally fall on their snouts from trees. It is also possible that the sticks were used simply for camouflage. The observed predation attempt could be a singular coincidence. No observations of stick-displaying crocodiles catching birds have been reported by employees of Madras Crocodile Bank; the occurrence of stick-displaying behavior is reportedly dependent on stick availability rather than birds' nesting activities.

Of the four very large crocodile/alligator parks in Florida, two have semi-natural alligator ponds with tall trees standing in the water, and both have egret rookeries, where normally-shy birds sometimes nest within a meter or two of boardwalks frequented by tourists. The rookery pond at St Augustine Alligator Farm Zoological Park, located in St Augustine (Florida, USA), is used by over 600 wading birds, mostly greater (*Ardea alba*), snowy (*E. thula*), and cattle (*Bubulcus ibis*) egrets and little blue herons (*E. caerulea*). During the nest-building season, many wading birds are desperately searching for small sticks and twigs, often engaging in stealing from their neighbors and violent fights (SIEGFRIED 1972). In 13 years of working at the park, J.C. Brueggen and J.D. Brueggen have regularly observed American alligators (*Alligator mississippiensis*) floating in the pond with sticks balanced across their snouts. They have also observed successful predation resulting from this behavior (Fig. 2). During the peak



Fig. 1. — A well-camouflaged mugger crocodile (*Crocodylus palustris*) in stick-displaying behavior. Madras Crocodile Bank, Tamil Nadu, India.



Fig. 2. — Successful predation on a snowy egret (*Egretta thula*) by a lure-using American alligator (*Alligator mississippiensis*). St Augustine Alligator Farm Zoological Park, Florida, USA. Photo by Don Specht, reproduced with permission.

nest-construction season, stick-displaying behavior can be observed on multiple occasions daily (Z. TÖRÖK pers. comm.).

Systematic observations

In Louisiana, where wading birds have a shorter and more clearly defined nesting season, V. Dinets observed alligators for 1 year at two rookeries and at two sites located within the same bodies of water 1–2 km from the respective rookeries.

METHODS

Systematic observations were conducted for 1 year using previously developed non-invasive methods (DINETS 2011) at four sites in Louisiana, USA: (1A) a rookery dominated by cattle egrets at Millers Lake (Evangeline Parish); (1B) a different part of Millers Lake located ~ 2 km from the rookery; (2A) a rookery dominated by great and snowy egrets, roseate spoonbills (*Ajaja ajaja*) and white ibis (*Eudocimus albus*), at Lake Martin (Louisiana); (2B) a different part of Lake Martin located ~ 1 km from the rookery. Each site was observed between 1 and 4 hr after sunrise, monthly in August–February and weekly in March–July. Juvenile alligators (those visually estimated to be less than 1.5 m long) were excluded; they have never been observed floating with sticks, probably because their heads are too narrow. The proportions of alligators observed with sticks on their snouts were compared (1) between 6 weeks during the nest-building season (24 March–5 May) and the 6 following weeks (5 May–14 June) at the two rookery sites; (2) between sites with and without rookeries during the 6 weeks of the nest-building season. Two-tailed Mann-Whitney Test was used in both cases.

RESULTS

Stick-displaying behavior was recorded (n = 11) only during the birds' breeding season (the earliest date was 23 March and the latest 10 June). At the two rookery sites, this behavior was observed more frequently (U = 35, P = 0.035) in late March and April, during the nest-building season, than in May and early June, even though the birds were

present at the rookeries until July. In late March and April, stick displaying was more frequent (U = 34, P = 0.03) in alligators living at rookeries than in those living in the same bodies of water but away from rookeries.

DISCUSSION

The significant increase of stick-displaying behavior by alligators in Louisiana during the time of nest building by wading birds, and the fact that such increase was only observed near the rookeries, could be alternatively explained by higher numbers of sticks floating in the water, either due to the birds' activity or to rookery trees shedding twigs this time of year. Both these explanations seem unlikely. Virtually no freely-floating sticks or twigs were seen by the observer at that time, and none are visible in photographs of rookery ponds made at that time. Any available sticks were probably quickly picked up by birds looking for nest material. Later, at or immediately prior to the time of chicks fledging, there were some incidences of sticks falling from nests, or even entire nests partially disintegrating, but by that time the stick-displaying activity had already decreased. Of the two species of trees dominating the rookery sites – baldcypress (*Taxodium distichum*) and water tupelo (*Nissa aquatica*) – neither is known to shed branches or twigs, and both shed leaves in the fall rather than in spring. It is, however, possible that some twigs were broken off or dropped by the birds without being seen by the observer.

The present paper is the first report of tool use by any reptiles, and also the first known case of predators timing the use of lures to a seasonal behavior of the prey. Very recently, BURGHARDT (2011) lamented "meager to nonexistent records of tool use in amphibians and reptiles" among hundreds of examples of tool use by animals ranging from echinoderms to primates listed in SHUMAKER et al. (2011). Now we know that at least one group of animals traditionally included in reptiles is capable of relatively complex tool-using behavior.

It is unknown what factors stimulate stick-displaying behavior at particular locations and at particular times of year. The predators might be reacting to the presence of large numbers of wading birds flying low over water, to the sounds made by courting birds, or to some other environmental clue. Interestingly, both the mugger and the American alligator are generalist species with particularly broad habitat and prey preferences among crocodilians (ALDERTON 1991).

It is also unknown to what extent stick displaying (and possibly other forms of bird baiting) by crocodilians is produced by individual insights, cultural transmission and/or previously evolved instinct. At least in the case of the American alligator, it could be a vestige from the time before the plume-hunting era of 1870–1910, when wading bird rookeries were much more numerous in the alligator's range (MCIVER 2003).

The spectacular complexity of crocodilian behavior has been recognized only recently. Historically viewed as lethargic, stupid and boring, crocodilians are now known to exhibit flexible multimodal signaling, advanced parental care and highly coordinated group hunting tactics (DOODY et al. 2013). These discoveries are interesting not just because they show how easy it is to underestimate the intelligence of even relatively familiar animals, but also because crocodilians are a sister taxon of dinosaurs and flying reptiles. Phylogenetic bracketing by birds and crocodilians suggests that the behavior of non-avian dinosaurs was most likely very complex as well.

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