

Dangerous traps: Anhingas mistake anthropogenic debris for prey fish at an urban site in South-eastern Brazil

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ABSTRACT: Impacts of anthropogenic inedible debris on seabirds have been well documented, but on inland waterbirds this kind of pollution remains poorly recorded. Herein we report 21 instances of inedible objects stuck in the bill of Anhinga (*Anhinga anhinga*), a fish-eating waterbird which has the cutting edges of the mandible serrated. Disturbance and harm by pieces of plastic, rope, and cotton stuck in the bill were recorded. Debris caused drag and prevented the birds from fishing. Birds with small pieces of material stuck on their bills were still able to fish, but their hunting success decreased. When the debris was large and stuck on the bill for long, the birds possibly starved and some of them died. The time spent to clean up the bill was related to the type of material, ranging from 1 to 17 days. Our records illustrate the deleterious effect that anthropogenic debris has on the life of a Neotropical aquatic inland bird.

KEY-WORDS: Anhingidae, anthropogenic pollution, deleterious effects, foraging impairment.

INTRODUCTION

Anthropogenic debris is a worldwide problem for wildlife and its deleterious effect on seabirds and shorebirds that take the debris as food has been well documented (e.g. Azzarello & Van Vleet 1987, Avery-Gomm *et al.* 2013, Donnelly-Greenan *et al.* 2014). However, this pollution type effect is rarely reported for inland waterbirds (e.g. Peris 2003, Booth 2011, Henry *et al.* 2011, Sazima & D'Angelo 2015). This difference is possibly due to the general awareness of garbage pollution in the oceans when compared with such pollution type in inland waters (e.g., Booth 2011). Aside from being taken as food, anthropogenic debris cause waterbirds to entangle on plastic pieces and other materials (Waller *et al.* 2012, Corbo *et al.* 2013, Ryan 2013). Pollution by rubbish should be a concern for bird conservationists, particularly in the neglected tropical areas.

Darters and Anhingas (Anhingidae) dwell in a wide variety of inland waters, including lakes, ponds, slow-moving rivers, marshes and swamps. They forage underwater, swimming slowly with the neck held in a kink ready to dart the bill forward to spear prey with one or both mandibles, which have serrations pointing backwards on distal edges (Orta 1992, Frederick & Siegel-Causey 2000). The only record we found of Anhingidae entangled with anthropogenic material is a brief mention of an African Darter (*Anhinga rufa*) with

its bill enmeshed in a clump of steel wool in South Africa (Ryan 2013). Herein we report and comment on the disturbance and harm anthropogenic materials caused to a small population of Anhingas (*Anhinga anhinga*) at an urban site in South-eastern Brazil.

METHODS

We observed the Anhingas at the “Parque Ecológico Prof. Hermógenes de Freitas Leitão Filho” (22°48'42"S, 47°04'21"W; Campinas, São Paulo, South-eastern Brazil). This mainly recreational park is surrounded by residential quarters and buildings of a local university (see a map in D'Angelo 2014). The park has a total area of 0.13 km², of which about 75 % is occupied by a large pond (0.1 km²) surrounded by native and exotic vegetation composed of trees, bushes and grass patches. The pond is bordered by a sandy path about 1.5 km long used by people for walking, running, and promenading. Two playgrounds, three kiosks, several benches and tables, as well as wastebaskets along the path accentuate the recreational nature of the site. There are two rainwater and occasional sewage discharges at one side of the park, whose drifting rubbish flow is partly restrained by floating barriers of absorbent material. One of the discharges created a pool that was a favoured fishing site for several waterbirds, as it concentrated small fish that fed on detritus (D'Angelo & Sazima 2014).

Our records were made between August 2010 and February 2015, covering most of the months of the year, but November and December, both in the morning and in the afternoon. We observed the Anhingas with bare eye and through a 70-300 mm telephoto lens mounted on a camera from a distance of 3-15 m. Anhinga sexes are easily distinguished: males are black with silvery to white streaks and spots on upper back, scapulars, and wing-coverts, whereas females are duller with head, neck, and breast buffy; juveniles of both sexes are similar to adult females, but browner overall and lack most of the white marks on upperparts (Orta 1992, Frederick & Siegel-Causey 2000). Some individuals with anthropogenic debris impaled on bill were recognised by natural marks or site attachment (see Sazima & D'Angelo 2012). Throughout the observational sessions, we used the “*ad libitum*” and “sequence” samplings (Altmann 1974), which are adequate

to record fortuitous or rare events. The anthropogenic materials carried by the Anhingas were identified visually or assessed from samples collected on the pond bank. The size of these materials was assessed against the bill length (culmen) by enlarging the digital photos to actual bill measurements taken from 10 museum specimens (5 males = 90-95 mm, 5 females = 85-88 mm) and measuring the debris with a flexible scale directly on the screen. Voucher digital photographs of the Anhingas with anthropogenic material impaled on bill are on file at the Museu de Zoologia da Universidade Estadual de Campinas (ZUEC).

RESULTS

The number of Anhinga individuals we recorded at a given time in the park never surpassed six, including



FIGURE 1. Anhingas (*Anhinga anhinga*) with impaled prey and anthropogenic debris stuck on bill. An adult male surfaces with a *Tilapia* (*Coptodon rendalli*) impaled on bill (a); a juvenile male swimming with a piece of cotton impaled on bill – note similarity of shape and general colour of the debris and a fish prey, besides the carrying posture of the bird (b); a juvenile male perches to release a piece of plastic stuck on bill (c); a juvenile female with a small piece of rope stuck on bill perches with an impaled *Tilapia* to free the prey and swallow it (d); an adult female with a large piece of worn-out and tangled rope perches to shake and dip the debris in an attempt to free the bill (e); the same female perches and pull a large piece of rope attempting to free the bill (f). After about 2-3 weeks, with the rope still attached on bill, this individual died.

nestlings or juveniles (Sazima & D'Angelo 2012). The birds habitually foraged close to the banks and, after a successful hunting dive, the birds surfaced with a fish impaled on bill (Figure 1a). The prey was released from the serrated bill with vigorous horizontal shaking of the head, sometimes accompanied by opening and closing of the bill. After release, the fish was flipped in the air and swallowed, a habitual behaviour for this bird (Orta 1992, Frederick & Siegel-Causey 2000, Corbo *et al.* 2013).

We recorded 21 examples of anthropogenic objects impaled on bill of 10 adult females, 3 adult males, and 8 juveniles. The objects varied from threads to ropes, including cloth pieces and cotton wastes (Figures 1b-c, e-f). The size of these objects varied from 1-3 cm (worn-out threads, cotton wastes) to 50-70 cm (worn-out and tangled cloths, ropes).

The Anhingas tried to release the debris with movements similar to those they use to free stabbed prey (Figures 1b-c). The birds shook the debris, dipped it and shook again, at times thrashing the object against the water surface. When the debris was large, the birds sought a perch where, besides shaking the debris vigorously, they scrubbed it against branches (Figures 1e-f). This scrubbing wounded the softer parts of bill, mostly at its base.

The birds managed to free most of the debris from bill in 17 out of 21 instances in 1-8 days after spending effort and time (several rounds up to 30 min), although small pieces or threads of worn-out debris remained stuck for 10-17 days. A male was able to free its bill from a large piece of woven plastic in 1 day (Figure 1 c). Another individual was recorded free of a small and worn-out debris piece after 10 days (Figures 2 e-f). From all debris



FIGURE 2. Anhingas (*Anhinga anhinga*) with anthropogenic debris stuck on bill and freed of it. An adult female with a cloth piece entangled on both mandibles tries to open the bill wide (a); the same individual just missed a stabbed fish prey that it was unable to hold and swallow (b); a juvenile male with a cotton waste stuck on bill pursued by a dominant female that dived (yellow asterisk on upper left) to surface next to the chased bird (c); the same male, with completely soaked plumage takes flight to evade the pursuer bird (d); an adult female with a natural mark (scar) behind the eye still carries a small piece of worn-out debris stuck on mandible (e) and free of the debris 10 days latter (f).

we found impaled on the bill of the Anhingas, ropes were fatal to two adult females. One of them carried a rope about 70 cm long for 2-3 weeks before dying (Figure 1f). An adult male with a tangled cotton waste about 40 cm long totally enmeshed around its bill died after about 1-2 weeks, and an adult female with both mandibles entangled by a piece of cloth (Figures 2 a-b) also died after about 1-2 weeks. We were unable to retrieve the dead birds due to the deep layer of mud on the bottom of the pond and the dense scrubs the Anhingas perch on.

Small pieces did not prevent the birds from fishing (Figure 1d), but their hunting success decreased. An individual recorded in two occasions at the same site for 30 min had a foraging success of 0.2 fish per min without debris on bill, but it dropped to 0.07 fish per min after impaling a piece of rope about 10 cm long. When debris was wrapped on both mandibles, the birds were unable to fish (Figures 2 a-b). Sometimes a bird carried more than one type of debris, perhaps caused by entanglement of other types of objects on the initially impaled debris.

Besides being troubled with debris impaled on bill, an additional trouble could occur due to the territorial behaviour of Anhingas while fishing. We recorded one juvenile male with cotton waste impaled on bill pursued by a dominant female (Figure 2c), the chase ending when the pursued bird took flight (Figure 2d).

DISCUSSION

Anthropogenic objects stuck to bill of Anhingas are related to the foraging behaviour of these birds, which probably mistake waterborne debris for their prey. For instance, cotton wastes or worn-out and tangled cloths may seem a fish to Anhingas foraging in translucent or turbid waters. Due to this probable mistake, the fishing birds stab the objects, which remain stuck on bill because of the fine serrations pointed backwards (Orta 1992, Frederick & Siegel-Causey 2000). The serrations, which preclude prey fish to free themselves from the bill, become a major trouble when debris is impaled instead of fish. There are records of waterbirds such as White Storks (*Ciconia ciconia*) in France that ingest rubber bands while foraging in rubbish dumps, possibly mistaking the bands for earthworms (Henry *et al.* 2011). Additionally, at the same site we studied the Anhingas, we recorded Wood Storks (*Mycteria americana*) handling and ingesting pliable plastic cable pieces that they likely mistook for elongate fish or snake prey (Sazima & D'Angelo 2015). However, the most similar mistake to that we recorded for Anhingas occurs with sea turtles that ingest floating plastic debris instead of jellyfish (Mrosovsky *et al.* 2008, Schuyler *et al.* 2013). In a few cases, however, accidental debris entangling cannot be completely ruled out, as

Anhingas occasionally begin a dive with semi open bill (our pers. obs.).

The effort Anhingas invest to free the impaled debris is a waste of time and energy, and may hurt the birds while they scrub the bill against branches. Additionally, large objects cause drag to swimming and diving Anhingas. Drag also disturbs feeding effort and decreases its success, even when the debris is small, due to the spearing technique employed by Anhingas (Orta 1992, Frederick & Siegel-Causey 2000). The ropes are a case apart among the anthropogenic objects in the pond, because the two instances we recorded with this type of debris resulted in death of the individuals that impaled a knot at the end of the rope. A knot is the bulkiest part of the rope and would be targeted by Anhingas as a fish prey.

Anthropogenic objects and their risk to underwater hunting birds include an instance of an African Darter with a clump of steel wool enmeshed on the bill in South Africa, briefly mentioned by Ryan (2013). This instance is the most similar situation to that we present here for the Anhinga. At sites frequented by fishers in the USA, entanglement with monofilament line and ingestion of hooks and fishing gear by Anhingas would be a threat, but there are no quantitative data (Frederick & Siegel-Causey 2000). Enmeshing the bill with an anthropogenic object invariably results in death by starvation, according to Ryan (2013). We were unable to find obvious indications of Anhingas starving in our study, as these birds have a slender built that makes such kind of checking a difficult task. However, starving to death was possible in the cases of the two females that impaled a rope, one male with bill enmeshed in a large cotton waste, and the female that had the two mandibles tied by a cloth piece. Besides starvation, they could become exhausted and drowned. Thus, anthropogenic debris caused the death of four individuals, a heavy toll for the small number of Anhingas that dwell (or dwelt) in the park.

At this study site, adult Anhinga females hold hunting territories, with one of them dominant (Sazima & D'Angelo 2012) and reproductively active, outnumbering males by 2:1 (our pers. obs.). The death of an adult male negatively affects the reproductive cycle of Anhingas at the studied area until the arrival of a new male and its mating with the dominant female, which may delay reproduction in the pond for 2-3 years (our pers. obs.). Thus, besides affecting foraging activities, the anthropogenic debris stabbed by Anhingas may affect their reproductive cycle as well.

Clearly, anthropogenic waterborne debris is a hazard for Anhingas and other waterbirds such as Wood Storks in the park (present paper, Sazima & D'Angelo 2015). We suspect that most of this debris reaches the pond via the sewage and rainwater discharges. A gravel sieve-like device mounted on the outlets would catch

the waterborne rubbish and lessen this problem in the pond. This sieve should be periodically cleaned to prevent clogging. However, the "Anhinga problem" at the pond seems to have no end due to the generalised bad custom to discard waste everywhere.

The Anhinga may be regarded as an environmental indicator (*sensu* Sekercioglu 2006) of some types of anthropogenic debris at our study site. Waterborne inedible rubbish negatively affect foraging and may hamper the breeding of small or range-restricted populations. We suggest that additional observational studies will reveal that the type of accident we described herein occurs in others habitats in which Anhingas forage in, and that are polluted by anthropogenic inedible debris. As almost nothing is known about the survivorship of the Anhinga, which is a long-lived bird that may reach about 10-15 years and has few predators (Orta 1992, Frederick & Siegel-Causey 2000), the hazard caused by anthropogenic objects deserves particular attention by conservationists and wildlife officials.

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