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Integrating citizen nature photography to natural history science: New record of bird-lizard predation

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Abstract Understanding high biodiverse areas and interactions among organisms requires reciprocal action between scientists and community through citizen science. This paper results from the joint efforts of an amateur nature photographer and scientists to describe the predation behaviour of the heron *Ardea cocoi* upon the lizard *Ameiva ameiva*. We also discuss the importance of citizen science and digital photography for natural history studies.

Key words: *Ameiva ameiva*, *Ardea cocoi*, digital photography, Neotropical, saurophagy.

INTRODUCTION

The digital era brought to light the remarkable opportunity to engage millions of citizens as volunteers collecting, categorising or analysing scientific data worldwide, contributing to building comprehensive databases and addressing local problems (Bonney *et al.* 2014). The confluence between community and scientists, the called citizen science, strides to be considered a high trend from now on (Bonney *et al.* 2014).

Photography is long-standing used by naturalists to illustrate biodiversity and ecological interactions (Sabino 2009; Sazima & D'Angelo 2011). Nowadays, citizen nature photographers can contribute to science by registering and sharing their photographs on the internet. Birds are particularly an attractive and photogenic taxon, resulting in several high-quality online databases (e.g. WikiAves) powered daily by birdwatchers and ornithologists.

Saurophagy is rarely observed directly, and description often lack details required to understanding the hunting tactics and behaviours displayed by birds (Martín & López 1990; Sick 1997; Poulin *et al.* 2001; Lopes *et al.* 2005). For instance, descriptions of saurophagy by common neotropical birds (e.g. herons, Ardeidae) are still restricted to few occasional observations (Miranda & Collazo 1997; Ríos-López *et al.* 2015). Here, we describe the predation behaviour of Cocoi Heron *Ardea cocoi* Linnaeus, 1766 (Ardeidae) consuming the lizard *Ameiva ameiva* (Linnaeus, 1758) (Teiidae), an observation made using photographs taken by a citizen nature photographer.

The data were obtained by Eduardo Messas Junior on 26 August 2015 in a residential condominium located in Itu, São Paulo, Brazil (23°17'11.23"S, 47°15'16.28"W). Although urban, the site contains three lakes and a green area inhabited by several aquatic and semi-aquatic bird species, reptiles, and other vertebrate and invertebrate species. EMJ was using a digital camera coupled to a 70-300mm telephoto lens in an automatic mode, with lens' autofocus and continuous shooting mode. The overall adjustment was a fast shutter speed ranging from 1/400s to 1/500s, a low aperture (f-stop 9), and sensor sensibility values from 320 to 500. The saurophagy record started at 11:40, with 60 sequential images acquired over six minutes.

EMJ detailed to us the behaviours he observed and authorised us to edit and process the images. We selected the best photographs that revealed the main behaviours, and we performed careful slight adjustments of exposure (brightness, contrast, levels, and curves), colour (saturation and hue), sharpness, and crops, without modifying specific regions of the images or any manipulations. We analysed in detail each photograph at full resolution to describe the saurophagy, and we used the metadata of the photographs to determine the intervals between the behaviours displayed by *A. cocoi*.

An individual of *A. cocoi* was resting on a fallen tree trunk near a nest of *Anser anser* Linnaeus, 1758

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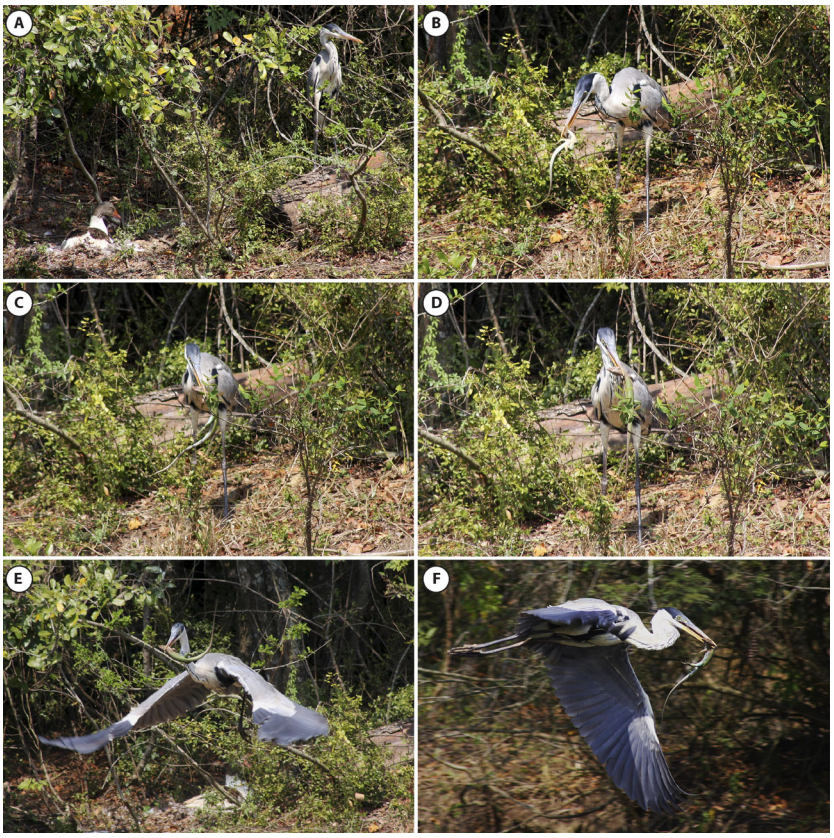

Fig. 1. Sequential images of the predation behavior of Cocoi Heron *Ardea cocoi* upon the lizard *Ameiva ameiva*, made by a citizen nature photographer: (a) Individual of *A. cocoi* near a geese nest. (b-c) *A. cocoi* shaking the lizard to subdue the prey. (d) Languid *A. ameiva* on *A. cocoi* bill. (e) The bird lifted flight carrying the lizard, and (f) flew towards a lake. Photographs: Eduardo Messas Junior.

(Anatidae), containing an adult female protecting its eggs (Fig. 1a). Suddenly, an individual of *A. ameiva* ran through the ground vegetation towards the *A. cocoi*, which quickly captured the lizard by the neck using its bill (Fig. 1b). The bird suspended the prey and repeatedly moved its bill to left and right directions while the lizard was struggling to free himself (Fig. 1b–c). This behaviour lasted about two minutes until the lizard stopped moving (Fig. 1d). The bird never pecked multiple times or hit the lizard against the ground, keeping all the time the prey suspended using its bill like a tweezer. Immediately after the demise of lizard movements, the bird took flight (Fig. 1e–f) and moved to a flooded surface near the capture site. After three minutes, the bird threw the prey in the air and grabbed it by the head with its bill facing up. The bird performed contorted movements (S-shaped) with its neck until swallowing the prey.

It is the first record of the complete predation behaviour, from prey capture to ingestion, of *A. ameiva* by a heron. The predation occurred during the daytime, coinciding with the activity period of *A. ameiva* and the bird (Martínez-Vilalta & Motis 1992; Vitt & Colli 1994), and with the timing of other records of saurophagy of *A. ameiva* by birds (e.g. Granzinolli *et al.* 2007). The use of photography as a non-invasive technique (Harasti & Gladstone 2013) was essential to the acquisition of high-quality images without interfering with the species' behaviour. In previous records of *A. ameiva* saurophagy by birds, the predators flew away when the researchers got close to them (Tozetti *et al.* 2005; Granzinolli *et al.* 2007). Digital photography can be extremely useful in science by allowing a non-invasive approach that generates quantifiable and high-quality data, allows access to inhospitable environments and studies of temporal events, and reveals the occurrence of rare organisms in nature.

The strategies used by different bird species to kill and hold *A. ameiva* differ greatly. Lizards attacked by *Buteo albicaudatus* (Vieillot, 1816) (Accipitridae) presented excoriations near the head, which was partially separated from the body since this bird held the dead lizard using its claws (Granzinolli *et al.* 2007). On the other hand, *Athene cunicularia* Molina, 1782 (Strigidae), ripped off the lizard's head and held the prey using the bill (Tozetti *et al.* 2005). The predation behaviour exhibited by *A. cocoi* differs from these species in some ways: (1) the bird suspended and killed its prey by successive jolts, (2) did not cause external damages to the lizard and (3) used only the bill, from capture to consumption. The morphological range of bills and claws between groups of birds, each performing specific functions, certainly helps explain such behavioural variability.

Ardea cocoi seems to have used a hunting tactic called 'bill stab', which consists of a downward or

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lateral blow involving rapid and directed movements of the head and neck while the body remains stationary (Kushlan & Hancock 2005). This is a capture stroke characteristic of long-necked herons, in which their specialised cervical vertebrae act as a hinge for the forward stroke. Along with 'bill stab', it seems that the hunting tactic 'grasping' or 'grasp capture' was used next, which is when the prey is caught using the bill like tweezers (Kushlan & Hancock 2005).

The few descriptions of saurophagy by *A. cocoi* most described hunting tactics prior to predation (e.g. Martínez-Vilalta & Motis 1992; Sick 1997; Kushlan & Hancock 2005), but rarely the behaviour of handling the prey between capture and ingestion. Río-López *et al*. (2015) reported saurophagy by herons in Puerto Rico involving species of the same genera, *Ameiva exsul* (Cope, 1862) and *Ardea alba* Linnaeus, 1758, reported here. The birds also used their bill as tweezers, without impaling or dismember the prey. Similar behaviour was observed on the predation of a water snake by the heron *Syrigma sibilatrix* (Temminck, 1824), which manipulated the prey using the bill for a few seconds, shaking its head quickly and repeatedly (Franz *et al*. 2007). This shaking behaviour can stun or kill the prey before ingestion (Ivan Sazima pers. comm.).

Citizen science photography can reveal details about organisms' behaviours that would, otherwise, be missed by more vague reporting in citizen science. To increase the scientific value of natural history findings, we suggest to photographers taking sequences of photographs that illustrate (1) the habitat where organisms occur, (2) different behaviours of a given interaction, (3) morphological details of the specimens, besides (4) registering the metadata (date, time and geolocation) of the images, and, if possible, (5) saving the files in the RAW (uncompressed and unprocessed) image format instead of JPGE. We highly recommend the upload of such photographs on public and open-access platforms of biodiversity (e.g. iNaturalist, Macaulay Library, Táxeus and WikiAves). Such initiative could help synthesise important repositories to enlarge our understanding of distribution, animal behaviour and natural history of the biota across different locations (e.g. Laitly *et al*. 2021). Moreover, by bringing population closer to environmental sciences and biodiversity, citizen science photography can be a powerful tool to decrease the environmental negligence shared in several parts of the world (Ripple *et al*. 2017).

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AUTHOR CONTRIBUTION

Yuri Fanchini Messas: Conceptualization (equal); Data curation (equal); Investigation (equal); Writing-original draft (equal). **Giulia Bagarolli D'Angelo:** Conceptualization (equal); Writing-original draft (equal); Writing-review & editing (equal). **Thaís Barreto Guedes:** Conceptualization (equal); Writing-original draft (equal); Writing-review & editing (equal). **João Vasconcellos Neto:** Conceptualization (equal); Data curation (equal); Writing-review & editing (equal).

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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