

Short Communication**A Defensive Attack by a Social Carnivore (White-nosed coati) against a Constrictor Predator (Mesoamerican boa constrictor)**Juan de Dios Astorga^{1,2} and José Manuel Mora^{3,4,*}

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Abstract

Ecological interactions are one of the most complex aspects of tropical biodiversity; among these, predation stands out due to the impact it has both on prey and predators. Two of the most prominent groups of predators in the tropics are snakes (Reptilia) and mammalian carnivores. White-nosed coati *Nasua narica* (Mammalia: Carnivora: Procyonidae) and the Mesoamerican boa *Boa imperator* (Reptilia: Squamata: Serpentes: Boidae) interact in cross-predatory events that depend on the size of the individuals involved. On 21 November 2019, at 1637 h, the researchers observed a herd of thirty-seven coatis, where a subgroup of twenty-three individuals, made up of mostly adult females and some young males, were aggressively attacking a large boa. The attack could have been a defensive reaction of the females of the herd who, perceiving a potential threat to their young, reacted aggressively to drive away the predator. This work reviews and places this observation in the context of previous records of interactions between these two species.

Key words: *Boa imperator*, Costa Rica, Ecological interactions, *Nasua narica*, Snake

Introduction

Ecological interactions are one of the most complex aspects of tropical biodiversity

(Andresen *et al.*, 2018). Among these, predation stands out due to the impact it has both on prey and predators. Predation influences several key aspects of fitness including feeding, breeding, and mortality; as such, it constitutes a fundamental aspect of the lives of wild animals (Humphreys and Ruxton, 2018). Predator-prey interactions are one of the main drivers of natural selection, influencing the structure of ecological communities, and the functioning of ecosystems (Portalier *et al.*, 2019; Valdez, 2020). The observation of predatory events and related aspects of natural history contributes to the understanding of ecological interactions, species behavior, energy transfer in the food chain, and other key aspects required to attain the ecological knowledge necessary as a basis for wildlife management and conservation (Sih and Christensen, 2001; Santos-Filho *et al.*, 2021). Two of the most prominent groups of predators in the tropics are snakes (Serpentes, Squamata) and carnivores (Carnivora, Mammalia). However, several tropical carnivores have specialized in eating fruits and many species are omnivorous (Mora, 2000). An example of these is the White-nosed coati *Nasua narica* (Linnaeus 1766), one of the most gregarious species of the Carnivora (Pérez-Irineo and Santos-Moreno, 2016). The white-nosed coati is diurnal and generally travels in bands of variable size, typically consisting of five to eighteen individuals (Kays, 2009). Most of the males

are solitary and are expelled from family groups or bands formed mainly by females and juvenile individuals (Kays, 2009). A unique case among carnivore species, a lek-like mating system in a population of white-nosed coatis *Nasua narica* was reported in Guatemala (Booth-Binczik *et al.*, 2004). The group works cooperatively in parental care, surveillance, and defense against potential predators, and larger groups have been found to have lower rates of predation (Gompper, 1997; Hass and Valenzuela, 2002). The white-nosed coati is distributed from the southwestern United States to the north and west of Colombia, from 0 to 2,879 m elevation (Kays, 2009). In Costa Rica, it is found mainly in lowlands, although it is also common in midlands (Mora, 2000). It is considered to be a medium-sized mammal, with a maximum length of 680 mm and a weight of 3.5 – 5.6 kg (Kays, 2009). It prefers forested habitats, but is commonly seen on the edges of these habitats and in thickets and disturbed sites in general (Reid, 2009). It feeds on invertebrates, fruits, small vertebrates, eggs and carrion and also takes nectar (Mora *et al.*, 1999). Although the coati is common or even abundant, its population ecology is insufficiently known in various areas (Pérez-Irineo and Santos-Moreno, 2016), even though it is pursued as food or as a nuisance or harmful (Velarde and Cruz, 2015).

The Mesoamerican boa constrictor or Becker (*Boa imperator*) is the largest, heaviest snake in Costa Rica (Leenders, 2019). It has a robust cylindrical body reaching a maximum length of 5 m (Solórzano, 2022). Its tail is short (10 – 15% of total length), and its head is large, wide, and well differentiated from the neck (Savage, 2002). The dorsum is covered with uniformly small, smooth, and iridescent scales (Leenders, 2019). This snake is found in lowlands and adjacent slopes from Northern Mexico to northeastern South America (Hynková *et al.*, 2009). In Costa Rica it is found in the lowlands and on premontane slopes throughout the country in tropical and subtropical shrublands and secondary forests, dry, moist, and wet

forests, from sea level to 1,500 m elevation, including the Central Valley (Savage, 2002; Solórzano, 2022). The Boa is terrestrial and arboreal, active mainly at night and crepuscular times (Solórzano, 2022). It frequents cultivated areas and farmlands as well as human buildings, and it tolerates a wide range of temperature and humidity levels (Leenders, 2019). Boas are sit-and-wait predators (Greene, 1983) and feed on a large variety of vertebrate prey, including small to medium-sized mammals such as rats, agoutis, raccoons, and ocelots, birds, and lizards, as well as some domestic animals (Savage, 2002; Brown, 2019; Solórzano, 2022). Prey size is largely dependent on the size of the snake with juvenile snakes taking smaller preys such as rats, mice, bats, and squirrels, and adult large snakes feeding on larger preys including opossums, monkeys and coatis (Leenders, 2019). Large prey such as jaguarundi (*Herpailurus yagouaroundi*; Mammalia: Carnivora: Felidae) and gray fox (*Urocyon cinereargenteus*; Carnivora: Canidae) also have been reported (Monroy-Vilchis *et al.*, 2011; Perez-Alvarado *et al.*, 2019).

The interactions between the White-nosed coati and the Mesoamerican boa are cross-predatory depending on the size of the individuals involved. Adult boas routinely eat coatis (Solórzano, 2022) and coatis take newborn and small boas (Reid, 2009). This note presents a case of a putatively defensive attack by a band of White-nosed coatis on an adult Mesoamerican boa based on observations of an interaction between these two species in northwestern Costa Rica. The paper reviews and places this observation in the context of previous records of interactions between these two species.

Materials and Methods

The researchers' observations were conducted at Taboga Forestry Reserve, Cañas, Guanacaste (10° 20' 17.5" N, 85° 09' 02.6" W, 30 elevation). Taboga is located in Tropical Premontane Moist Forest, basal transition life zone (Holdridge, 1967).

Average annual rainfall in this life zone varies between 1200 and 2200 mm, and mean annual temperature between 23° and 24°C (Bolaños *et al.*, 2005). It is a seasonal habitat with a marked dry season of 3.5 – 5 months between December and May, and a rainy season from June to November (Bolaños *et al.*, 2005). Sites adjacent to the reserve are mainly dedicated to agriculture, with sugarcane and rice as principal crops (Astorga and Mora, 2022). Based on general distribution and habitats, Taboga is a zone of sympatry for the White-nosed coati and the Mesoamerican boa.

Results

On 21 November 2019, at 1637 h, during a routine patrol within the Taboga protected area, the researchers observed a herd of thirty-seven coatis. The group was on the side of a gravel road in a secondary forest,

with minimal flow of traffic. A subgroup of twenty-three individuals, made up mostly of adult females and some young males, were aggressively attacking a large boa. During the attack, the rest of the group, made up of the youngest in the group, remained about 10 m from the site, observing the attack. The interaction was observed for a period of twenty minutes, during which time lunges and bites were constant. After that period, the group of coatis began to gradually withdraw from the site. The snake seemed very exhausted, and minutes later it moved towards the forest. The researchers did not observe who initiated the attack or why the attack occurred; however, it could be interpreted as a defensive reaction of the females of the herd who, perceiving a potential threat to their young, reacted aggressively to drive away the predator. A video of the interaction can be seen at https://www.youtube.com/watch?v=_0tpTu-6l6A.



Figure 1. A band of White-nosed coatis (*Nasua narica*) attacking a Mesoamerican boa (*Boa imperator*) in Northwestern Costa Rica. Photo by J. de D. Astorga.

Discussion

Natural history observations constitute the fundamental basis of empirical studies that enable results to be viewed and analyzed in an appropriate context; this is particularly true for antagonistic interactions between predatory species (Morrison, 2018). Although coatis have been studied fairly extensively, there remain numerous gaps with respect to the researchers' knowledge of this carnivore. Similarly, a recent case of parthenogenesis in *Boa imperator*, resulting in all-female offspring, shows how much we still have to learn about this snake species (Leenders, 2019). Boas often are involved in cross-species predatory encounters, even including other snakes such as a Central American Indigo Snake (*Drymarchon melanurus*; Squamata: Colubridae) attempting to prey on an individual in Honduras (Brown and Murcia, 2021). The snakes were in combat for over ten minutes, and assumed defensive postures after intervention and separation (Brown and Murcia, 2021). Some prey defend themselves aggressively from predatory attempts by boas; for example, turkeys fend off predators using their beaks, large bodies, wings, and spurs on the back legs as weapons (Brown, 2019).

The researchers are uncertain in the present instance why the coatis attacked the boa (or even if they initiated the agonistic interaction), because the boas as a prey item was too large for the coatis. A defense mechanism against snakes seems a more plausible behavior on the part of the coatis. Coatis on Barro Colorado Island in Panamá, reacted with mixed alarm, aggressiveness, and curiosity when two large boas were presented to them, and one coati even bit the tail of one of the snakes (Janzen, 1970). Protecting conspecifics from predation is considered a driving force for the development of sociality in many species (Hass and Valenzuela, 2002). There is one report of a 3.4 m boa killing a coati in Taboga, but before the snake asphyxiated the young coati, three adults defended its conspecific in an apparent display of altruistic behavior on the part of the prey coati's companions

(Janzen, 1970). The coatis continued to paw and bite the snake for several minutes until they were interrupted (Janzen, 1970). Apparently, only if the snake had been small, could the coatis have caused the release of their band member, or if vulnerable areas of the snake were exposed to the coatis (Janzen, 1970).

Interactions between predators are worth reporting because they help characterize the biology of species involved. However, natural history events involving snakes are difficult to observe in the field because they are discreet and habitually stealthy animals (Steen, 2010). The reporting of these cases helps fill gaps in this area of knowledge and understand the behavior, ecological interactions, and life history, of the species involved (Santos-Filho *et al.*, 2021). The researchers have worked in the field for over three decades, and although boas and coatis are common in their study sites, the interaction reported here has never been observed before. It would be worthwhile to determine whether this is an unusual interspecific interaction between the two species, or whether it is more commonplace. Behavioral studies of the two species in sympatry would help determine which of the two alternative hypotheses is more probable.

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