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Predation on sea turtles by jaguars in the Mexican Caribbean

Depredación de tortugas marinas por jaguar en el Caribe Mexicano

Víctor A. Rosales-Hernández[1], Lizardo Cruz-Romo[2], Fernando M. Contreras-Moreno[3*], Sandra Petrone[2], and Daniel Jesús-Espinosa[3]

[1]Proyecto AAK Mahahual A. C., Calle Bacalar 22, C. P. 77976. Othón P. Blanco, Quintana Roo, México. E-mail: proyectoaakmahahual@gmail.com (VAR-H).

[2]WWF-México. Insurgentes Sur 1216, C. P. 03100. Benito Juárez, Ciudad de México, México. E-mail: lcruz@wwfmex.org (LC-R); spetrone@wwfmex.org (SP).

[3]WWF-México. Calle Puerto Rico s/n, C. P. 24640. Calakmul, Campeche, México. E-mail: fernandom28@hotmail.com (FMC-M); danieljesus_esp@outlook.com (DJ-E).

*Corresponding author

Jaguars are opportunistic carnivores whose diet mainly depends on prey availability. Jaguar predation on sea turtles has not been sufficiently documented in México. In this study, we recorded the predation of loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles by jaguar (*Panthera onca*) in Mahahual, Quintana Roo, México. From May to August 2021, 10 camera-trap stations were set on a nesting beach. Meanwhile, daytime and nighttime tours were conducted along the beach to detect turtles nesting on the site, as well as carcasses with evidence of predation. With a sampling effort of 600 camera trap nights, we obtained 10 independent jaguar predation events and 3 photo events confirming jaguar predation on sea turtles. Jaguar predation on sea turtles has been documented on Costa Rican beaches, but rarely in México. This report contributes to improving our understanding of the diet of the jaguar in coastal areas and the relationship between this feline species and sea turtles in México.

Key words: Camera-trapping; carnivores; Mexican Caribbean; Testudines; turtle nesting.

Los jaguares son carnívoros oportunistas, cuya dieta depende principalmente de la disponibilidad de sus presas. La depredación de tortugas marinas por parte de los jaguares ha sido raramente documentada en México. En este estudio registramos la depredación de tortugas caguamas (*Caretta caretta*) y verdes (*Chelonia mydas*) por parte de jaguares en la región de Mahahual, en el estado de Quintana Roo, México. De mayo a agosto de 2021, se establecieron 10 estaciones de fototrampeo en una playa de anidación. De forma paralela se realizaron recorridos nocturnos y diurnos a lo largo de las playas, con el fin de detectar tortugas que ovopositaran en el sitio, así como carcasas en el sitio que presentaran señales de depredación. Con un esfuerzo de muestreo de 600 noches / cámara se obtuvieron 10 eventos independientes de la presencia de jaguar en la zona, los cuales sucedieron en horarios diversos tanto diurnos como nocturnos, así como 3 eventos fotográficos en los que se confirmó la depredación del jaguar a tortugas marinas. La depredación de tortugas marinas por jaguares ha sido documentada en las playas de Costa Rica pero casi nunca en México, este reporte contribuye al escaso conocimiento de la dieta del jaguar en sitios costeros, así como a la relación que existe entre estos felinos y las tortugas marinas de México.

Palabras clave: Anidación de tortugas; cámaras trampa; Caribe mexicano; carnívoros; Testudines.

The jaguar (*Panthera onca*) is the largest feline in America and is among the most charismatic wildlife species (de la Torre *et al.* 2017). Historically, jaguars are distributed from the southern United States to northern Argentina (Brown and López-González 2000; McCain and Childs 2008). Due to various anthropic pressures such as poaching, deforestation, and changes in land use (Ceballos *et al.* 2016; de la Torre *et al.* 2017), the distribution of the jaguar has been significantly reduced in the Yucatán Peninsula and the rest of the country (Rodríguez-Soto *et al.* 2011). The importance of Jaguar Conservation Units (JCUs) as priority sites for the species has been highlighted in México; two examples of JCUs are the Sian Ka'an Biosphere Reserve and the biological corridor that connects the Calakmul Biosphere Reserve and the Balaan Kaáx Flora and Fauna Protection Area (Rabinowitz and Zeller 2010).

Jaguars are opportunistic carnivores whose diet mainly depends on prey availability, including at least 85 species of mammals, birds, reptiles, and fish (de Azevedo and Murray 2007; Reid 2009; Aranda 2012; Gallo-Reynoso 2021). In México, there are reports of jaguars feeding on different mammal species, including the white-tailed deer (*Odocoileus virginianus*), Central American tapir (*Tapirella bairdii*), brocket deer (*Mazama* sp.), peccary (*Dicotyles crassus*), coatimundi (*Nasua narica*), lowland paca (*Cuniculus paca*), agouti (*Dasyprocta* sp.) and nine-banded armadillo (*Dasypus novemcinctus*); bird species reported to be consumed as prey include the ocellated turkey (*Meleagris ocellata*) and the great curassow (*Crax rubra*); reptiles such as crocodiles, boas, iguanas, and land and sea turtles are also occasionally preyed upon (Aranda and Sánchez-Cordero 1996; Núñez *et al.* 2000;

Simá-Pantí *et al.* 2020). Predation of sea turtles by jaguars has been frequently documented in Costa Rica, where the species consumed most frequently are the hawksbill, olive ridley, and green turtles (*Eretmochelys imbricata*, *Lepidochelys kempii*, and *Chelonia mydas*, respectively; Herrera *et al.* 2016; Escobar-Lasso *et al.* 2017). However, predation on sea turtles in México remains poorly documented. The only reports available include outreach materials describing the predation of *E. imbricata* and *C. mydas* in nesting sites of the Mexican Caribbean north of Sian Ka´an (Cuevas *et al.* 2014), and some government reports on the Pacific coast recording predation on olive ridley turtles (*Lepidochelys olivacea*; CONANP 2019) in the *Marismas Nacionales* Biosphere Reserve, Nayarit. The effects of predators on adult sea turtles have remained unnoticed throughout their distribution range (Heithaus *et al.* 2008) because of the complexities in observing and quantifying them, and since many of the studies addressing the jaguar diet have not considered coastal areas.

This note reports 3 cases of predation on sea turtles by jaguar: 1 regarding loggerhead (*Caretta caretta*) and 2 on green (*Ch. mydas*) turtles, based on evidence recorded using camera traps in Mahahual, a locality on the southern coast of Quintana Roo. These photos show the predation behavior of jaguar described as common in Costa Rica (Cuevas *et al.* 2014; Arroyo-Arce and Salom-Pérez 2015) but that has been rarely recorded in México and provides relevant information to the current knowledge of the jaguar diet and the relationship between these felines and sea turtles in coastal areas of México. This study aims to establish strategies to improve the coexistence between jaguars and humans and determine the interaction of jaguars and sea turtles in the Mahahual coastal area.

From May to August 2021, 10 Browning digital camera traps (Strike force; Browning Trail Cameras) were placed at sea turtle nesting sites along Pulticup beach (19° 3′ 14.62″ N, 87° 34′ 14.74″ W, and 19° 10′ 9.00″ N and 87° 32′ 30.82″ W; Figure 1). Cameras were affixed to a tree or trunk 50 cm above the ground, always running parallel to the coast. The cameras were set to capture photos continuously over 24 hours and were reviewed every 20 days. In parallel, daytime and nighttime tours were conducted along the beach to detect turtles nesting on the beach and carcasses of turtles predated by jaguars.

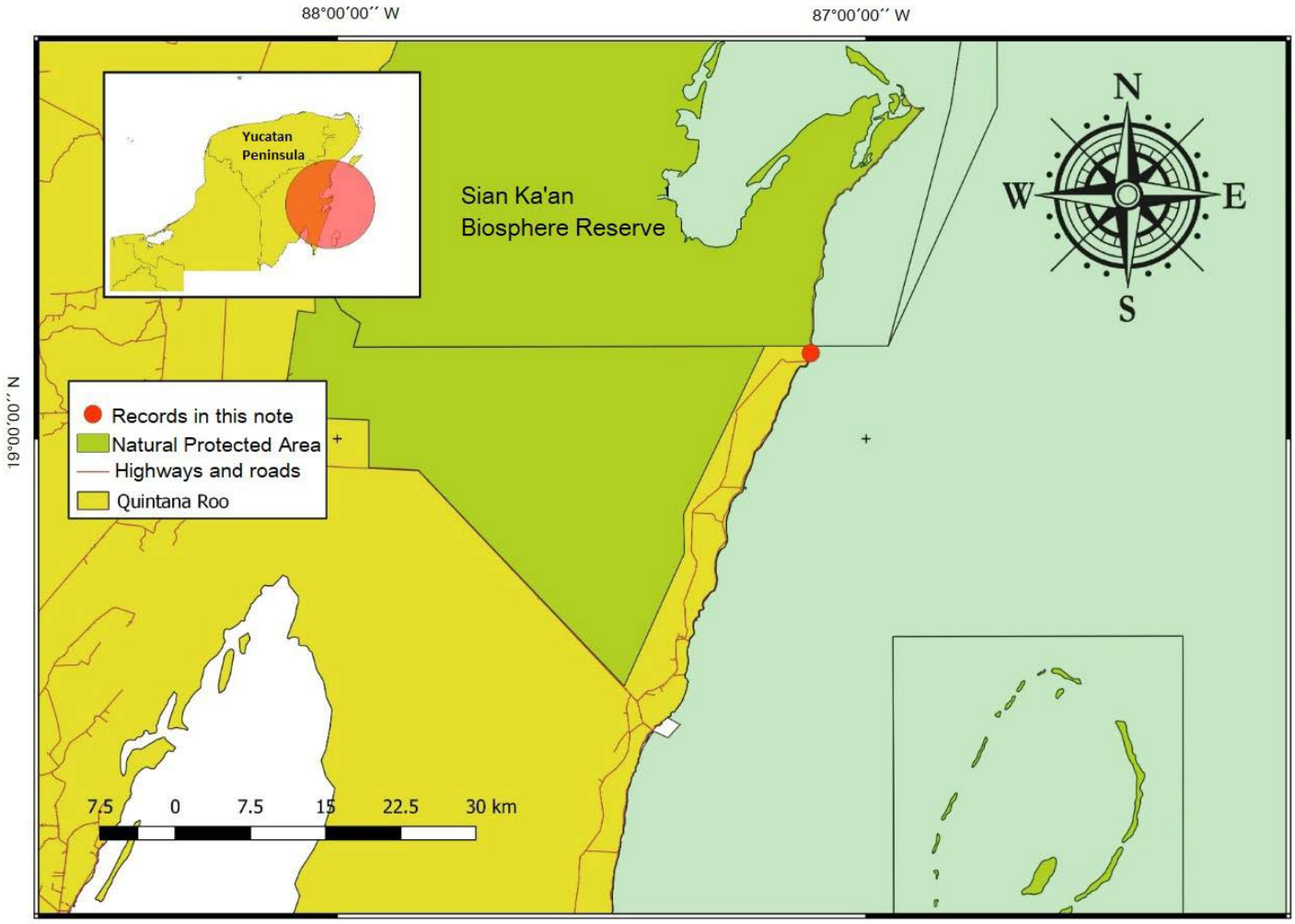

Figure 1. Location of the study site at coordinates 19° 4′ 51.91″ N, 87° 33′ 8.31″ W, in Mahahual, Quintana Roo, México, marking the exact site (red circle) where turtle carcasses were observed and the photographs of jaguars preying on sea turtles were recorded.

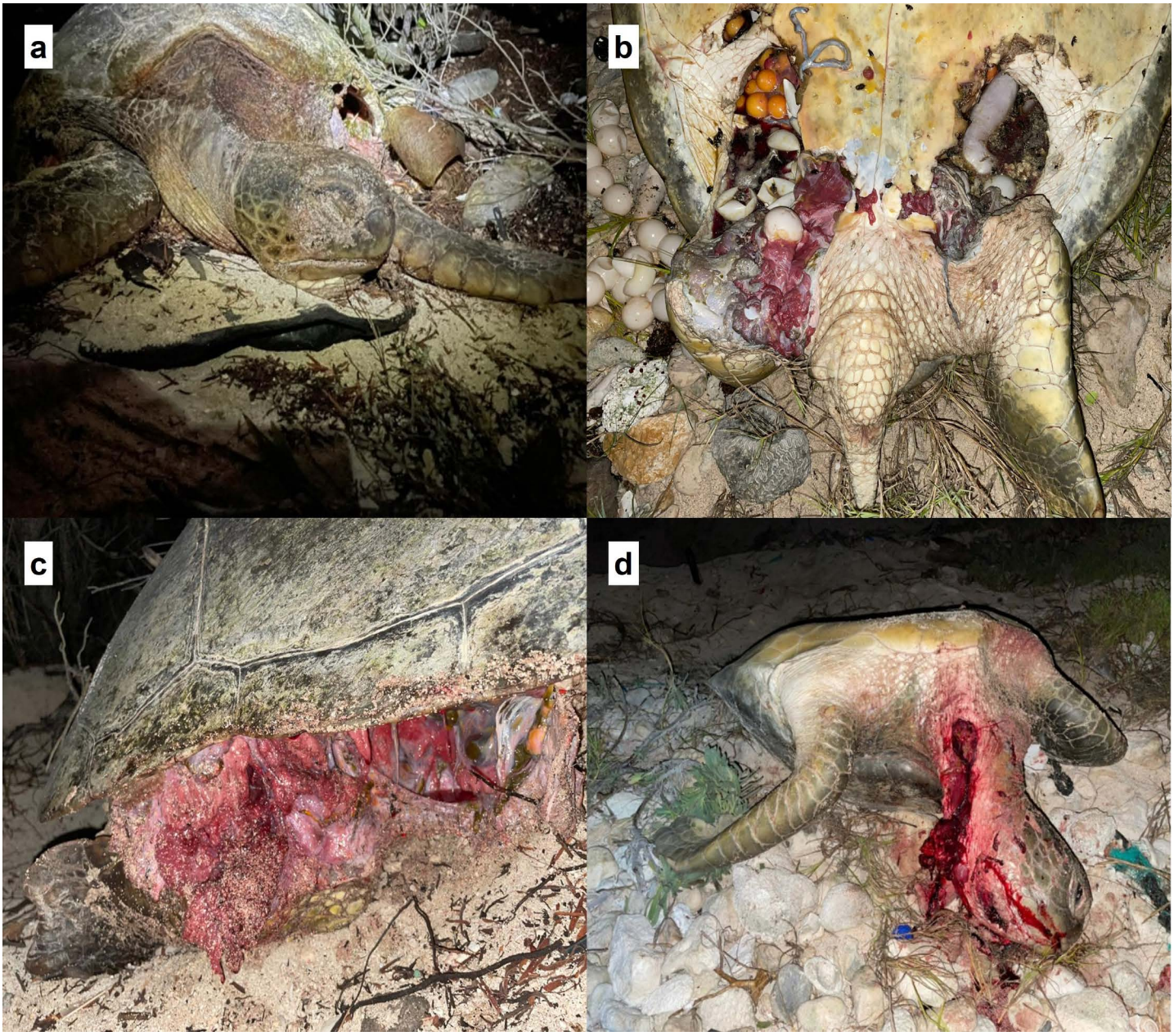

Figure 2. a-d) Turtle carcasses with evidence of jaguar predation. The records were collected on the beach in Mahahual, Quintana Roo, México.

With a sampling effort of 600 camera trap nights, we recorded 10 independent events of the presence of jaguar, which were captured at various times of the day and night, plus 3 photo events confirming jaguar predation on sea turtles. Multiple jaguar tracks (footprints and scats) were observed on the beach during the monitoring period, in addition to carcasses of jaguar-predated turtles (*C. mydas* and *C. caretta*) on 25, 28, and 29 July 2021.

A series of photographs were captured with a camera trap placed on the dunes of the beach at coordinates 19° 4′ 51.91″ N, 87° 33′ 8.31″ W (Figure 1), recording a jaguar walking in the same area where carcasses were found on 28 July (Figure 2a–2d), plus 2 photographs recorded on 29 July 2021 that captured 2 male jaguars feeding on sea turtles subsequently identified as *C. mydas* (Figure 3a) and *C. caretta* (Figure 3d) by direct observation. These carcasses showed bite marks on the legs and were partially eaten on the thighs; eggs were also consumed (Figure 3d). The characteristic spot-rosette pattern allowed identifying 2 solitary adult jaguar males that feed on turtles in the area. Dogs have also been observed at the site, occasionally scavenging on turtle carcasses left by jaguars. All predation events occurred at about 15–30 m from the coastline, between 0:00 and 5:00 hr. Jaguars were not recorded returning a second time to feed on the carcasses on subsequent nights.

Predation on sea turtles by jaguars in the Mexican Caribbean has not been sufficiently documented. Since nesting turtles are easy to capture, some jaguar individuals have likely learned to take advantage of these preys as sources of protein and energy, since preying upon them represents a low energy cost to meet the jaguar nutritional needs (Cuevas *et al.* 2014).

In the 2021 nesting season in Mahahual, we located 24 nests of *C. caretta* and 62 nests of *C. mydas* (Rosales-Hernández pers. comm. 2021). The number of nesting females of *C. mydas* has increased exponentially throughout the Gulf of México and the Caribbean Sea in recent years (Christianen *et al.* 2014), leading to higher abundance on the beach, even in places where it was rarely observed at least a decade ago (Lara-Dzul *et al.* 2014). This rise in the number of nests has been attributed to the outstanding implementation of protected beaches as habitats for sea turtles, mainly by the efforts of governments and conservation organizations (Shaver *et al.* 2020).

The use of camera traps has allowed documenting various aspects of the jaguar everyday life; however, they had rarely been used to evidence predation on sea turtles (Cuevas *et al.* 2014). The nighttime tours had no apparent effect on the presence of jaguars in turtle-nesting areas; in fact, the first author was able to directly take a photograph of a jaguar preying on a turtle (Figure 3d).

Dog predation by jaguars has been recorded in the study area (Carral-García *et al.* 2021). The particular spot–rosette patterns allowed identifying that the same jaguars were hunting both turtles and dogs, suggesting that they have diversified their diet to leverage on the local conditions and adapt their behavior to the environmental and anthropic factors around them. The current evidence indicates that in the Mexican Caribbean, the jaguar feeds on hawksbill, green, and loggerhead turtles; there is no evidence suggesting that it also consumes leatherback turtles (*Dermochelys coriacea;* de la Esperanza *et al.* 2017). Considering the low abundance of the leatherback turtle (*D. coriacea*), one might think that the jaguar is not discriminating between turtle species, but is feeding opportunistically since its dietary habits largely depend on prey availability (Seymour 1989; Núñez *et al.* 2000; Arroyo-Arce *et al.* 2014; Wolf and Ripple 2016). Sea turtles are consumed by a wide variety of natural predators during their early life stages *i.e.*, eggs and hatchlings (Engeman *et al.* 2005). However, they have few natural predators in their adult stage (Heithaus *et al.* 2008); therefore, these 2 new records of predation on sea turtles provide relevant information that will contribute to a better understanding of the feeding behavior of the jaguar, and document predation events on adult sea turtles. It also expands the current knowledge of the interactions of sea turtles with their natural predators on nesting beaches in countries where this same behavior has been previously reported, such as Costa Rica, Guyana, Suriname, and México (Fretey 1977; Autar 1994; Cuevas *et al.* 2014; Guilder *et al.* 2015). The relevance of this note is evident since the turtle species reported and the jaguar are classified as conservation priorities by the Mexican government, besides being considered flagship species in many countries.

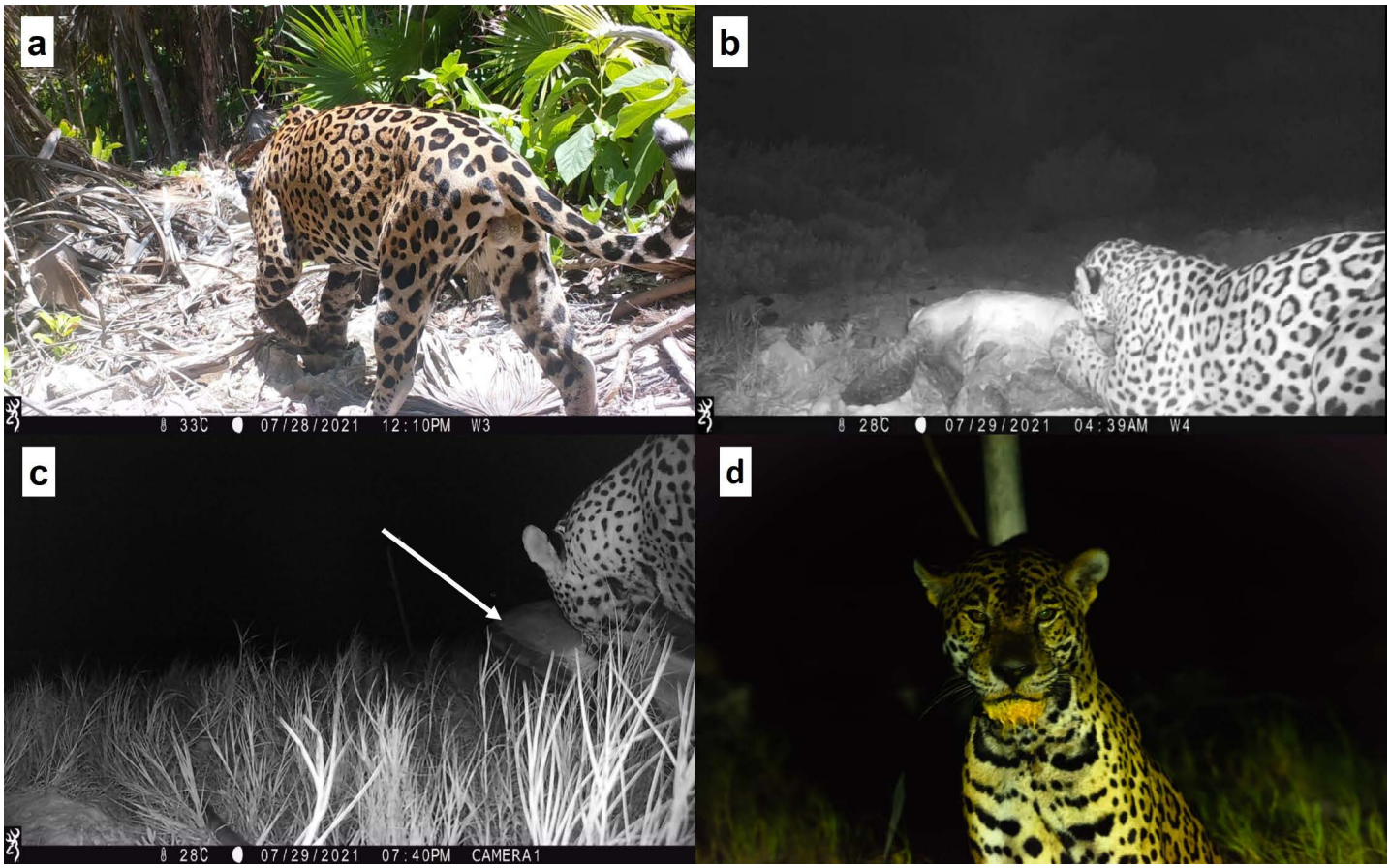

Figure 3. a-b) Jaguar wandering on the beach where preyed turtle carcasses were observed. c-d) Two jaguar predation events on sea turtles (*C. caretta*, c; *C. mydas*, d). The arrow in c marks the carcass of a turtle being eaten by a jaguar. The records were collected on the beach in Mahahual, Quintana Roo, México.

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