

Predation on the Hawksbill Turtle *Eretmochelys imbricata* by the Jaguar *Panthera onca* in the Pacific coast of Costa Rica

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In the sea, the most common predators of adult sea turtles are sharks (i.e., *Carcharhinus leucas*, *Carcharodon carcharias*, *Galeocerdo cuvier*) (Witzell 1987, Cliff & Dudley 1991, Fergusson et al. 2000) and killer whales (*Orcinus orca*) (Fertl & Fulling 2007); while on their nesting beaches, female turtles are susceptible to predators like jaguars (*Panthera onca*) and crocodiles (*Crocodylus acutus*) (Ortiz et al. 1997, Heithaus et al. 2008).

Throughout America, jaguars have been recorded killing Green (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacea*), Hawksbill (*Eretmochelys imbricata*) and Leatherback (*Dermochelys coriacea*) sea turtles (Fretey 1977, Autar 1994, Carrillo et al. 1994, Chinchilla 1997, Tröeng 2000, Heithaus et al. 2008, Veríssimo et al. 2012, Barça 2013, Keeran 2013, Arroyo-Arce et al. 2014, Cuevas et al. 2014, Arroyo-Arce & Salom-Pérez 2015, Guilder et al. 2015). At locations where both species persist, sea turtles could be an important food resource for jaguars because they are easy to prey upon, and they represent an important income of biomass (Veríssimo et al. 2012, Arroyo-Arce & Salom-Pérez 2015, Guilder et al. 2015). Additionally, they can be key resources in periods when the availability of other prey is low (Veríssimo et al. 2012).

One of the most exploited, threatened and unknown sea turtle is the Hawksbill or Carey Turtle (*E. imbricata*) (Mortimer & Donnelly 2008). Hawksbills have a circumtropical distribution, and often nests on small oceanic islands, but they are also found feeding and nesting on mainland coasts (Mortimer & Donnelly 2008). Nesting is very disperse; there are not many large aggregations of nests (Ficetola 2008). The Hawksbill has been listed by the IUCN as Critically Endangered (Meylan & Donnelly 1993, Mortimer & Donnelly 2008). Historic and recent accounts estimate a 90 percent population decrease globally in all major oceans during the past 100 years (Mortimer & Donnelly 2008). There is evidence that in the Neotropical region, the populations of *E. imbricata* are decreasing in both the Atlantic and Pacific Oceans (Mortimer & Donnelly 2008). Currently, most of its nesting beaches are located in the Caribbean Sea (Meylan 1999, Troëng et al. 2005) while in the Pacific Ocean, the hawksbill is rare or with nesting sites that are scattered and very low in numbers (Troëng et al. 2005).

Due to the small population size and low predation rates on adults of Hawksbill turtles, observations of predator-prey interactions are understandably rare in this species (Heithaus et al. 2008, Cuevas et al. 2014, Arroyo-Arce & Salom-Pérez 2015). For example, predation on *E. imbricata* by jaguars has been observed only in three locations on the coast of the Caribbean Sea (Reserva de la Biosfera Sian Kaan, Mexico; Tortuguero National Park, Costa Rica; and the Shell Beach stretch, Guyana) and, to date, predation events are unknown on the coast of the Pacific Ocean (Keeran 2013, Cuevas et al. 2014, Arroyo-Arce & Salom-Pérez 2015) (Figure 1). Here, we present the first record of the predation of *E. imbricata* by jaguars on the Pacific coast, as well as the first report of this species nesting inside the Santa Rosa National Park, Costa Rica.

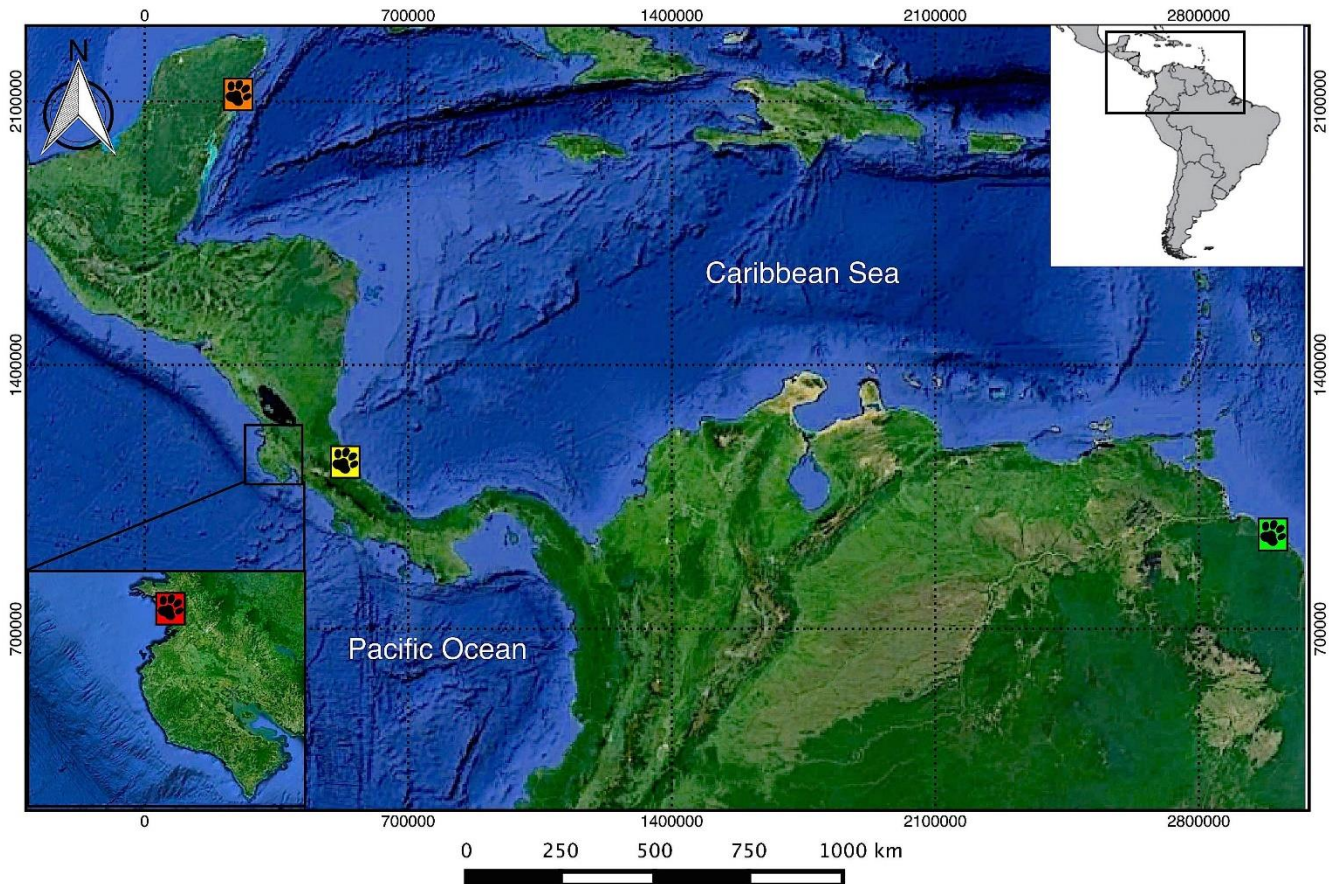


Figure 1. Locations of jaguar predation events on *Eretmochelys imbricata*. Orange paw: Biosphere Reserve Sian Kaan, Quintana Roo, México (Cuevas et al. 2014). Yellow paw: Tortuguero National Park, Limón, Costa Rica (Arroyo-Arce & Salom-Pérez 2015). Green paw: Shell Beach stretch, Guyana (Keeran 2013). Red paw: Santa Rosa National Park, Guanacaste, Costa Rica (new record for the Pacific Ocean).

The predation event was observed on July 20th 2015 at 14h00 at the Potrero Grande beach, Santa Rosa National Park ($10^{\circ}51'03.20''N$, $85^{\circ}47'31.41''W$; 3 masl) (Figure 1). The carcass was found in the vegetation near the beach. The carapace was 70 cm long and 55 cm wide, corresponding to an adult female (Figure 2). The carcass was partially consumed by the jaguar and we are sure that the death of this individual was due to jaguar predation because the carcass had all the distinctive characteristics of jaguar predation such as bite marks on the neck and front flippers (Veríssimo et al. 2012).

Most of the knowledge about the trophic relationship between jaguars and sea turtles has been derived from studies in Costa Rica (Carrillo et al. 1994, Chinchilla 1997, Tröeng 2000, Veríssimo et al. 2012, Barça 2013, Arroyo-Arce et al. 2014, Arroyo-Arce & Salom-Pérez 2015, Guilder et al. 2015). Such studies have been conducted on nesting beaches, mainly at three local national parks: Tortuguero, Corcovado and Santa Rosa (Carrillo et al. 1994, Guilder et al. 2015). Within the Santa Rosa National Park, Cornelius (1986) and Carrillo et al. (1994) documented jaguar predation events on Green and Olive Ridley sea turtles at Naranjo and Nancite beaches. Our observation at the Potrero Grande beach constitutes the first record of a Hawksbill predation by a jaguar in this park on the Pacific coast



Figure 2. Individual of *Eretmochelys imbricata* predated by a jaguar at Potrero Grande beach, Santa Rosa National Park, Costa Rica (Photo by Jennifer Castro).

Cornelius (1986) mentioned that in the beaches and sea area of the Santa Rosa National Park, four species of sea turtles could be found (i.e., *L. olivacea*, *C. mydas*, *E. imbricata* and *D. coriacea*). However, he clarifies that the nesting of *E. imbricata* has never been recorded in the park (although, juveniles may be seen swimming along the base of the rocky cliffs between Tule and Nancite beaches). In addition, an ongoing study on sea turtles within the Santa Rosa National Park has been unable to record the nesting or presence of an adult *E. imbricata* (Fonseca et al., 2009). Thus, our observation in the Potrero Grande beach also represents the first record of an adult Hawksbill turtle in the Santa Rosa National Park. Further investigation of this type is required to determine if predation of *E. imbricata* by jaguars is a widespread phenomenon on beaches where both species are sympatric, and whether this can influence the size of the populations of *E. imbricata*.

The information about predation of sea turtles by jaguars in the Santa Rosa National Park is still anecdotal and descriptive (e.g. Carrillo et al. 1994, current report). Santa Rosa National Park does not have a substantial jaguar research program such as those in the Tortuguero National Park, and information about the temporal and spatial trends of jaguar predation, carcass utilization rates and the impact of jaguar predation on sea turtle populations is unavailable (see Veríssimo et al. 2012, Arroyo-Arce et al. 2014, Arroyo-Arce & Salom-Pérez 2015, Guildera et al. 2015). Therefore, research efforts similar to those in Tortuguero should be made at Santa Rosa National Park sea turtle nesting beaches to better understand the predator-prey relationship between jaguars and sea turtle nesting populations and make management decisions that facilitate the sustainability of jaguar and turtle populations and their predator-prey interactions.

The trophic relationship between jaguars and sea turtles involves two species threatened by human impact. In Costa Rica, both species are widely recognized as conservation flagships and large-scale projects have been developed to conserve them. Knowledge on the ecological relationship between jaguars and sea turtles may contribute to their conservation, especially for jaguars whose bulk of terrestrial prey continue to decline throughout its range (Caso et al. 2008). It can also set the basis for

the establishment and management of sound touristic programs in the few places where jaguars, sea turtles and people (volunteers, researchers and tourists) converge.

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