**Rapid Communication**

# Coyote recent expansion in Quintana Roo State, Northeast Yucatan Peninsula, Mexico

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## Abstract

Coyotes are successful generalist carnivores that are favored by anthropogenic activities. We document a range expansion for the species into the State of Quintana Roo, Mexico. We used camera traps to determine the presence and documented two separate events during 2020 and 2021. We discuss the implications for the presence of the species in highly developed areas dedicated to tourism and livestock. Habitat transformation seems to be a conducive factor that facilitates colonization and will have future impacts on urban developments in the region.

**Key words:** camera trap, carnivores, deforestation, urban expansion

## Introduction

The coyote (*Canis latrans* Say, 1823) is a generalist carnivore, opportunistic, and highly adaptable (Bekoff and Gese 2003). These characteristics have a positive influence on their successful expansion into new regions, turning it into a species with a highly invasive potential (Hody and Kays 2018). During the past century, coyotes have undergone a dramatic range expansion across much of North and Central America. From their original distribution in northern and central Mexico, the southwestern United States, and western Canada coyotes, the species is currently distributed throughout most of the United States, portions of eastern Canada to southern Alaska (Bekoff and Gese 2003). In the southern part of their distribution, coyotes are now widespread in Mexico except in portions of the Yucatan Peninsula reaching central Panama (Bekoff and Gese 2003; Hidalgo-Mihart et al. 2004a; Hody and Kays 2018).

The recent deforestation of tropical areas by human activities has been suggested as the key factor contributing to the establishment of new coyote populations in the southern part of their distribution (Hidalgo-Mihart et al. 2004a). This probably has contributed to the recent coyote records in the Yucatan Peninsula including northern Yucatan (Sosa-Escalante et al. 1997), Campeche (Hidalgo-Mihart et al. 2013; Guzmán-Soriano et al. 2013),

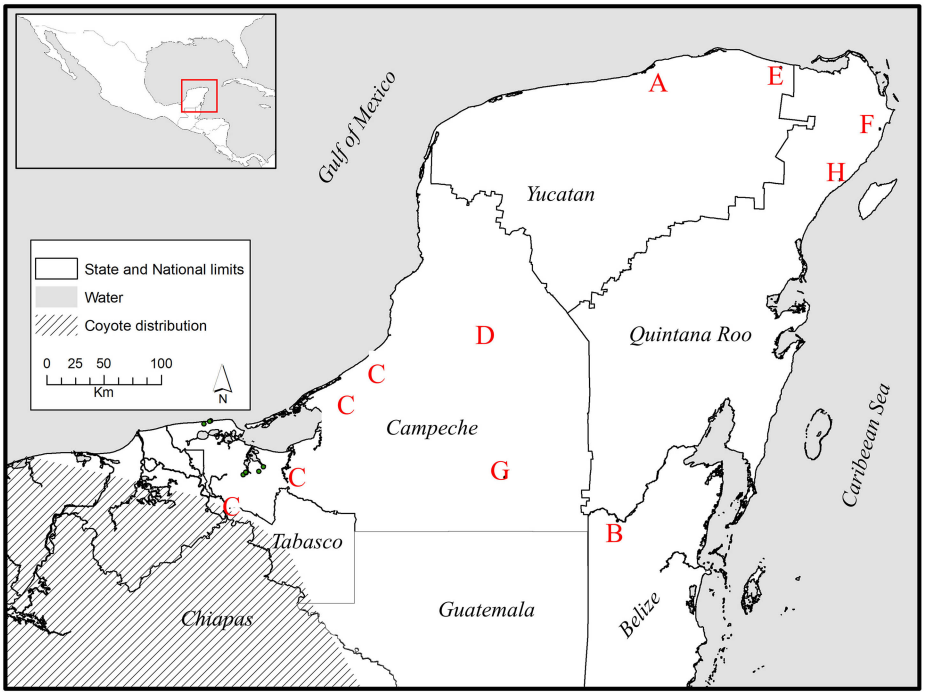


**Figure 1.** Location of the study area and the coyote records along the Yucatan Peninsula. A. – Sosa-Escalante et al. 1997; B. – Platt et al. 1998; C. – Hidalgo-Mihart et al. 2013; D. – Guzmán-Soriano et al. 2013; E. – iNaturalist users 2021a; F. – iNaturalist users 2021b; G.– Contreras-Moreno et al. 2020; H. – Current study. Coyote distribution was obtained from Hall 1981.

Calakmul (Contreras-Moreno et al. 2020), and Belize (Platt et al. 1998; Jones et al. 2020). However, coyotes have not been yet recorded in the eastern portion of the Yucatan Peninsula (mostly comprised by the Quintana Roo state in Mexico), even though extensive mammal surveys have been performed in the area (eg. Pozo-de la Tijera and Escobedo-Cabrera 1999; Faller-Méndez et al. 2005; Urquiza-Haas et al. 2011; Hernández-Díaz et al. 2012; Sosa-Escalante et al. 2013; González-Gallina et al. 2018a).

As part of a study of jaguar (*Panthera onca*) and puma (*Puma concolor*) ecology in the Playa del Carmen suburbs in Quintana Roo, Mexico, we carried out an extensive camera trap effort and recorded the presence of coyotes in the area. This is the first-time coyotes were recorded within the Quintana Roo State, expanding the known distribution of the species to the west from the previously known records of the species (Sosa-Escalante et al. 1997).

## Materials and methods

The study area took place in the northeastern portion of the Yucatan Peninsula *ca.* 15 km southwest of the Playa del Carmen city in the Solidaridad municipality, Quintana Roo, México (Figure 1). The area, as most of the Yucatan Peninsula, is flat with an average elevation of < 10 m. The weather is warm and sub-humid with annual mean temperatures as low as 21 °C (mean minimum) and as high as 31 °C (mean maximum). Annual mean rainfall is 1330 mm, and around 75% of the precipitation occurs from June to October (Instituto Nacional de Estadística y Geografía 2019). The original

vegetation in the area was tropical evergreen forest (Rzedowski 2006). However, the northeastern portion of Quintana Roo is subject to the loss of large tracts of tropical forests. Mostly due to the expansion of subsistence agriculture, unplanned urban expansion associated with the growth of tourist activities in the cities of Cancún and Playa del Carmen, and the effect of hurricanes that frequently hit the region, causing damage to the forest and favoring forest fires (Ellis et al. 2017).

The main goal of the study was to determine the presence and abundance of large felids and their potential prey in the area. To accomplish this objective, we placed 23 single camera trap stations (Browning BTC-7A) in 2018, 2019, 2020, and 2021 for at least 85 days each year for a total effort of 4,289 camera days. The cameras were set from March to June of each year and were active 24 h per day (one camera day equals one camera station in operation for 24 h). We installed the cameras on human-made trails and roads used frequently by large felids located in the tropical evergreen forests and the mature second-growth forests of the region. We attached cameras to trees at a height of 50 cm above the ground and programmed to operate 24 hours per day. The photographs of the observed mammal species were identified using Reid (2009).

To document additional records of the presence of the coyote in the eastern portion of the Yucatan peninsula, we searched for occurrence data in the web-based database Global Biodiversity Information Facility (GBIF; http://www.gbif.org) and iNaturalist (www.inaturalist.org). We only considered coyote live or death photographs or osteological evidence included in scientific collections as valid coyote records from GBIF and iNaturalist.

## Results

We obtained a total of 32,929 wildlife photographs and two were coyote records. We obtained the first coyote picture on April 16, 2020 at 08:18, and the second coyote was photographed on May 18, 2021 at 8:07. Both records were from the same camera trap, located along a dirt road in the study area (87.1694W; 20.6095N; Figure 1). We identified the photographed individuals as coyotes due to the characteristic slender body, the pointed nose, and the coat color (Figure 2; Reid 2009). We are unable to discern sex or age from the photographed individuals.

We found four recent records of the species georeferenced in the GBIF and iNaturalist databases. Two of the records corresponded to coyote tracks or scats, that do not fulfill our prerequisites to be considered valid records. Then we only validated two coyote photographic records obtained in the Northeast of the Yucatan Peninsula: GBIF 3090871584 from Tizimín, Yucatán obtained on 19 May 2017 (iNaturalist users 2021a) and GBIF 1699383497 from "Moon palace, Benito Juárez, Quintana Roo" obtained on 24 October 2017 (iNaturalist users 2021b; Figure 1).


**Figure 2.** Coyote camera trap pictures obtained in Northeastern Quintana Roo state, México in the Northeastern portion of the Yucatan Peninsula. A. – Coyote picture obtained in 2020; B. – Coyote picture obtained in 2021. Both pictures were obtained at the same camera trap location.

## Discussion

The records obtained in this report represent the first-time coyotes were observed in the northeast of the Yucatan peninsula and the first record of the species in the Quintana Roo state. The observed records expand the known distribution of the species 160 km to the west from the previously known records of the species (Sosa-Escalante et al. 1997) and increase the mammal fauna of the Quintana Roo state to 109 species, 19 of them carnivores from the original list of Sosa-Escalante et al. (2013). The results of the search in the GBIF and iNaturalist database showed that coyotes have been in northeastern Quintana Roo at least since 2017. However, other studies performed during the same period failed to record coyotes in the area (González-Gallina et al. 2018a). In addition, despite an extensive camera trap effort in the area, we were able to obtain only two coyote records (0.006% of total photos). This is probably an indication that coyotes in the region are in an early process of colonization and lack established permanent populations in the area.

The origin of the coyotes arriving to our study area is uncertain. The closest certainly occupied area by coyotes is in the North of the Yucatán state (Sosa-Escalante et al. 1997). Hidalgo-Mihart et al. (2004a) observed that coyotes in tropical areas of southern Mexico and Central America were absent in most of the areas where extensive patches of tropical moist forests persist, including large portions of the Yucatan Peninsula. In the Quintana Roo state, from the year 2000 to 2013, more than 330,000 ha of mature forests were transformed into induced pastures and second-growth forests, mostly in the southern part of the state (Ellis et al. 2017). In the case of the northeastern portion of the state, even though the land-use change for agricultural purposes is not as important, it still suffers the loss of large tracts of tropical forests. This loss comes mostly due to an unplanned urban expansion associated with the growth of tourist activities in the cities of Cancun, Playa del Carmen, and Tulum (Campos-Cámara 2008; Ellis et al. 2017). The transformation of forested habitats into open habitats could be contributing to the expansion of coyotes, adding new localities in the region, and in accordance with the current land use transformation in the area will favor the occurrence of the species in the future.

In Mexico and Central America coyotes are considered pests because frequently conflict with sheep and cattle production (Soto-Shoender and Giuliano 2011; Hernández-Lara 2010). The northeastern portion of Quintana Roo state is an area where tourism is the dominant economic human activity (Instituto Nacional de Estadística y Geografía 2019) and has limited sheep and cattle grazing areas (Padrón Ganadero Nacional 2021). Although there is evidence of wildlife depredation on sheep and cattle (*pers. obs.*) in the area, the most common cause of human-wildlife conflicts in the region is dog (*Canis lupus familiaris*) predation, especially in the suburban areas (Carral-García et al. 2021). Coyotes have agonistic interactions with dogs, including predation (Alexander and Quinn 2011). Under the current scenario where urban growth in northeastern Quintana Roo will continue (Campos-Cámara 2008; Ellis et al. 2017), it is possible that in the near future coyote-dog interactions will occur and be the prevalent cause of human-wildlife conflicts in the region.

Coyotes may represent the new apex predator in eastern North America and other parts of the continent, with cascading effects on predator communities and disease dynamics (Gompper 2002; Levi and Wilmers 2012). Our study records, along with the GBIF record occurred in the vicinity of the Playa del Carmen and Cancun cities respectively. Coyotes have been previously observed using areas where urban residues are disposed (Hidalgo-Mihart et al. 2004b). Coyotes are considered important disease vectors because they can live in the interface between the urban and forested areas and commonly use garbage disposal areas (Murray et al. 2016). The occurrence of coyotes in the landfill areas of the Quintana Roo cities is foreseeable. Garbage disposal sites in Quintana Roo are used by

other carnivore species including jaguars (González-Gallina et al. 2018b), making possible the intense interactions between coyotes and other wild carnivores in these sites, favoring disease dispersion among the different species that visit the disposal areas.

Coyote is not the only mammal species whose recent expansion has been documented in the eastern Yucatan Peninsula fostered by large-scale deforestation in recent times. Hidalgo-Mihart et al. (2017) recorded the presence of Eastern cottontail rabbit (*Sylvilagus floridanus*) range expansion in the Quintana Roo probably related to the land-use change in the region. Two new mammals expanding their range probably as a result of deforestation, indicate that several other vertebrate species that thrive in induced grasslands or associated to urban expansion could be invading this region. It is necessary to increase surveys of the vertebrate fauna in the region, especially in deforested areas to early detect the presence of new invading species and carry out the necessary management actions to avoid the colonization of new invasive species.

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## Authors' contribution

CALG and MGHM conceptualized and wrote the manuscript. CALG and MFCT designed and carried out the field study. CALG, MGHM, and MFCT reviewed the final draft of the manuscript.

## Ethics and permit

Authorized and evaluated by the Ethics Committee of the DIP UAQ Resolution #DIP/369-19. We carried out fieldwork under the SEMARNAT permits SGPA/DGVS/03793/20 and SGPA/DGVS/03793/20.

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