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NOTES ON GEOGRAPHIC DISTRIBUTION

Mammalia, Carnivora, Canidae, *Canis latrans* (Say, 1823): Actual distribution in Panama

Pedro Méndez-Carvajal [1,2*] and Ricardo Moreno [2]

1 Fundación Pro-Conservación de los Primates Panameños (FCPP), 0816-07905 Panamá, República de Panamá.
2 Proyecto Yaguará-Panamá, Sociedad Panameña de Biología (SPB), Panamá, República de Panamá.
* Corresponding author. E-mail: *fcprimatespanama@gmail.com*

ABSTRACT: This study reports the occurrence of *Canis latrans* on eastern Panama, including the first report of it presence across the Panama Canal, which expands the known distribution for this species to its southernmost point. The presence of *Canis latrans* on this region suggests that it is expanding its range Southwards by using deforested areas and areas of cattle ranching alongside the Panamerican Highway. This highway crosses the isthmus up to the Darien Province.

Canis latrans (Say, 1823) is one of the most widespread canid species in Mesoamerica (Andrews and Boggers 1978; Gompper 2002), with up to 20 recognized subspecies (Wilson and Reeder 2005), but only three of them occurring outside of Canada, Mexico, and the United States. The Panamanian coyote is most closely related to the Salvadorian coyote *Canis latrans dickeyi* (Nelson 1932; Csuti 1980). *C. latrans* has populated central Mexico to Central America since pre-Columbian times, and fossil records confirm its presence in Mesoamerica in the Pleistocene (Cisneros 2005) and Early Holocene (Hidalgo-Mihart 2004). Although there are reports of coyote in Nicaragua from 1514, it seems that this species expanded its distribution in Central America from Mexico during the 20th century southwards to Belize, Guatemala (Ordoñez-Garza *et al.* 2008), Honduras, El Salvador (Monje-Nájera and Morera-Brenes 1987), Costa Rica since the 1960s (Umaña *et al.* 2009), and Panama since the 1980s (Méndez *et al.* 1981). Coyotes are commonly distributed in western Panama, but with few records for central and eastern Panama.

C. latrans have naturally entered Panama since 1995 in the Barú District (Iglesias 2002), and were accidentally introduced in Doléga District, when some captive individuals escaped from a private military farm called "Los Pirrales," (Iglesias 2002). Thus, the first sightings of coyotes in Panama were anecdotally reported in Paja de Sombrero, Gualaca and Los Angeles in the Gualaca District, and in Barú and Renacimiento Districts, specifically the community of Breñon (Méndez *et al.* 1981). *C. latrans* has been reported extensively by local newspapers as causing damage and preying on calves in western Panama since the 1980s (La Prensa, Panamamerica, La Nación, Crítica), while migrating through Panama's ranch and farmland (Vaughan *et al.* 1983; Iglesias 2002). Coyotes have been settling in the Azuero Peninsula in groups of five individuals or more from 1995 to 2000 (Méndez-Carvajal 2005). Azuero Peninsula is a densely populated area, and one of the main areas in Panama for cattle production (Méndez-Carvajal 2011). In Azuero, *C. latrans* prey on calves, dogs, turkeys, goats, and other corral animals, including wildlife such as *Tamandua mexicana* and *Alouatta coibensis* (Méndez-Carvajal 2005). The Panamanian Environmental Authority (ANAM) confirmed coyote attacks on more than 55 chickens and 17 goats in Macaracas area in 2006, Los Santos Province.

We used presence/absence surveys, random sampling, camera traps, direct observations and *ad libitum* data to generate a distribution database, following Graham *et al.* (2004) and Guisan and Wilfried (2005). We set up 378 understory camera traps (Cuddeback and Bushnell-Trophy Cam) to identify mammal diversity from 2002 to 2013 in Cana, Cocle del Norte, Panama Canal Watershed, Guna Yala, Panama, Punta Burica, Boquete, Golfo de Montijo, Cerro Canajaguas, Azuero Peninsula, Bajo Chiquito Embera–Wounam Reserve, and Chucanti Nature Reserve. We also carried out informal interviews and direct observations in 151 localities in Panama, along with consult to local newspapers and ANAM data. Then, we assembled these data to determine the presence/absence of *C. latrans* in Panama (Table 1, Figure 1).

C. latrans has been recorded in Las Margaritas, Chepo District, eastern Panama in January 2013 by Sergio Bermúdez (9°11′08.20″ N, 79°04′48.07″ W). This record is the Southernmost locality for *C. latrans* in Mesoamerica (Figure 2).

The presence of *C. latrans* in Panama has gone almost unnoticed by the Panamanian population, but it is causing alarm in people who live in farming areas. However, there have been no reports of coyotes attacking humans in Panama. Few areas from their actual distribution have been detected as established habitat for coyotes, mostly zones where they can be detected by their nocturnal howls. The movement of coyotes in Panama is not unexpected due to the presence of cattle ranches near the Panamerican Highway, and their distribution is expected to reach the Darien province (Monje-Nájera and Morera-Brenes 1986; Hidalgo-Mihart *et al.* 2004).

The success of *C. latrans* is due to its high reproduction rate, good adaptation to pastures mixed with secondary forest, human disturbance, and lack of natural predators (Umaña *et al.* 2009). The successful establishment of *C.*

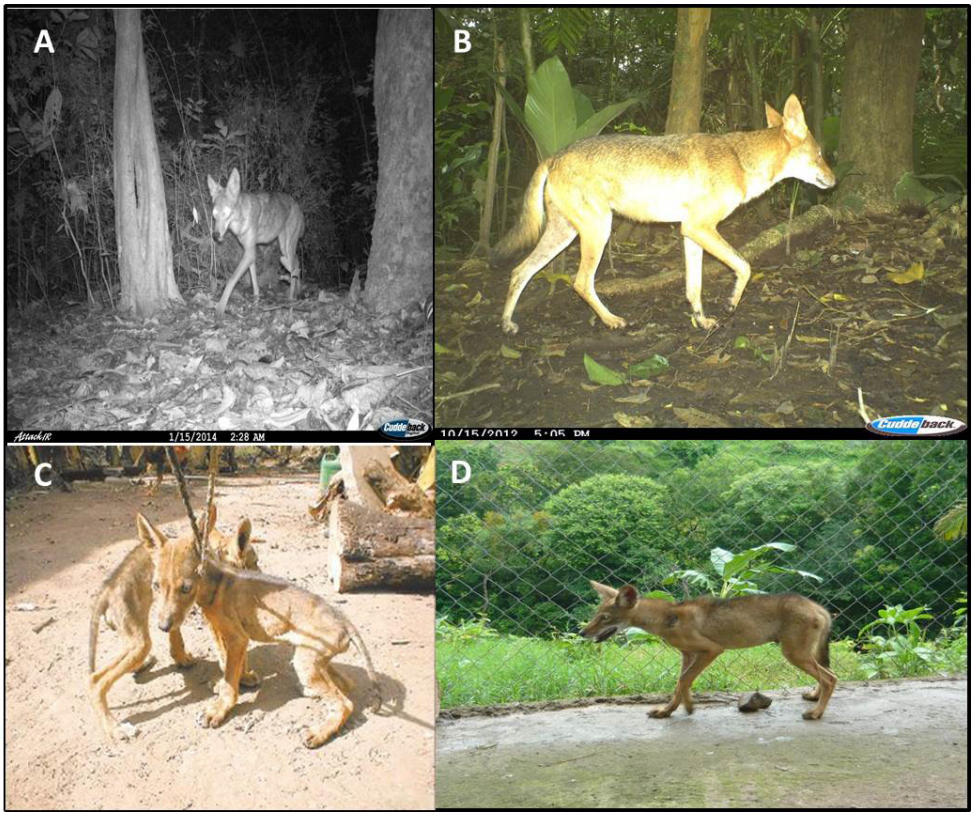

Figure 1. Coyote *Canis latrans* in Panama. A: An individual of coyote captured in Herrera Province; B: Coyote picture captured in a camera trap at San Lorenzo National Park, Colón Province; C: Coyote's cubs found in Tonosí, Los Santos Province, Azuero Peninsula; D: Juvenile of coyote captured at El Colmón of Macaracas, Los Santos Province.

Table 1. Locality records of Canis latrans in Panama. A: attacks reported, DO: direct observation, C: camera trap, I: interview, T: tracks

LOCALITY	PROVINCE	GEOGRAPHIC COORDINATES	PRESENCE	METHOD	SOURCE
Punta Burica	Chiriqui	8°5′8.10″ N, 82°52′13.64″W	Yes	DO	FCPP
Volcan	Chiriqui	8°43′46.09″ N, 82°18′11.56″ W	No	I	FCPP
Boquete	Chiriqui	8° 47′23.4″ N, 82° 24′ 46.5″ W	No	I	FCPP
David	Chiriqui	8°27′21.20″ N, 82°17′54.28″ W	Yes	I/DO	FCPP
Golfo de Montijo	Veraguas	7°52′25.58″ N, 80°56′12.32″ W	Yes	T/C	FCPP
Santa Fe	Veraguas	8°28′40.83″ N, 80°57′6.16″ W	No	I/C	SPB
Cerro Canajaguas	Los Santos	7º 26′48.9″ N, 80º 16′25.3″ W	Yes	C	FCPP/SPB
La Miel	Los Santos	7°59′48″ N, 80°41′37″ W	Yes	I/A	FCPP/Prensa
El Cacarañal	Los Santos	7° 27′00.75″ N, 80° 21′00.21″ W	Yes	I/A	FCPP/Prensa
Pedasi	Los Santos	7°26′07″ N, 80°11′38″ W	Yes	I/A/DO	FCPP/Prensa
Llano Hato	Herrera	7°59′24″ N, 80°41′33″ W	Yes	I/A	FCPP
Llano Grande	Herrera	7°59′89″ N, 80°41′62″ W	Yes	I/A	FCPP
Llano de la Cruz	Herrera	7°43′30″ N, 80°48′41″ W	Yes	I/A	FCPP
Las Minas	Herrera	7°44′55″ N, 80°48′52″ W	Yes	I/A	FCPP
El Montuoso	Herrera	7°43′57″ N, 80°48′01″ W	No	I	FCPP
Pesé	Herrera	7°55′22.55″ N, 80°37′11.55″ W	Yes	I/A	FCPP
Penonome	Coclé	8°38′1.96″ N, 80°23′6.74″ W	Yes	I/A	Prensa
Chame	Panama	8°34′11.07″ N, 79°51′33.89″ W	Yes	I/A	Sergio Bermúdez-IGES/Prensa
Capira	Panama	8°38′40.02″ N 79°55′6.62″ W	Yes	I/A	Sergio Bermúdez-IGES/Prensa
Campana	Panama	8°46′50.15″ N, 79°51′33.89″ W	Yes	I	Sergio Bermúdez-IGES/Prensa
Chorrera	Panama	8° 57′28.87″ N, 79° 36′25.78″ W	Yes	I	Sergio Bermúdez-IGES/Prensa
Arraijan/Howard	Panama	8° 52′47.44″ N, 79° 45′7.27″ W	Yes	I/DO	FCPP/Prensa
Colon Highway	Colon	9°14′47.0″ N, 79°41′10.7″ W	Yes	DO	SPB
P. N. Soberania (Pipeline road)	Colon	9°09′13.7″ N, 79°44′26.0″ W	Yes	C	SPB
San Lorenzo	Colon	9°15′46.4″ N, 79°57′53.0″ W	Yes	C	MWH
Chepo	Panama	9°11′08.20′′ N, 79°04′48.07 W	Yes	I/DO	Sergio Bermúdez-IGES
Nusagandi	Guna Yala	9°20′45.2″ N, 78°59′18.9″ W	No	I/C/DO	SBP
Bajo Chiquito	Darien	8°29′01.0″ N, 77°38′23.3″ W	No	I/C/DO	SPB/FCPP
Chucanti	Darien	8°47′22.0″ N, 78°27′05.6″ W	No	I/C/DO	SPB/FCPP
Cana	Darien	7°54′27.6″ N, 77°39′03.7″ W	No	I/C/DO	SPB
Pirre	Darien	7°55′11.6″ N, 77°42′43.5″ W	No	I/DO	SPB

latrans in Azuero Peninsula could be related to cattle farming activity in an area that is 80% deforested, but still with forest reserves, gallery forest and living fences. Thus, *C. latrans* could use both habitats and hunt eventually calves and corral birds when natural prey is lacking. Although *C. latrans* do not use areas permanently, observations suggest that it has attacked calves mostly during the rainy season. Observations from locals also report this species eating fruits, including *Manguifera indica*, *Byrsonima crassifolia*, *Spondias mombin*, and *Citrillus lanatus*. Part of the reason for *C. latrans* to prefer farming and cattle lands could be the lack of natural predators in the area. The high negative pressure that natural predators (*e.g.* jaguars and cougars) have experienced for more than 60 years have lead them to near-eradication in almost the entire peninsula (Méndez-Carvajal 2011). The absence of natural predators could facilitate the colonization of other predators, such as *C. latrans* that use the forest as a refuge for reproduction and pastures to hunt (Monje-Nájera and Morera-Brenes 1986, Palomares and Caro 1999; Figure 2).

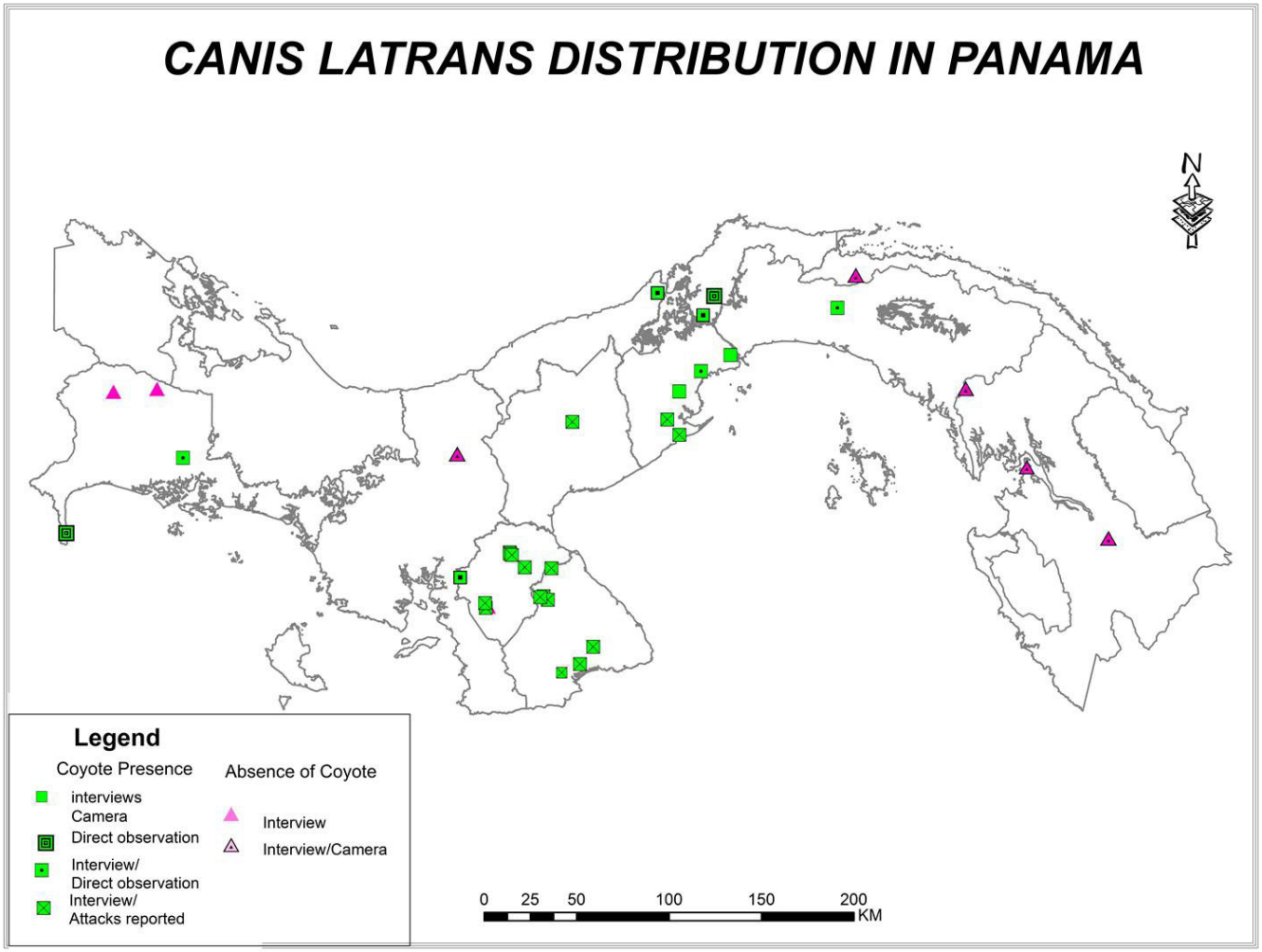

Figure 2. Actual distribution of *Canis latrans* in Panama.

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