



Geographic Expansion of the Common House Gecko, *Hemidactylus frenatus* (Squamata, Gekkonidae), in Baja California Sur, Mexico

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Across the globe, species continue to be introduced outside their native ranges where they may colonize, spread, and possibly cause extinctions of vulnerable native species through predation, competition, and habitat modification (Mack et al. 2000; Hoskin 2011). About 185 species of reptiles have been introduced and established outside their native ranges (Lever 2006), and within the Squamata, geckos of the genus *Hemidactylus* are the prevalent introduced group (Rödder et al. 2008). The Common House Gecko, *H. frenatus* (Duméril and Bibron 1836), is native to tropical Asia and the Indo-Pacific, and has been introduced throughout the world (Lever 2006; Kraus 2009), becoming one of the world’s most widely distributed lizards (Hoskin 2011). *Hemidactylus frenatus* is a highly adaptable and competitive colonizer, known to invade natural habitats, and serves as a carrier of novel parasites that can affect native reptilian species (Case et al. 1994; Hanley et al. 1995; Rödder et al. 2008).

In México, *H. frenatus* has become established in 24 states: Aguascalientes, Baja California, Baja California Sur, Campeche, Chiapas, Colima, Guerrero, Hidalgo, Jalisco, México, Michoacán, Morelos, Nayarit, Puebla, Oaxaca, Querétaro, Quintana Roo, San Luis Potosí, Sinaloa, Sonora, Tabasco, Tamaulipas, Veracruz, and Yucatán (Valdez-Villavicencio and Peralta-García 2008; Quintero-Díaz et al. 2008; Farr 2011). In Baja California Sur, *H. frenatus* was first reported in La Paz based on a gecko collected on 4 March 1983 (Reynoso 1990) and likely was introduced by maritime shipping between La Paz and ports in southwestern México (Grismer 2002). To date, *H. frenatus* has been reported at four locations in the Cape Region of the state (Reynoso 1990; Grismer 2002; Norman 2003), four locations north of the Cape Region (Grismer 2002; Luja et al. 2010, 2011; Lara-

Resendiz et al. 2017), and one insular record in the Gulf of California (Dayton et al. 2020). Herein we report additional records of *H. frenatus* and describe its ongoing geographic expansion in Baja California Sur.

Our data are based on observations made from 2003 to 2017, including a focused biological survey in the Cape Region that sampled every other month from September 2014 to September 2016, opportunistic visits to cities, towns, and ranches, and recent records on the community science platform iNaturalist (<http://www.naturalista.mx>). We conducted visual searches during the night with teams of 3–5 people walking slowly around urban areas and rural settlements in the Cape Region and in urban areas along the Transpeninsular Highway north of La Paz. We used photographic vouchering and collected geckos by hand, sometimes with the aid of rubber bands or lassos. At every location, we interviewed local residents to determine the year when the species was first observed. Collected specimens were deposited in the herpetological collection at the Universidad Autónoma de Baja California (UABC) in Ensenada, Baja California, México.

We found *H. frenatus* at 60 new locations (including 25 records from the iNaturalist platform) from the five municipalities in the state (Fig. 1) for a total of 69 locations documenting the species in the Baja California Sur (Table 1), 53 (82%) of which are from Cape Region localities between La Paz and Cabo San Lucas, the two largest cities in the state. At most locations surveyed, we found evidence of well-established *H. frenatus* populations with all life stages present. According to interviews with locals, the main pathway of introduction has been human-mediated dispersal by incidental transport in local products and from national commercial

products that came from other states in mainland Mexico (e.g. Jalisco, Guerrero). The oldest oral history record was

from a resident of Ejido Melitón Albañez who recalled the initial arrival of these geckos in 2000.

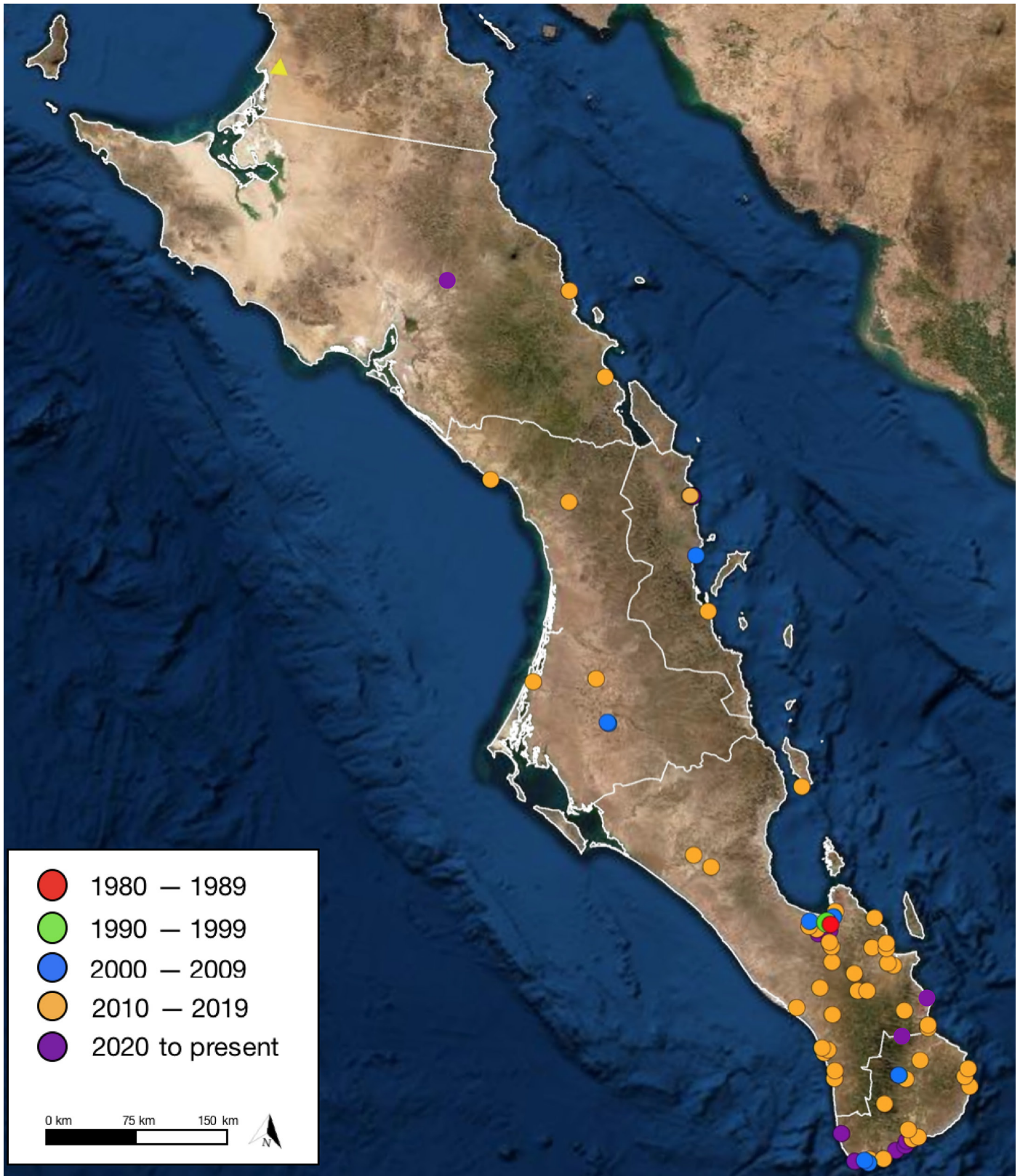


Figure 1. Records of the Common House Gecko (*Hemidactylus frenatus*) in Baja California Sur, Mexico, indicated by year. White lines delimit municipalities and the yellow triangle represents the record from Jesus María, Baja California (Kabes et al. 2015), which is not included in Table 1.

Table 1. Locations where Common House Geckos (*Hemidactylus frenatus*) have been recorded in Baja California Sur, Mexico. Records from the citizen science platform iNaturalist (iNat) include the observation number.

Locality; Life Stage(s); Year of Arrival	Source	Date Observed
San Ignacio (27.29878, -112.90451); Adult; —	iNat 114718380	30 April 2022
Santa Rosalia, Hotel El Morro (27.32491, -112.24968); Adults; —	Luja et al. (2011)	25 May 2010
Mulegé (26.89088, -111.98534); Juveniles, adults; —	UABC 2563–4	1 July 2015
San Basilio (26.37177, -111.42879); All stages; —	UABC 2587–8	6 December 2019
San Juanico (26.24361, -112.51536); Adult; —	iNat 57018841	2 July 2015
La Purísima (26.18964, -112.07338); Hatchling; —	Lara-Resendiz et al. (2017)	8 September 2017
Loreto (26.01021, -111.34367); All stages; —	Grismer (2002), this study	19 September 2015
Ensenada Blanca, Villa del Palmar (25.71858, -111.23340); Juvenile; —	iNat 19385456	1 January 2019
Ciudad Insurgentes (25.26211, -111.77959); Juveniles, adults; 2013	UABC 2565–8	7 July 2016
Puerto López Mateos (25.19219, -112.11579); Juveniles, adults; 2015	UABC 2569–70	7 July 2016
Ciudad Constitución (25.03222, -111.67414); Juveniles, adults; —	Luja et al. (2010), this study	25 October 2008
Isla El Partidito, Golfo de California (24.85286, -110.58053); Juveniles, adults; 2010	Dayton et al. (2020)	17 June 2019
Las Pocitas (24.39536, -111.10432); Juvenile; —	UABC 2583	11 September 2016
El Cién (24.34646, -111.00211); Juveniles, adults; 2004	UABC 2584–5	10 September 2016
Bahía El Caimancito (24.21151, -110.29524); Adult; —	iNat 20937288	1 March 2019
Rancho Las Cruces (24.20916, -110.07942); Juveniles, adults; —	This study	13 November 2014
Hotel La Palmira (24.18007, -110.30068); Adult; —	UABC 2540	1 April 2003
La Paz (24.13580, -110.31183); All stages; —	Reynoso (1990), this study	4 March 1983
El Comitán (24.13557, -110.42663); All stages; —	This study	7 November 2005
El Centenario (24.10945, -110.42345); All stages; —	This study	30 September 2013
Fracc. La Cima, La Paz (24.10199, -110.34110); Adult; —	iNat 47006642	23 May 2020
Near UABCS, La Paz (24.10138, -110.31167); Adult; —	iNat 50224413	19 June 2020
Chametla (24.09873, -110.38218); Adult; —	iNat 22984584	14 April 2019
El Sargento (24.08420, -109.99395); All stages; —	UABC 2549-2550	15 November 2014
La Paz Airport (24.07575, -110.36725); Adult; —	iNat 64447740	5 November 2020
La Ventana (24.05357, -109.98994); Juveniles, adults; —	UABC 2551	15 November 2014
Rancho El Chivato (24.04570, -110.06738); Adult; 2016	This study	11 September 2016
Colonia Ayuntamiento, 11.4 km S of La Paz (24.04035, -110.30004); Adults; —	This study	11 July 2015
Colonia Calafia, 14 km S of La Paz (24.01880, -110.28827); Adult; —	iNat 3634099	6 July 2016
3.4 km W of San Juan de Los Planes (23.97641, -109.96857); All stages; —	UABC 2586	26 May 2016
San Juan de Los Planes (23.96772, -109.93717); All stages; —	UABC 2552–3	15 November 2014
San Pedro (23.93584, -110.27185); All stages; —	UABC 2562	11 July 2015
Rancho Los Divisaderos (23.89215, -110.14158); Adult; 2011	UABC 2558	10 July 2015
El Cardonal (23.84197, -109.74027); Juvenile; —	iNat 110630822	5 April 2022
San Antonio (23.81096, -110.05874); All stages; —	UABC 2552–3	18 May 2015
El Triunfo (23.80174, -110.10936); Adults; —	UABC 2559–60	10 July 2015
El Carrizal (23.78597, -110.31326); Juveniles, adults; 2008	UABC 2581–2	10 September 2016
San Bartolo (23.73551, -109.84039); Juveniles, adults; —	UABC 2548	8 September 2014
Los Barriles (23.67880, -109.70271); All stages; —	UABC 2555	17 November 2014
Buenavista, S of Los Barriles (23.66252, -109.69911); Juveniles, adults; —	This study	17 November 2014
Ejido Melitón Albañez (23.66195, -110.42155); All stages; 2000	UABC 2579–80	10 September 2016
Todos Santos, 22.8 km N of La Ribera (23.65357, -110.22505); Adult; —	UABC 2577–8	10 September 2016
La Ribera (23.59348, 109.58640); Adult; —	iNat 41144933	31 March 2020
Rancho El Refugio, Cañón San Dionisio (23.54976, -109.81742); Adult; —	iNat 146342753	2 January 2022

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Santiago (23.48151, -109.71516); Juveniles, adults; —	UABC 2556	17 November 2014
Cabo Pulmo, 5 km NW of Todos Santos (23.47830, -109.44934); Adult; —	iNat 1753385	5 July 2015
3.5 km NW Todos Santos (23.46567, -110.25245); Juvenile; —	iNat 21126262	9 March 2019
Todos Santos (23.46141, -110.21942); All stages; —	UABC 2547	7 September 2014
Hotel La Poza, Todos Santos (23.44189, -110.23797); Adults; —	This study	7 September 2014
Cabo Pulmo (23.43096, -109.45944); Adult; —	UABC 2545	10 November 2013
Boca de la Sierra (23.38555, -109.81703); Adults; —	Grismer (2002), this study	17 November 2014
Los Frailes Bay (23.38235, -109.42534); Adult; —	iNat 44797683	1 November 2019
Miraflores (23.36835, -109.77652); Juveniles, adults; —	UABC 2554	17 November 2014
El Pescadero (23.35541, -110.16501); Juveniles, adults; —	UABC 2576	11 July 2016
Los Cerritos (23.31105, -110.16016); Adult; —	UABC 2574–5	11 July 2016
Retiro Budista, 19 km NW San Jose del Cabo (23.21793, -109.86845); Juvenile; —	iNat 10866193	24 December 2015
El Zacatal, San José Viejo (23.09926, -109.72039); Adult; —	iNat 4487299	2 November 2016
Hotel Misión la Serena, San José del Cabo (23.06669, -109.65927); Adult; —	iNat 7012132	11 July 2015
San José del Cabo (23.06458, -109.70812); —; —	Grismer (2002)	Unknown
Estero San José (23.05161, -109.68940); Juveniles, adults; —	UABC 2571–3	11 July 2016
Club Campestre San José (23.03717, -109.71952); Adult; —	iNat 54691652	4 July 2020
3.5 km SE of Migriño (23.02092, -110.07531); Adult; —	iNat 56088596	10 August 2020
Punta Palmilla (23.01103, -109.72283); Juvenile; —	iNat 66495958	12 December 2020
Hotel Ventanas al Paraiso (22.97765, -109.76990); Adult; —	iNat 41128339	15 February 2020
Hotel Fiesta Americana (4.5 km W of Los Cabos) (22.92220, -109.82870); Juvenile; —	iNat 3514896	5 February 2016
Los Cabos Gulf Resort (22.90724, -109.90144); Adult; —	iNat 400594	25 August 2013
Hotel Oasis, Cabo San Lucas (22.89660, -109.92727); All stages; —	This study	6 September 2009
Hotel Bahía, Cabo San Lucas (22.88846, -109.90565); Adult;	Norman (2003)	3 January 2001
Cabo Baja (22.88288, -109.98202); Juvenile; —	iNat 62359702	10 October 2020

Hemidactylus frenatus was first reported in Baja California Sur in 1990 in the city of La Paz (Reynoso 1990) from a specimen collected in 1983 (UABCS 331). However, ships have been traveling to La Paz since the early 1800s, with regular shipping dating to 1828 (Busto-Ibarra 2013). The establishment of ferry routes between La Paz and mainland Mexico, connecting La Paz and Mazatlán, Sinaloa, started in 1964 (Sánchez 2017). The introduction of *H. frenatus* likely occurred earlier than 1983, as the species was well established in mainland Mexico as early as 1895 (Farr 2011). Since their arrival in La Paz, the species has become widely dispersed based on observations of geckos on walls of houses and buildings throughout the city (all specific locations not shown in Fig. 1). Our data (Fig. 2) confirm the persistence of *H. frenatus* in locations previously reported (Reynoso 1990; Grismer 2002; Norman 2003; Luja et al. 2010, 2011) and clearly document geographic expansion within the Cape Region and localities to the north.

Even though these introduced geckos are associated with urban areas, they are known to occur in natural habitats as well (Valdez-Villavicencio and Peralta-García 2008; McKay and Milenkaya 2020). In 2013, our survey team heard the

easily recognizable chirping of *H. frenatus* in a rocky canyon west of the settlement at Cabo Pulmo, where *H. frenatus* was common on buildings. We were unable to locate the gecko due to the rocky terrain. Recently, a gecko was documented on Isla El Pardito in the Gulf of California (Dayton et al. 2020), and populations probably are present on other inhabited islands in the state (e.g., Islas Carmen, Magdalena, and Santa Margarita have human settlements). *Hemidactylus frenatus* is an aggressive species that can exclude native or previously established introduced species of geckos from food resources and retreat sites (Petren et al 1993; Brown et al. 2002; Powell 2003, 2004; Cole et al. 2005). The spread of *H. frenatus* over Isabel Island on the coast of Nayarit likely displaced the native Yellowbelly Gecko *Phyllodactylus tuberculatus* (Valdez-Villavicencio and Peralta-García 2008). The only other location reported in this study where *H. frenatus* occupied natural habitat was in the palm oasis of Estero San José. However, this locality is surrounded by the city of San José del Cabo. Additional fieldwork will be necessary to assess the possible displacement of native geckos, the San Lucan Leaf-toed Gecko (*Phyllodactylus unctus*) and the Cape Leaf-toed Gecko (*P. xanti*), by *H. frenatus*.



Figure 2. Common House Geckos (*Hemidactylus frenatus*) from Baja California Sur, Mexico: (A) Cabo Pulmo, 10 November 2013; (B) Hotel 4 Misiones, Ciudad Constitución, 6 September 2014; (C) Mulegá, 14 July 2015; (D & E) Loreto, 19 September 2015; (F) Ciudad Insurgentes, 7 July 2016; (G) Las Pocitas, 11 September 2016; and (H) Bahía San Basilio, 6 December 2019. Photographs by Jorge H. Valdez (A–F), Clark R. Mahrtdt (G), and Bradford Hollingsworth (H).

The absence of *H. frenatus* in the Vizcaíno Desert and Guerrero Negro in the northern part of the state might be attributed to this region's cool onshore breeze, cold temperatures (13–19 °C), and dense fog cover produced from the California current (Rebman and Roberts 2012). A record of *H. frenatus* from Jesus María, in the State of Baja California, located 35 km north of Guerrero Negro (Kabés et al. 2015), is an isolated occurrence based on the recent introduction of a single individual, and conversations with local residents indicate that the species has not been observed again. We are unsure whether this northernmost record on the peninsula was an unsuccessful colonization or the species persists in such low abundance that detection is difficult.

We suspect the species has already spread to most urban centers in the state. Future studies to confirm the distribution and prevalence of internal parasites (e.g., helminths, coccidian, or blood parasites) should focus on whether the species carries parasites that could threaten populations of native reptilian species (Hoskin 2011; Vanderduys and Kutt 2013).

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