

A Distinctive New Species of Mud Turtle from Western México

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ABSTRACT. – The genus *Kinosternon* in Mexico is represented by 12 species of which only 2 inhabit the lowlands of the central Pacific region (*Kinosternon chimalhuaca* and *Kinosternon integrum*). Based on 15 standard morphological attributes and coloration patterns of 9 individuals, we describe a new microendemic mud turtle species from the central Pacific versant of Mexico. The suite of morphological traits exhibited by *Kinosternon* sp. nov. clearly differentiates it from other species within the genus *Kinosternon* by a combination of proportions of plastron and carapace scutes, body size, and a large yellow rostral shield in males. The new species inhabits small streams and ponds in and near the city of Puerto Vallarta, Jalisco. Unfortunately, natural populations are unknown so far. The habitat is damaged by urban growth, and only one female is known. The available information would suggest that *Kinosternon vogti* sp. nov., is one of the most threatened freshwater turtle species. An urgent conservation program is necessary as well as explorations in the area to find viable populations of the species.

RESUMEN. – El género *Kinosternon* en México está representado por 12 especies, de las cuales solo dos habitan las tierras bajas de la región Pacífico central (*Kinosternon chimalhuaca* y *K. integrum*). Con base en la evaluación de quince atributos morfológicos y la coloración de nueve individuos, describimos una nueva especie de tortuga lodo micro-endémica del Pacífico central de México. El conjunto de rasgos morfológicos exhibidos por *Kinosternon* sp. nov., lo diferencia claramente de otras especies dentro del género *Kinosternon* por una combinación de proporciones de escudos de plastrón y caparazón, tamaño del cuerpo y un escudo rostral de color amarillo en los machos. La nueva especie habita pequeños arroyos y estanques en y cerca de la ciudad de Puerto Vallarta, Jalisco. No se conocen poblaciones naturales hasta el momento. El hábitat está dañado por el crecimiento urbano, y solo se conoce una hembra. La información disponible sugeriría que *Kinosternon vogti* sp. nov., es una de las especies de tortugas de agua dulce más amenazadas. Es necesario un programa de conservación urgente, así como exploraciones en el área para encontrar poblaciones viables de la especie.

KEY WORDS. – Reptilia; Testudines; Kinosternidae; *Kinosternon vogti* sp. nov.; microendemism; endangered species; Jalisco

Turtles are among the world's most endangered tetrapod vertebrate (Turtle Taxonomy Working Group [TTWG] 2017). The life history, ecology, and conservation status for most species is unknown, although turtles have a close cultural relationship with human communities in rural areas of the world (Páez et al. 2012; Legler and Vogt 2013). Currently, the scientific attention has been directed toward identifying biological diversity, filling

information gaps, and directing conservation priorities (Ceballos et al. 1998; Koleff et al. 2009; Martínez-Meyer et al. 2012). For example, reviews of terrestrial vertebrates in Mexico are based on accurate distributional data for amphibians, mammals, and birds (Peterson et al. 1993; Bojórquez-Tapia et al. 1995; García 2006) but often ignore the diversity of terrestrial and freshwater turtles. As a result, distributional knowledge is incomplete and limited

(Legler and Vogt 2013), which can lead to faulty conservation strategies for turtle species (see Macip-Ríos et al. 2015) and confusion about their taxonomy and distribution. Flores-Villela and García-Vázquez (2014) mentioned that a large number of new reptile species have been described in recent years, but a thorough taxonomic revision of turtles, particularly of the turtle genera *Kinosternon* and *Trachemys*, deserves urgent attention.

The exploration of Mexican aquatic environments in the second half of the 20th century resulted in the descriptions of 6 new species of freshwater turtles. Legler (1960) and Webb and Legler (1960) described—57 yrs ago—the Cuatro Ciénegas Slider *Trachemys taylori* and the Black Spiny Softshell *Apalone atra* (now *Apalone spinifera atra*), and Iverson (1979) described the Durango Mud Turtle *Kinosternon durangoense*. Thereafter, the same working group began to explore the aquatic environments along the western Pacific coast, describing the Yaqui Slider *Trachemys yaquia*, the Oaxaca Mud Turtle *Kinosternon oaxacae*, and the Alamos Mud Turtle *Kinosternon alamosae* (Legler and Webb 1970; Iverson 1979; Berry and Iverson 1980; Berry and Legler 1980). To our knowledge, the most recent freshwater turtle described was the Jalisco Mud Turtle *Kinosternon chimalhuaca* by Berry et al. (1997).

The genus *Kinosternon* in Mexico consists of 12 species of which 7 inhabit the Pacific coastal plain (Legler and Vogt 2013). There are no published records of freshwater turtles along some portions of the Pacific coast (TTWG 2017), but this may result from a lack of exploration or incorrect locality data. Urban and periurban areas are especially poorly studied and are not areas where new species are expected. An example is the Bahía de Banderas region on the coast of Jalisco and Nayarit, in the coastal plain of Puerto Vallarta, where 2 native species of freshwater turtles occur with the Ornate Slider *Trachemys ornata* and Mexican Mud Turtle *K. integrum* (Casas-Andreu et al. 2015; Fuentes-Castrejón and Maldonado-Gasca 2015; TTWG 2017). Surprisingly, the number of nonnative turtle species reported within and near to Puerto Vallarta has increased. Recent short communications reported the presence of *Apalone spinifera emoryi*, *Chelydra serpentina*, *Gopherus berlandieri*, and *Trachemys scripta* (Cupul-Magaña and Rubio-Delgado 2003; Cupul-Magaña 2012; Fuentes-Castrejón and Maldonado-Gasca 2015). The ecosystem effects of these nonnative species of turtles near Puerto Vallarta are unfortunately unknown. One of the most striking records was the occurrence of the Jalisco Mud Turtle *K. chimalhuaca* near the Campus of Centro Universitario de la Costa (hereafter termed CUC) of the Universidad de Guadalajara in Puerto Vallarta (Cupul-Magaña and Rubio-Delgado 2003), 125 airline-kilometers northwest of the known distribution (Berry et al. 1997). However, our recent review of these records showed that they actually represent an undescribed species of the genus *Kinosternon* with potential endan-

gered conservation status mainly due to accelerated urban coast growth.

We here describe *Kinosternon vogti* sp. nov. and propose an assessment of the conservation status of the species based on the number of specimens found, the skewed sex ratio, and the quality of its habitat.

METHODS

The characteristics of the new turtle specimens were compared with those of related Mexican species as provided by Berry and Iverson (1980), Berry et al. (1997), and Legler and Vogt (2013). We recorded 16 standard morphological attributes; character abbreviations are CL (maximum carapace length); CW (carapace width at the level of contact between marginal scutes 5–6), CH (maximum carapace height), HW (head width at the level of jaw articulation), AHW (width of anterior plastral lobe at the anterior hinge), PHW (width of the posterior plastral lobe at the posterior hinge), BRL (length of left bony bridge), HL (maximum length of the plastral hindlobe), LPH (length of interposterior humeral scute seam), FL (maximum length of the plastral forelobe), FEL (length of left interfemoral scute seam), PL (maximum length of the plastron), AIC (axillary–inguinal contact, or lack thereof), M2C (contact between the second marginal scute and the first vertebral scute, or lack thereof), V1–V5 (length and width of vertebral scutes 1–5), and M1–M11 (length and height of marginal scutes 1–11). We recorded the plastral formula described by Legler and Vogt (2013). All measurements were taken using digital calipers (ROK®) to the nearest 0.1 mm, and means \pm 1 standard deviation (SD) are provided. The first author measured all specimens. The sex of turtles was determined by the criteria of Berry and Shine (1980), where the males exhibited a long, prehensile, spine-tipped tail and clasping organs on the rear legs, and the females lacked thereof.

No systematic monitoring of the species exists in the region. Nonscientific collectors collected all known live specimens during the rainy season on the streets of Puerto Vallarta. Some people have donated specimens to “Reptilario Cipactli” of CUC, Universidad de Guadalajara in Puerto Vallarta. Two specimens kept in captivity at the Reptilario Cipactli and 2 specimens from a private collection were examined. Rafael García de Quevedo Machain and Frank McCann (Professor of the CUC and local photographer, respectively) provided some photographs of the specimens, and they were used to complement the description of live specimens (Appendix 1). One specimen that was run over by vehicles was donated to one of the authors (F.G.C.-M.) but not preserved. Some specimens had been photographed over time since 2000; if there was a reference measurement, we estimated other measurements using the Bersoft Image Measurement Program version 8.16 (Bersoft Software & Technology, Bridgewater, Nova Scotia, Canada). When

there was no reference measure, only the shell proportions were estimated.

SYSTEMATICS

Order: Testudines

Suborder: Cryptodira

Family: Kinosternidae

Kinosternon vogti sp. nov.

Vallarta Mud Turtle, Casquito de Vallarta

Holotype. — IBH-31568, whole, liquid-preserved adult male (CL = 87.1 mm); collected from an urban stream in Puerto Vallarta, Jalisco, Mexico (WSG84, 20°38'24.99"N, 105°13'55.57"W, 10 m elev. masl). Collected in July 2005 by F.G. Cupul-Magaña.

Paratypes. — Two males in the live collection of Reptilario Cipactli, Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT-UMA-EA-0035-JAL) numbers CUC-REPTILARIO K01 (CL = 83.1 mm) and CUC-REPTILARIO K02 (CL = 80 mm), collected in July 2012 near Río Pitillal in Puerto Vallarta, Jalisco (WSG84, 20°38'56"N, 105°13'48"W 10 m elev. masl), to be deposited on death to Colección Nacional de Anfibios y Reptiles (CNAR) from the Instituto de Biología at Universidad Nacional Autónoma de México. IBH31550, whole, liquid-preserved young male adult (CL = 77.6 mm), collected 4 September 2015 by E. Centenero-Alcalá in a temporary stream of Ixtapa, Puerto Vallarta, Jalisco, Mexico, near the CUC of the Universidad de Guadalajara (WSG84, 20°41'42"N, 105°12'9"W, 40 m elev. masl). IBH-31569, whole, liquid-preserved adult male (CL = 89 mm), collected from an urban stream in Puerto Vallarta, Jalisco, Mexico (WSG84, 20°38'24"N, 105°13'55"W, 10 m elev. masl) in July 2005 by F.G. Cupul-Magaña; one dried carcass (sex unknown), with carapace (CL = 101.5 mm) and plastron in good condition, collected in July 2005 in a concrete channel near Río Pitillal (WSG84, 20°38'27"N, 105°13'54"W, 10 m elev. masl), deposited in Reptilario Cipactli. Recently, during diurnal surveys (25 August 2017) in a stream near the CUC, Universidad de Guadalajara (WSG84, 20°42'24"N, 105°13'16"W, 40 m elev. masl), 1 male (cicea-kv-01) (CL = 83.5 mm) and 1 female (cicea-kv-02) (CL = 88.7 mm) were captured by M.M. Ramírez-Ramírez. These individuals were deposited alive in the Centro de Investigación y Conservación de Especies Amenazadas CICEA (INE/CITES/DFYFS-CR-IN-0023-TAB/99) of the División Académica de Ciencias Biológicas of Universidad Juárez Autónoma de Tabasco in Villahermosa City, Tabasco, Mexico, to begin a program of captive reproduction and create an assurance colony for this species.

Diagnosis. — *Kinosternon vogti* is the smallest member of the genus. The largest known specimen is a carcass of unknown sex (CL = 101.5 mm) with a depressed and weakly unicarinate carapace. It differs from the remaining species of the genus along the southern Pacific coastal plain of Mexico described in Berry et al. (1997) and

Legler and Vogt (2013) in having 1) a conspicuous yellow rostral shield in males, occupying all space between the eyes and nostrils (absent in all congeners); 2) the greatest relative carapace width of any member of the genus found along the Pacific coast (CW/CL = 74%; $n = 9$) compared with *K. chimalhuaca* (CW/CL = 66%; $n = 37$), *K. integrum* (CW/CL = 63%; $n = 34$), *K. oaxacae* (CW/CL = 63%; $n = 3$), and *Kinosternum scorpioides* (CW/CL = 67%; $n = 117$); 3) a very small plastron (PHW/CW = 47%–52%; $n = 9$) compared with *K. chimalhuaca* (PHW/CW = 50.5%–57.6%; $n = 54$), *K. integrum* (PHW/CW = 61.1%–67%; $n = 58$), *K. oaxacae* (PHW/CW = 54%–58.5%; $n = 18$), and *K. scorpioides* (PHW/CW = 63.4%–73.1%; $n = 24$); 4) a long interfemoral scute seam (FEL/HL = 32%–43%; $n = 9$) compared with *K. chimalhuaca* (FEL/HL = 23.1%–41.8%; $n = 54$), *K. integrum* (FEL/HL = 14.8%–28%; $n = 58$), *K. oaxacae* (FEL/HL = 23.6%–39%; $n = 18$), and *K. scorpioides* (FEL/HL = 0%–16.7%; $n = 24$); 5) a narrow bridge (BRL/CL = 13%–18%; $n = 9$) compared with *K. chimalhuaca* (BRL/CL = 15.3%–20.6%; $n = 54$), *K. integrum* (BRL/CL = 19.6%–27.4%; $n = 58$), *K. oaxacae* (BRL/CL = 19.4%–24.4%; $n = 18$), and *K. scorpioides* (BRL/CL = 27.3%–32.4%; $n = 24$); 6) a relatively large axillary scute, approximately 70% of the size of the inguinal scute and in broad contact with the latter compared with *K. chimalhuaca* (58%; $n = 2$), *K. integrum* (29%; $n = 4$), *K. oaxacae* (37%; $n = 1$), and *K. scorpioides* (29%; $n = 5$), and poorly in contact, sometimes separated in most of the Pacific coast species; 7) the inguinal scute only in contact with marginals 6 and 7 (never with M8) compared with the inguinal scute in contact with M6, M7, and M8 in the other Pacific coast species; and 8) the first vertebral scute not in contact with M2 (100%; $n = 10$) compared with *K. chimalhuaca* (88.9%; $n = 54$), *K. integrum* (106.4%; $n = 58$), *K. oaxacae* (0%; $n = 17$), and *K. scorpioides* (20.8%; $n = 24$).

Description of Holotype. — The holotype shown in Fig. 1 is an adult male, with the left bridge broken but otherwise in excellent condition. The holotype has the following characteristics: CL = 87.1 mm; CW = 63.0 mm; CH = 31.1 mm; HW = 22.8 mm; HL = 21.8 mm; AHW = 32.0 mm; LPH = 20.3 mm; FL = 26.4 mm; PHW = 29.9 mm; carapace relatively compressed and wide (CW/CL = 72%); unicarinate with longitudinal keel slightly evident; growth rings evident on plastral and carapacial scutes; scutes imbricate; V1 narrow, not in contact with M2; M1–M9 aligned; M10 slightly higher than M9; M11 of equal size to M9; V1 and V2 longer than wide; and V3–5 wider than long. Coloration of carapace brown-olive with the edge of scutes black. Plastron small (PL/CL = 79%), flat, with 2 kinetic hinges; anterior hinge straight and freely movable; posterior hinge flat anteriorly and slightly movable; posterior plastral lobe notched; axillary and inguinal scutes wide and in full contact; axillary extends from M4/5 seam to M5/6 seam; inguinal scute extending from anterior M6 to posterior M7. Plastral formula 4 > 6 > 5 > 1 > 3 > 2. Color of plastron yellow-

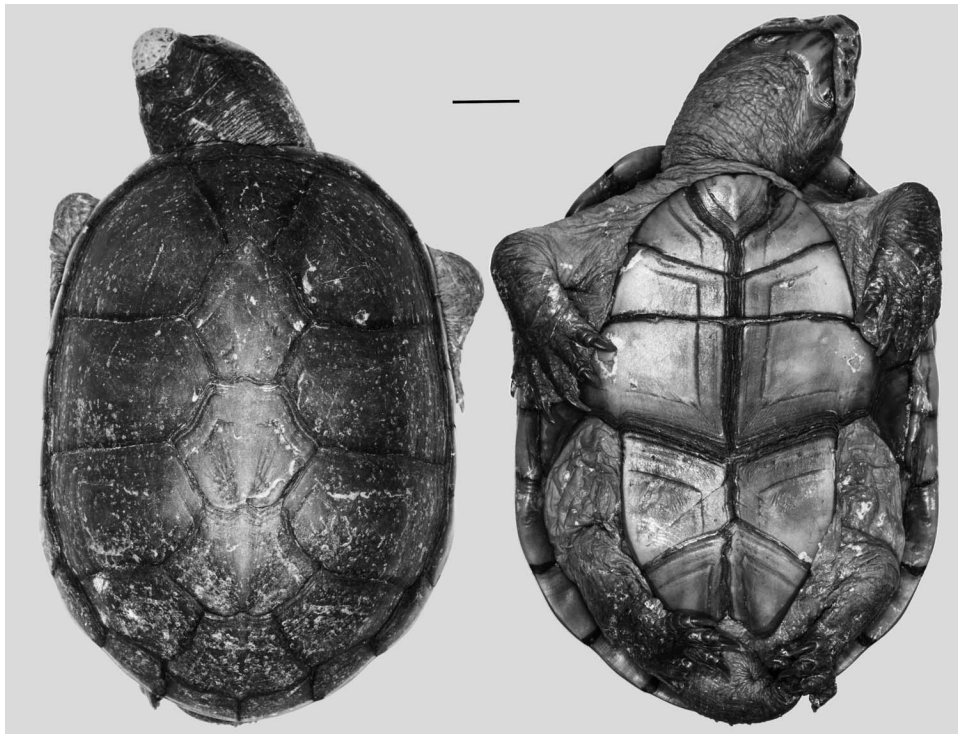


Figure 1. Holotype of *Kinosternon vogti* sp. nov. IBH-31568. (A) Dorsal view. (B) Ventral view. Black line represents 10 mm. Photo by Marco A. López-Luna.

orange with annuli proximal to midventral line dark brown; some darker stains on the gular scute, bridge, and posterior plastral lobe.

Head relatively large ($HW/CL = 26\%$), rostral shield large, rounded (not furcate or bell-shaped), and light yellow, with a reticulate pattern and fine black edge; maxillary sheath hooked. Diameter of the tympanic membrane as large as the eye socket. Two pairs of small chin barbels; the anterior pair elongated and conspicuous, the posterior pair reduced. Several isolated and small papillae on lateral or dorsal surfaces of the neck, no conspicuous rows. Tongue papillose. Head brown above with a small, light, reticulated pattern; light brown with a reticulated dark pattern on lateral and gular region. Jaw sheaths yellow, streaked with brown.

Manus and pes muscled and fully webbed; digital claws well developed. Keratinized patches on the posterior thigh and leg (clasp ing organs) present. Falciform scales on antebrachium and heel typically kinosternine, keratinized. Tail short and prehensile with a relatively small “claw” on the tip; proportional size of the tail is $< 50\%$ length of posterior plastral lobe; with 4 dorsolateral longitudinal rows of poorly developed papillae. Color of limbs and tail brown above, light reddish brown below.

Variation in Males. — Including the holotype, paratypes, and 2 other live individuals, we reviewed 1 exemplar in preservative, 1 carcass, and 3 exemplars in photographs (Fig. 2; Table 1). $CL = 79.9\text{--}101.5$ mm (mean = 87.7 ± 7.6 mm; $n = 8$); $CW = 60.8\text{--}73.0$ mm (mean = 65.1 ± 4.5 mm; $n = 8$); $CH = 29.17\text{--}42.4$ mm

(mean = 32.8 ± 4.6 mm; $n = 7$); $HW = 21.86\text{--}24.6$ mm (mean = 22.5 ± 1.1 mm; $n = 5$); $HL = 20.6\text{--}25.3$ mm (mean = 22.9 ± 1.8 mm; $n = 7$); $AHW = 32.0\text{--}43.4$ mm (mean = 36.6 ± 3.8 mm; $n = 7$); $LPH = 17.7\text{--}25.1$ mm (mean = 21.0 ± 3.0 mm; $n = 7$); $FL = 25.7\text{--}33.1$ mm (mean = 27.1 ± 2.9 mm; $n = 7$); $PHW = 29.9\text{--}37.9$ mm (mean = 32.2 ± 2.9 mm; $n = 7$); carapace relatively compressed and wide ($CW/CL = 73\%\text{--}78\%$, mean = 74% ; $n = 9$). Scutellation and color of carapace are similar to holotype. Proportion $PL/CL = 76\%\text{--}85\%$ (mean = 80% ; $n = 7$). Plastral formulae ($n = 10$): $4 > 6 > 5 > 1 > 2 > 3$ (60%), $4 > 6 > 5 > 1 > 3 > 2$ (20%), $4 > 6 > 5 > 3 > 1 > 2$ (10%), $4 > 6 > 5 > 2 > 1 > 3$ (10%). Color of plastron bright yellow to orange, some individuals with darkish stains, others with a smooth, unmarked plastron, and others with deep and dark interlaminar seams.

Relative head width (HW/CL) = $25\%\text{--}27\%$ ($n = 5$); all individuals with a distinctive large, yellow, oval rostral shield, occupying the interocular and supranasal region. Pattern color of the rostral shield can be smooth or with dark reticulation, bordered by a thin black line along the edge. Chin barbels and neck papillae similar to holotype. Head brown-greenish with small, light reticulations with mottled reddish and orange laterally. Some individuals with a conspicuous postocular, light-colored lateral line that extends to the neck; broken into mottles in others. Jaws sheaths yellow streaked to reticulated with brown. Lateral and ventral neck pale. Color of muscled manus, pes, and tail brown above, thighs and forearm pale. Characteristics of tail similar to holotype.

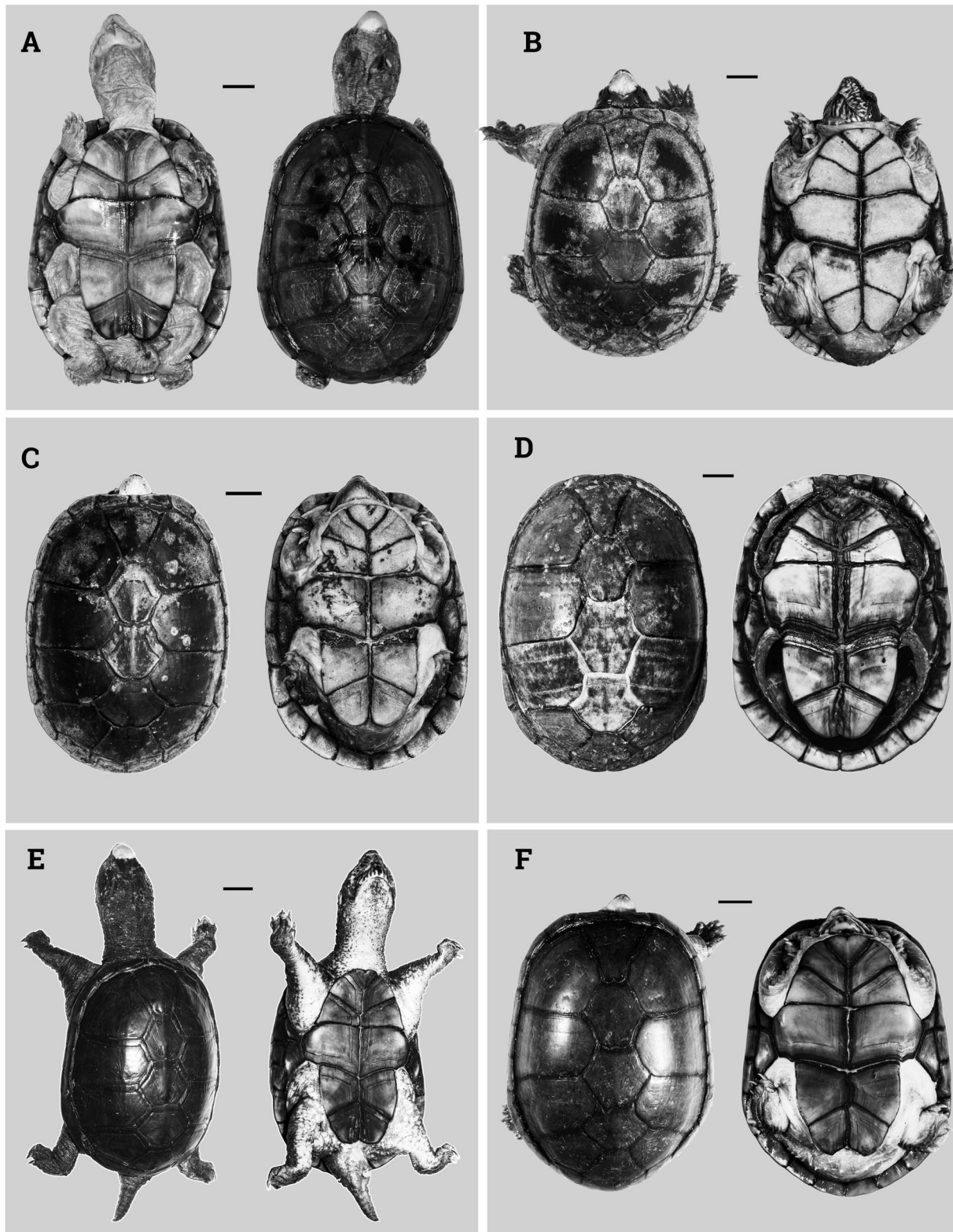


Figure 2. Paratypes of *Kinosternon vogti*. (A) IBH-31569. (B) CUC-REPTILARIO K01. (C) CUC-REPTILARIO K02. (D) Carcass in Reptilario Cipactli. (E) IBH-31550. (F) CICEA-KV-01. Black lines represent 10 mm. Photos by Marco A. López-Luna and Eric Centenero Alcalá.

Description of Only One Female (Fig. 3). — CL = 88.7 mm; CW = 66.9 mm; CH = 36.3 mm; HW = 20.8 mm; HL = 33.9 mm; AHW = 40.2 mm; LPH = 19.9 mm; FL = 31.1 mm; PHW = 35.5 mm;

carapace relatively compressed and wide (CW/CL = 75%). Scutellation and color of carapace are similar to holotype. Proportion PL/CL = 87%. Plastral formula: 4 > 6 > 2 > 1 > 5 > 3. Color of plastron

Table 1. Characters useful in distinguishing males of *Kinosternon* species in southern Pacific Coastal Mexico. (All data except those of *K. vogti* are from Berry et al. 1997.) Characters defined below and in the text.

	<i>n</i>	CL (mm)	Mean (range)					FEL/HL (%)	AIC, <i>n</i> /total (%)	M2C, <i>n</i> /total (%)
			AHW/CW (%)	PHW/CW (%)	BRL/CL (%)	FEL/HL (%)	AIC, <i>n</i> /total (%)			
<i>K. vogti</i> sp. nov.	9	88.5 (77.6–101.5)	56.0 (51–59)	49.9 (47–52)	15.5 (13–18)	38.3 (32–43)	4/8 (100)	0/9 (0)		
<i>K. chimalhuaca</i>	54	121.0 (98–157)	60.3 (54.6–66.1)	54.5 (50.5–57.6)	18.6 (15.3–20.6)	30.8 (23.1–41.8)	54/54 (100)	6/54 (11.1)		
<i>K. integrum</i> (Río Ameca)	10	133.8 (102–172)	75.0 (69.3–81.5)	64.7 (61.1–67)	24.2 (22–26.3)	20.6 (14.8–28)	8/10 (80)	9/10 (90)		
<i>K. oaxacae</i>	18	140.8 (93–175)	67.3 (62.3–72)	55.9 (54–58.5)	22.4 (19.4–24.4)	30.8 (23.6–39)	18/18 (100)	17/17 (100)		
<i>K. scorpioides</i>	24	122.0 (109–133)	76.6 (68.2–83.5)	67.0 (63.4–73.1)	29.8 (27.3–32.4)	7.4 (0–16.7)	1/24 (4.2)	19/24 (79.2)		

CL = carapace length; AHW = width of anterior plastral lobe at anterior hinge; CW = carapace width at level marginal scutes 5–6; PHW = width of posterior plastral lobe at posterior hinge; BRL = length of bony bridge; FEL = length of interfemoral scute seam; HL = length of plastral hindlobe; AIC = axillary-inguinal contact; M2C = contact between second marginal scute and first vertebral.

orange with darkish stains, and dark interlaminar seams.

Head relatively narrower (HW/CL = 23%) than in males. Surprisingly, the only female does not show the typical yellow rostral shield seen in males; it is bell-shaped rather than nearly round. Color of dorsal head light brown-olive with light mottling of black, reddish, and orange, and color of the tip between eyes and nostrils is light gray to dark orange. Chin barbels similar to holotype, and neck papillae absent. Jaw sheaths yellow-whitish and without reticulations. Lateral and ventral neck pale. Color of manus, pes, and tail brown above, thighs and forearm pale. Claspings organs absent. Tail short, no longer than the distance to the M10.

Etymology. — With great pleasure we name this new species in honor of one of the most important and enthusiastic researchers of freshwater chelonians of the 21st century, Professor Richard Carl Vogt. “Dick,” as his friends know him, has been involved for more than 40 yrs in studies of high scientific impact, mentoring along the way younger scientists in the study of freshwater turtles across the American continents, in the United States, Mexico, and Central and South America.

Geographic Range. — To our knowledge, the range of *K. vogti* is only from the urban area of the city of Puerto Vallarta, Jalisco. However, surveys in the lowlands of the same drainage basin, but outside urban areas, could extend its range. The municipality of Puerto Vallarta is located in the northern coastal region of the state of Jalisco. It is limited to the north by the state of Nayarit, south by the municipality of Cabo Corrientes and Talpa de Allende, on the east by San Sebastián del Oeste and Mascota, and on the west by the Pacific Ocean (Fig. 4). Currently, Puerto Vallarta is one of the most popular tourist destinations in the country. Because of urban pressures and tourism, the vegetation is constantly modified for agriculture, and wetlands are filled for urban development. Wetlands in the city have riparian vegetation including mangroves (*Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa*, and *Conocarpus erectus*), wetland plants (*Typha dominguensis* and *Thalia geniculata*), and riparian forest represented mainly by *Salix bonplandiana*, *S. humboldtiana*, and *S. taxifolia* as well as trees of the genus *Ficus*, and near to the coast *Hibiscus pernambucensis* (Ramírez-Delgado and Cupul-Magaña 1999).

DISCUSSION

Chelonian Knowledge along the West Coast of Mexico. — Herpetologists have explored the western coast of Mexico since the 19th century, and many herpetological records are from in the central and mountainous area of the state of Jalisco. Unlike other herpetofaunal groups, knowledge of the continental chelonian of the Mexican Pacific coast is incomplete (Chávez-Avila et al. 2015), and only recently have some distributional and taxonomic problems of freshwater

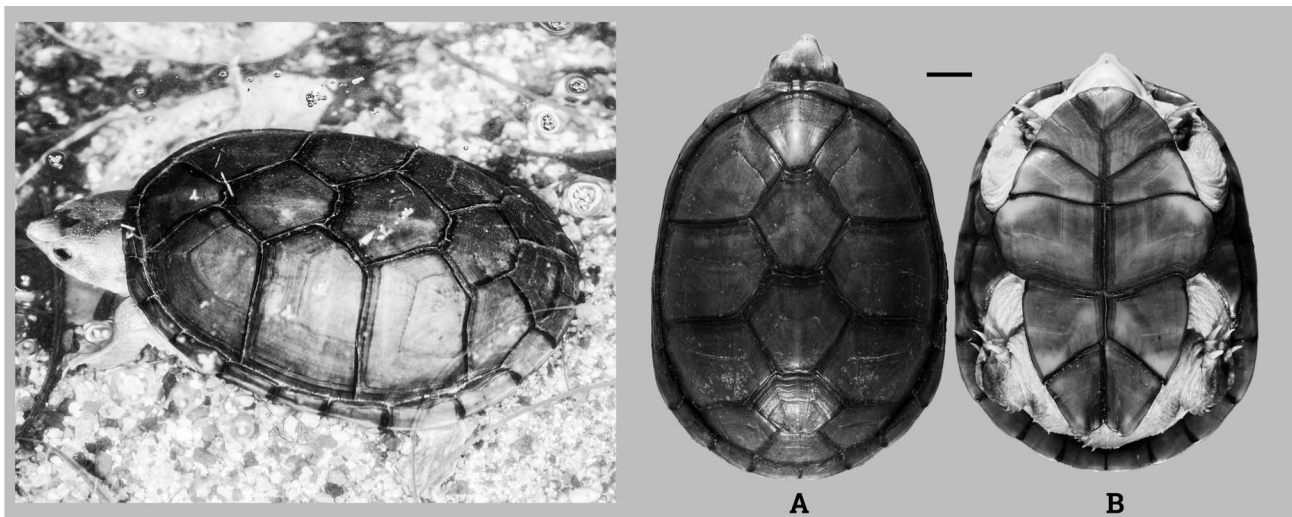


Figure 3. Female of *Kinosternon vogti* CICEA-KV-02. Note yellow nose-scale absence, characteristic in males. (A) Dorsal view. (B) Ventral view. Black line represents 10 mm. Photo by Marco A. López-Luna.

turtles in the area been clarified (Parham et al. 2015). Taxonomically, kinosternid turtles have surprised the research community in a recent, relatively short period. Three new species of *Kinosternon* have been described

since 1980 for the Pacific coast of Mexico (*K. alamosae*, *K. chimalhuaca*, and *K. oaxacae*), which suggests that there could be other cryptic species in the area (R. Macip-Ríos, and R.C. Vogt, *pers. comm.*, September 2017). On

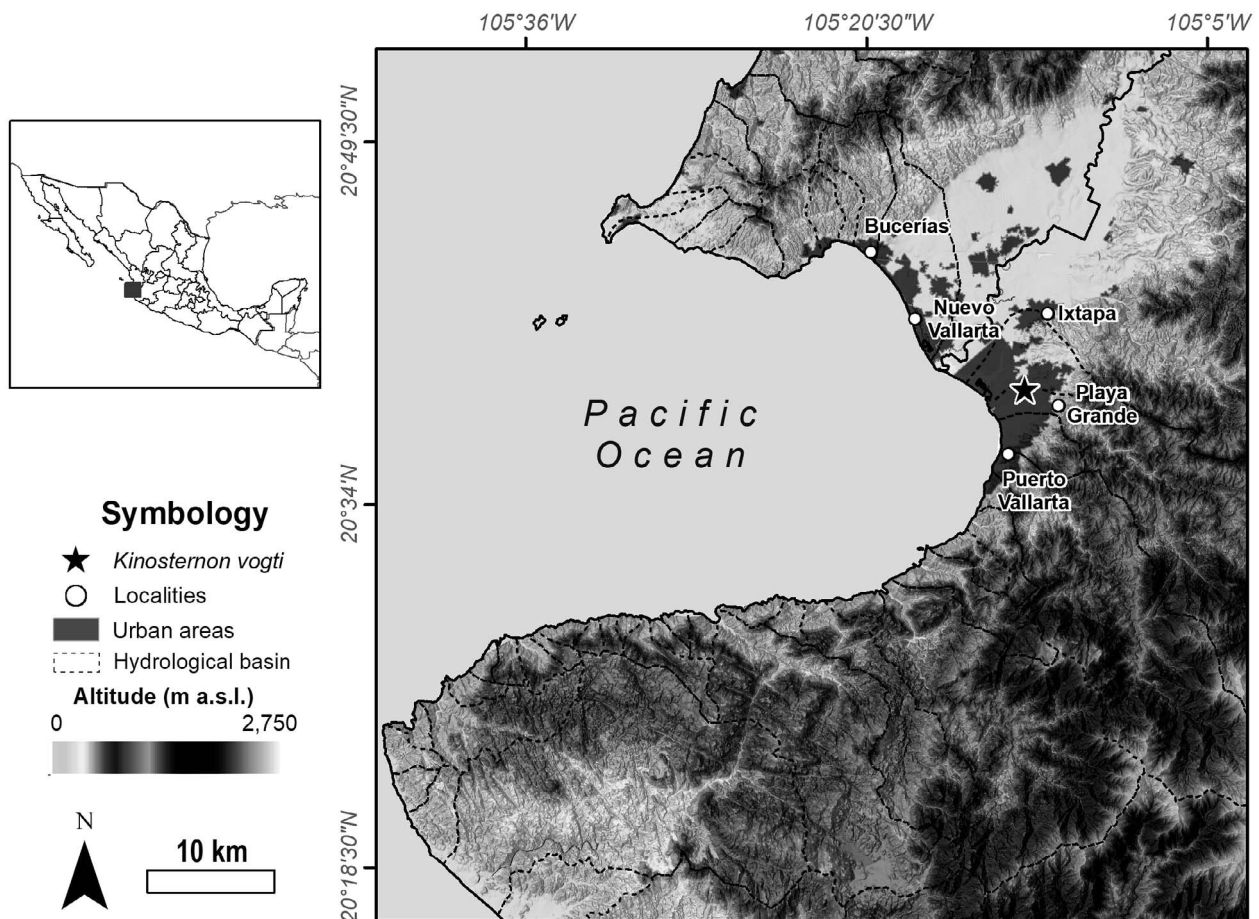


Figure 4. Known distribution of *Kinosternon vogti* in western Mexico. The dark gray polygons represent urbanized areas; the largest are Puerto Vallarta, Jalisco, and Nuevo Vallarta, Nayarit. Black star indicates type locality. Black dashed lines represent the hydrological basin Instituto Nacional de Estadística, Geografía e Informática (INEGI), Instituto Nacional de Ecología (INE), Comisión Nacional de Agua (CONAGUA) (INEGI-INE-CONAGUA 2007).

the other hand, the only species of *Kinosternon* reported in the Bahía de Banderas is *K. integrum* (Legler and Vogt 2013), although a study of potential habitat predicts that *K. chimalhuaca* could be present, and this species may extend its range to the coast of Nayarit (Chávez-Avila et al. 2015). Cupul-Magaña and Rubio-Delgado (2003) originally reported the occurrence of *K. chimalhuaca* from Puerto Vallarta but, based on our review of the material, that specimen is actually *K. vogti*. Webb (2001) described the characteristics of a specimen tentatively designated as *K. chimalhuaca* and collected in the north of Nayarit. With exception of a wider head, the description corresponds in size and proportions to *K. vogti* female. This would indicate that the distribution of the new species is much wider than we consider. It is necessary to do a revision of the specimen besides doing survey work to find more specimens in that region. The scarcity of turtle records in the Bahía de Banderas region suggests that with more-intense studies, the biodiversity in the area will be better known.

Related Species. — *Kinosternon vogti* is morphologically similar to other extant species. *Kinosternon angustipons* (from Caribbean lowlands of Nicaragua to Panama), *Kinosternon dunni* (from northwestern South America), and *Kinosternon herrerae* (from northeast Mexico) all have a narrow and weakly kinetic posterior plastron plus a short bridge. It has been suggested that there is an important relationship between the permanence of the aquatic environment and relative plastron size in this family. Kinosternid species found in permanently aquatic environments typically have a small plastron (Bramble et al. 1984). Although it is also suggested that the increase of predators in the tropics could be an important factor in the evolution of the morphology of turtle-shell in kinosternids (Iverson 1991), natural history observations indicate that species with a small plastron are primarily aquatic, rarely venturing out of the water, and when they do it is usually associated with rainfall and/or within the same swamp and stream system (Legler 1966; Rentería-Moreno et al. 2012; Cázares-Hernández 2015). *Kinosternon vogti* has been observed only during the rainy season in inundated channels (F.G.C.-M. and M.M.R.-R., *pers. obs.*).

Conservation Status. — There are no data to determine the exact location of even one small natural population of *K. vogti*. Total population size of this species is also unknown; there have been fewer than 20 individuals seen or collected incidentally by hand in the last 17 yrs, and only 5 individuals have been observed since 2013. Nothing is known about the natural history of this new species, and survey work is desperately needed.

We believe that this species is adapted to permanent aquatic habitats and, therefore, population decline is expected due to habitat fragmentation and reduction in the Bahía de Banderas region. Population fluctuations are unknown, although the observations of individuals in the rainy season may indicate temporary migration linked to increased interconnections of the remaining available

small bodies of water; the known habitat is largely urbanized and/or heavily modified. The presence of *K. vogti* may possibly extend across the drainage area of the Bahía de Banderas in the states of Jalisco and Nayarit in an area of perhaps 300 km². However, they have only been recorded to date in a few localities in the state of Jalisco in the city of Puerto Vallarta, within an area of less than 20 km². In this area, there are ponds and shallow canals associated with rivers such as “Pitillal” and streams near the CUC of the Universidad de Guadalajara. A qualitative analysis of these data suggests that the species exhibits many high-risk indicators: populations with significant declines, restricted distribution and decline, small population size and decline, very small and restricted population, and no data for a Population Viability Analysis. Considering the criteria of the International Union for Conservation of Nature (IUCN; 2012), the species may qualify for the category Critically Endangered: CR A1acB1ab(iii)2ab(i,ii,iii,iv,v)C2a(i,ii).

In Mexico, and considering the criteria of “Método de Evaluación del Riesgo de Extinción de las Especies Silvestres en México (MER)” (Sánchez et al. 2007), the species can be labeled Very Restricted because it is distributed on less than 5% of the territory of Mexico. The habitat status with respect to natural development is Hostile or Very Limiting. Some capture localities have already been completely modified. The intrinsic biological vulnerability of the taxon is considered Highly Vulnerable because the population size is unknown. Fewer than 20 specimens have been observed since 2000, and almost all have been adult males. Unfortunately, only one female is known, and therefore we have no reproductive information. Finally, the impact of human activity on the taxon is High Impact because Puerto Vallarta is the city with the highest rate of urban growth on the Mexican Pacific coast. The Instituto Nacional de Estadística y Geografía (INEGI; National Institute of Statistics and Geography) of Mexico in 2010 and 2015 estimated the Puerto Vallarta population as 255,681 and 275,000 inhabitants, respectively, and more than 5 million tourists annually, which suggested that the local annual population increase is 1.4% (INEGI, 2015). The city of Puerto Vallarta has one of the highest rates of urban development in the country, growing from 37,000 inhabitants in 1970 to almost 300,000 inhabitants in 2010 (Cárdenas-Gómez and Rodríguez-Bautista 2012), a rate of 5.4% per year. The use of land for housing and tourism has modified virtually all the lower area of Bahía de Banderas, the only known distribution for the species. With these criteria, the Vallarta Mud Turtle *K. vogti* should be considered Endangered (P) by MER.

The loss of species in rainforests due to deforestation and other human activities has been sadly and widely anticipated (Wright and Muller-Landau 2006) to such a magnitude that the global rate of loss of animal populations and species has been called the “sixth extinction wave” (Ceballos et al. 2010). Besides direct negative human activities, urban development produces the greatest local



Figure 5. Habitat of *Kinosternon vogti* sp. nov. transformed for anthropogenic use. Photos by Marco A. López-Luna.

extinction rates and eliminates native species. Unfortunately, the impacts of urban development have been poorly studied or understood (McKinney 2002). The known habitats for freshwater turtles in the Puerto Vallarta area have been decimated (Fig. 5). Some localities where *K. vogti* was previously recorded are now concrete canals, shopping malls, or busy streets where we have found road-killed turtles (Fig. 6). Without immediate conservation intervention, this distinctive new cryptic species may well disappear before we can learn anything about its biology.

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Figure 6. A road-killed specimen of *Kinosternon vogti* on a street in Puerto Vallarta, Jalisco. Sex and measurements unknown. Specimen not preserved. The species was identified by yellow nasal-scale, the first vertebral scute not in contact with M2, and relative head width. Photo by Fabio G. Cupul-Magaña.

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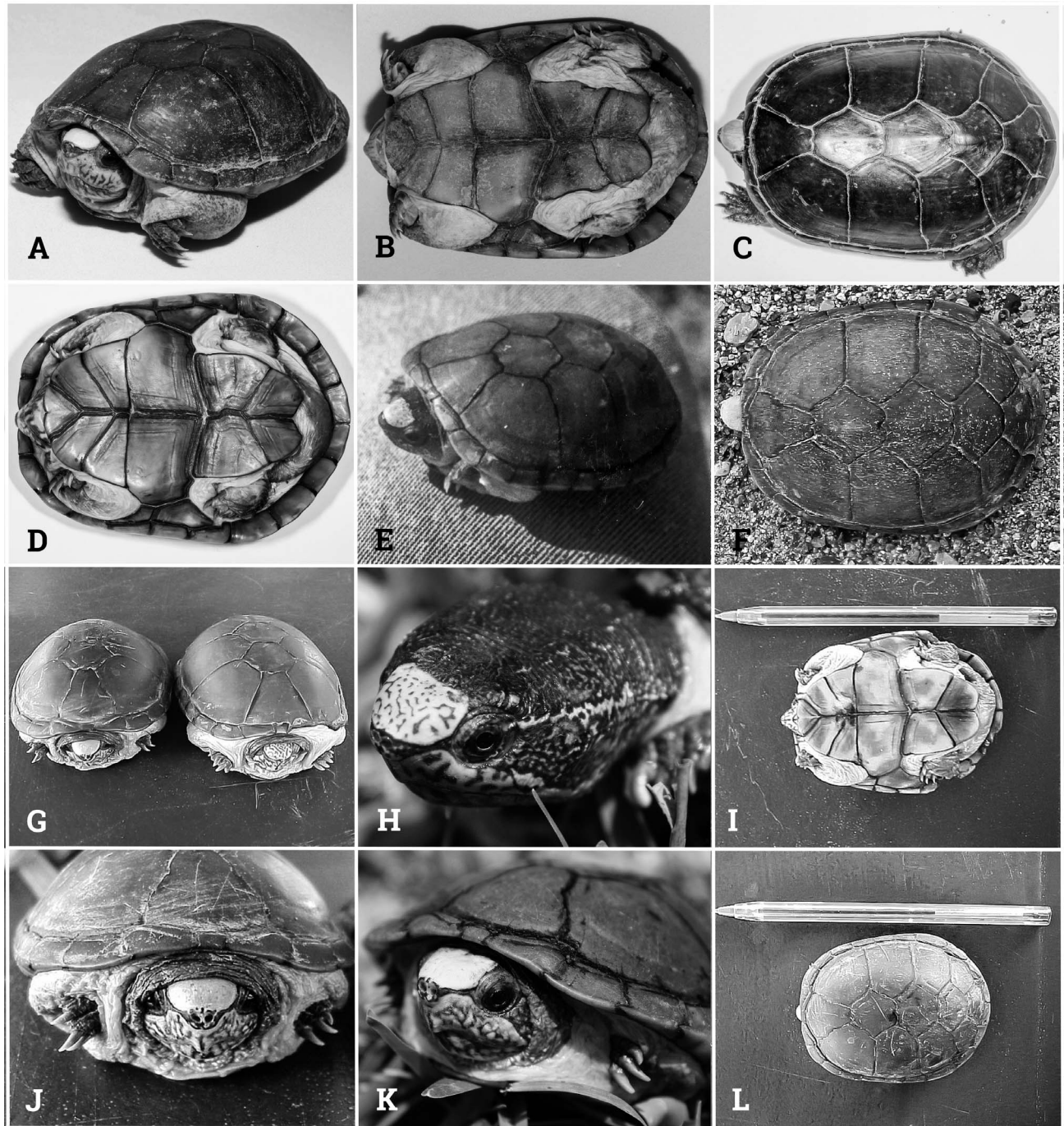
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Appendix 1. Male specimens examined (besides type series). (A, B) JLR-01 (CL = 95 mm), and (C, D) JLR-02 (80.5-mm) specimens of a private collection; collected in a flooded street near Río Pitillal in 2012 and 2016 during the rainy season. Photos by Marco A. López-Luna. (E–L) Specimens collected and photographed between 2000 at 2015 by Rafael García de Quevedo Machain and Frank McCann.