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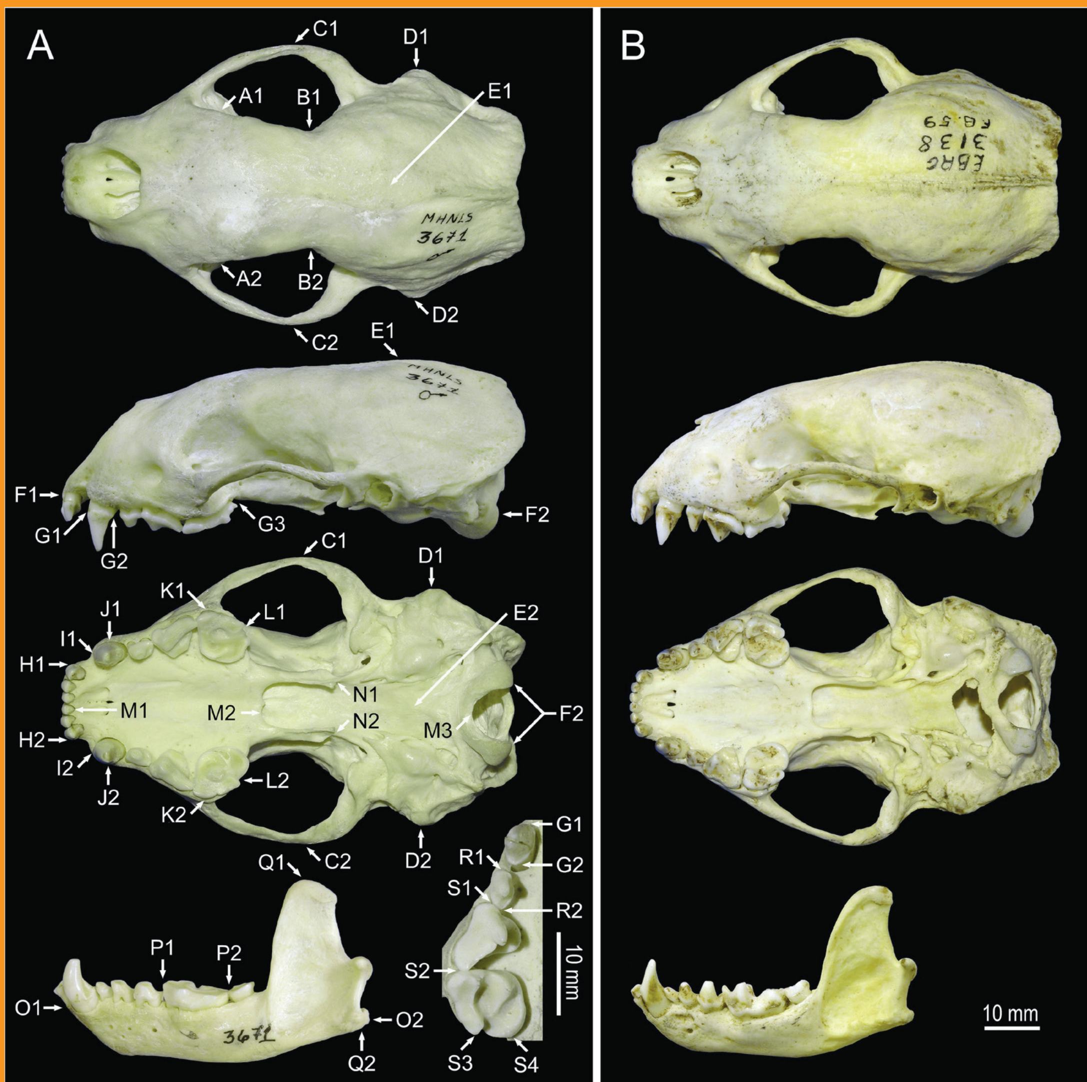

Cráneos de dos subespecies de zorrillos venezolanos, *Conepatus semistriatus* (Boddaert, 1784)

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Imágenes comparativas de cráneos de mapurites venezolanos (*Conetapus semistriatus,* Boddaert, 1784) con indicación de abreviaturas de puntos de referencia morfométrica. La serie B, lado derecho, corresponde a *C. semistriatus elieceri* Molinari *et al.*, **n. ssp.**, taxón endémico de la Isla de Margarita que se describe en este trabajo (Molinari *et al.*: 23–44).

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Contenido

Recensiones

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Editorial

Ochenta años del Instituto de Ciencias Naturales del estado Zulia, sus ciclos de creación y destrucción

En 1777, Francisco de Santa Cruz, Gobernador de la Provincia de Maracaybo, territorio que ese año, por instrucción del Rey Carlos III de España, traspasaba su dependencia política y militar del Virreinato de la Nueva Granada a la recién creada Capitanía General de Venezuela, hizo al Rey un curioso envío de muestras de diversos tipos de maderas de Maracaibo y de otros objetos de historia natural. Juntaba una detallada memoria explicativa de cuya lectura podría colegirse el elevado nivel de instrucción de nuestro gobernador español, quien probablemente tenía en posesión alguna de las dos últimas ediciones del *Systema Naturae* de Carolus Linnaeus (1758 y 1767). Las cajas con el muestrario y su catálogo arribaron a Madrid en 1778, y fueron incorporadas al Real Gabinete de Historia Natural, instituido en 1771 con la colección donada por su fundador el noble guayaquileño Pedro Franco Dávila. La institución abrió sus puertas al público en noviembre de 1776. Puede ser difícil de imaginar que en aquel edificio construido poco antes en el número 13 de la calle Alcalá de Madrid, para este exclusivo propósito, se inaugurara la primera exposición de ciencias naturales de la cuenca del Lago de Maracaibo. Se reporta igualmente la llegada de algunos mamíferos y aves vivos de la región para ser exhibidos en la *ménagerie* de los Jardines del Palacio Real de Aranjuez, algunos de los cuales parece que no fueron del total agrado del rey.

Durante los próximos cuarenta años no hay otros registros o testimonios evidentes de que alguien ocupara sus horas de ocio en la recolección o estudio de las formas de vida locales y de la naturaleza circundante, con excepción de algunas relaciones geográficas del final del siglo XVIII en donde consta mención de minerales, plantas y algunos animales. Cerrados los puertos de las ciudades y pueblos españoles de América para los mercaderes no hispanos desde el siglo XVI, y aparte de los rebeldes filibusteros y corsarios que en respuesta a tal prohibición saquearon y asolaron las ricas posesiones del Caribe, solamente los expedicionarios autorizados por el monarca imperial más poderoso del momento pudieron poner pie en tierras americanas. Fue por esto posible el desarrollo de la Real Expedición Botánica del Nuevo Reino de Granada (1783-1808, 1812-1816), constituida únicamente por españoles ibéricos y americanos, pero también la llegada autorizada a Venezuela como invitado especial para la Expedición de Límites del Orinoco del adelantado apóstol de Linnaeus, el naturalista sueco Pehr Löfling, quien ingresa al país por la costa oriental en 1754 y fallece prematuramente en 1756 en la misión de San Antonio del Caroní. Seguirán Alexander von Humboldt y Aimé Bonpland, quienes, entran por Cumaná en 1799, explorarán la geografía y los elementos naturales del macizo de Caripe, la Cordillera de la Costa, parte de los llanos venezolanos, el Orinoco hasta su conexión con el Amazonas en el brazo Casiquiare. A final de 1800 cuando dejan Venezuela hacia la isla de Cuba, se retiran sin haber conocido sino a través de relatos y lecturas, las regiones occidentales de la capitanía, el Lago de Maracaibo y su cuenca.

Haciendo uso de un extraño salvoconducto, el botánico francés Auguste Plée, logró ingresar a Venezuela por el puerto de Maracaibo, poco después de la batalla naval del lago. Viajó hasta la región de Perijá y acopia colecciones de plantas que fueron estudiadas por Agustin de Candolle en Suiza. También remitió a París las primeras muestras científicas de peces del lago, descritas por Georges Cuvier y Achille Valeciennes y algunos reptiles estudiados por André Duméril, su hijo Auguste Duméril y Gabriel Bibron. Sin embargo, a su regreso de las montañas en 1824, Plée fue acusado de espía por las autoridades revolucionarias de Maracaibo y expulsado del país, no sin antes habérsele confiscado sus colecciones biológicas. O al menos así lo afirmó con resentimiento un testigo de excepción quien además denunció el abominable acto de destrucción de las muestras, un coterráneo de Plée, oficial militar, que al ser sorprendido en actividades encubiertas sufrió su mismo destino.

Como quiera que sea, es oportuno señalar que la colección de maderas de Maracaibo del Gobernador Santa Cruz, mencionada previamente, no pudo ser localizada en el Museo Nacional de Ciencias Naturales de Madrid, en 1999, por lo cual se presume su desaparición. Y empezamos así relatando episodios para el prontuario maracaibero de creación y destrucción.

Se ha investigado poco el paso por la ciudad y en general por la región zuliana del extraordinario señor Don Christian F. Witzke, primeramente, danés y luego venezolano. Inquieto empresario venido a Maracaibo en 1879 como socio de la firma comercial Minios, Breuer & Co. (y yerno de su accionista principal H. G. Breuer), dedicada al comercio del café, pero también a inversiones tan diversas como el alumbrado eléctrico y las empresas ferrocarrileras regionales. Witzke devino en destacado hombre público, coleccionista, bibliófilo, anticuario y dirigente de organizaciones gremiales, al punto de tal notoriedad que el Rey de Dinamarca lo nombró cónsul de su país en Maracaibo. Admirador de la naturaleza tropical, de la geografía y la historia del generoso país que lo recibió, y en posesión de los medios materiales suficientes, se permitió el placer de instalar en los jardines de su residencia el primer zoológico del cual se tenga noticia en Maracaibo. Como sus agentes recorrían la cuenca navegando el lago y sus ríos, llenó sus jaulas de fieras y aves capturadas en las selvas milenarias. Puso tal colección viviente a la vista pública y los transeúntes informados pudieron acudir libremente a disfrutar de su espectáculo. En 1889 *El Zulia Ilustrado* hizo especial mención de un águila arpía que hizo traer Witzke del sur del lago. Requerido por el presidente Cipriano Castro, Witzke se mudó a Caracas en 1906, donde fue nombrado Director del Museo Nacional e hizo una destacada y variadísima carrera hasta su fallecimiento en 1921. Fundó, además, el Museo Bolivariano e hizo donación final de su extraordinaria biblioteca a la Academia Nacional de la Historia. Como no han quedado registros que indiquen lo contrario, es de suponer que al abandonar la región occidental se llevó su zoológico a la capital.

En 1930 el señor Benito Roncajolo (nieto del empresario corso de los ferrocarriles en el Zulia, Benoît Roncajolo Bruno), viajero de la cuenca, coleccionista de mariposas y amante de los animales estableció un nuevo zoológico privado en sus propios predios, donde hacía residencia, la Quinta Belfort, en el sector El Milagro. Poco tiempo después un joven folclorista, naturalista y taxidermista caraqueño, Agustín Pérez Piñango, quien llegó a Maracaibo en 1925, estableció con sus colecciones personales de objetos de historia natural, animales y plantas disecadas un museo de ciencias naturales de carácter privado, instalado en una casa ubicada al final de Bella Vista. Ni el zoológico de Roncajolo ni el museo de Pérez Piñango fueron tan conocidos en su momento. Con el paso del tiempo, Roncajolo, hombre proactivo en la vida pública llegaría a la presidencia del estado Zulia, promoviendo desde distintas posiciones de poder la institucionalización de recintos para el culto a las ciencias naturales. A Pérez Piñango la posteridad lo honraría con el humilde título de Profesor, llegando a ser personaje conocido, apreciado y relativamente influyente en el ámbito cultural local. No obstante, aún en 1935 por exhibir ramas secas y animales disecados fue motejado de brujo y su pequeña institución cerrada por orden de la máxima autoridad estatal. Al fallecer Juan Vicente Gómez al final de ese mismo año y preverse de inmediato la sustitución del presidente de la República y de los presidentes de los estados, Pérez Piñango se animó a continuar sus iniciativas culturales en pro del conocimiento de lo autóctono en lo natural y en lo social, y se ocupó diligentemente de la difusión de las tradiciones indígenas zulianas y del folclor musical y escénico. Orientado hacia esta temática estableció en 1936 "El Parque de la Tradición", institución que permanecería activa y en evolución como espectáculo cultural durante más de tres décadas. En general, se le deben iniciativas útiles durante el interregno de la universidad clausurada (1904-1946), su presencia en la ciudad atascada sirvió de estímulo para gestiones más formales que vendrían después desde la regularidad académica.

Favorecido por el advenimiento de Isaías Medina Angarita en la presidencia de la república, Benito Roncajolo preside el estado Zulia. En esta ventajosa condición y seguramente apoyado por sus allegados, establece en 1943 los decretos de creación del Instituto de Ciencias Naturales del estado Zulia (ICNEZ) y de la Cátedra de Zoología en la Escuela de Taxidermia de dicho instituto, al cual se incorpora el primer Jardín Zoológico dependiente de la administración pública. Los registros indican que Roncajolo puso a disposición su propia colección de animales para iniciar este último. El primer ICNEZ funcionaría en la casa del Club del Policía, donde además se reunía su primera junta directiva, presidida por Jesús Enrique Lossada. Otros miembros de esta junta fueron Adolfo Pons, José E. Araujo y Atilio Ferrer. Todos distinguidos como académicos o voluntariosos comerciantes. Al ser sustituido Benito Roncajolo en sus funciones gubernamentales, el nuevo presidente del estado, Héctor Cuenca, se apresura a derogar los decretos anteriores y el 22 de febrero de 1944 establece otra vez y por un nuevo decreto el Instituto de Ciencias Naturales del estado Zulia, el cual estaría constituido por una serie de dependencias similares a las previamente creadas: Museo de Ciencias Naturales, Jardín Zoológico, Jardín Botánico, División de Taxidermia, División de Herborización, y la Cátedra de Ciencias Naturales. Es de presumir que estas acciones se ejecutarían en acuerdo con el anterior presidente de estado, toda vez que existe relación escrita de que Roncajolo donó sus colecciones de especímenes zoológicos, los cuales conformaron el núcleo de las colecciones del museo. Simultáneamente se decre-

El destacado naturalista y folclorista venezolano, Profesor Agustín Pérez Piñango, director del Instituto de Ciencias Naturales del Estado Zulia, acariciando un león africano macho (*Panthera leo*) en las instalaciones del zoológico de Los Haticos, el cual formaba parte de dicho instituto. Enero 1956 (foto: Pedro Abel Barrios, cortesía de Hender Barrios, Maracaibo).

tó la fundación de la Sociedad de Ciencias Naturales del estado Zulia, encargada de elaborar el reglamento interno del ICNEZ y de la búsqueda de recursos económicos para su manutención y desarrollo. Estuvo integrada por destacadas e influyentes personalidades intelectuales y empresariales de Maracaibo: Jesús Enrique Lossada, Alberto Levy Romero, José Domingo Leonardi, Darío Parra, José Quintini, Marcelino Pulgar, Adolfo Pons, Ana M. Rodríguez, Hunaldo Cuenca, Ramiro Finol, J. M. Ríos, Ligia G. de Altimari, Graciela L. de Cáceres, Luis A. Alaña, Julio C. Pons, Benito Roncajolo, Hno. Ildefonso Gutiérrez, Manuel A. Belloso, José A. Araujo, Carlos Julio D'Empaire, Hans Adolf Graef, Silio Romero Paz y Atilio Ferrer Arria.

Medina Angarita asiste el 24 de julio de 1944 a la festiva inauguración del ICNEZ, establecido en un parque urbano en el sector La Arreaga del barrio Los Haticos, ya depositario del zoológico y en edificación sede de las otras dependencias, la que llegó a ser mejor conocida por alojarse allí las exhibiciones del museo. Estos espacios, a los cuales Pérez Piñango como director del instituto mudó los espectáculos dominicales del Parque de La Tradición, llegaron a ser importantes como localidad de enseñanza, recreación y esparcimiento. No obstante, algunos especialistas han documentado la relevancia de este zoológico como institución pionera en el estudio de los reptiles venezolanos, particularmente conocido por su exitoso programa de manejo de serpientes en cautiverio. Así mismo, y a pesar de que por la época no se trataba precisamente de un zoológico diseñado según los patrones modernamente recomendados o aceptados por los organismos internacionales reguladores de condiciones idóneas de espacio, ambientación y respeto ético hacia los animales, éste funcionó con éxito y la cantidad de animales mantenidos y exhibidos fue siempre en incremento hasta el momento de su cierre en 1966. Se recuerda particularmente en contexto anecdótico la aclimatación exitosa de un pingüino antártico (*Eudyptes chrysocome*) rescatado en la playa Zulia Mar (entre Paraguaipoa y Kaimarechico) en abril de 1955, el cual fue la atracción

Inusual registro fotográfico de una pareja de matamatas o caripatúas (*Chelus orinocensis*), especie de quelonio dulceacuícola de apariencia poco menos que espectacular. Zoológico de Los Haticos, Maracaibo. Enero 1956 (foto: Pedro Abel Barrios, cortesía de Hender Barrios, Maracaibo).

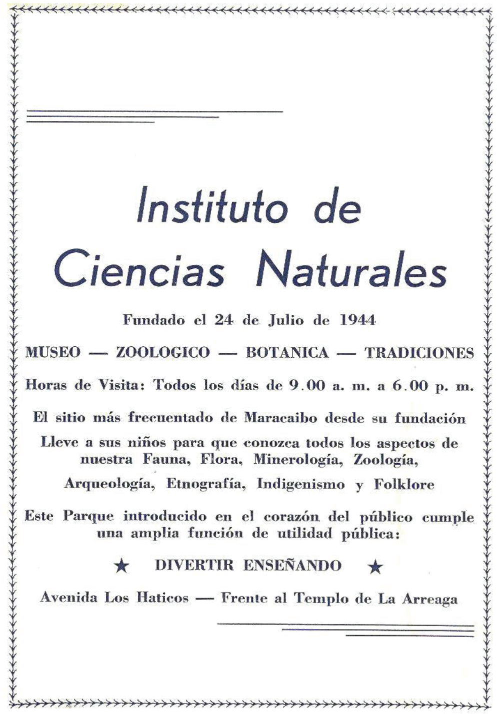
principal para los visitantes durante una temporada memorable. No se hacía investigación científica en el ICNEZ, sin embargo, algunos artículos de interés zoológico aparecidos en revistas especializadas mencionan registros taxonómicos y geográficos curiosos de animales depositados en las colecciones del Museo de Ciencias Naturales del estado Zulia, particularmente insectos. Referencias de credibilidad indican que la colección de mariposas de Roncajolo era singularmente grande y diversa. En 1958 se amplía la sección de Botánica del ICNEZ con el establecimiento de la Granja del Estado, dedicada a la producción de hortalizas, legumbres y frutas para dotar a las instituciones de beneficencia y a los comedores escolares del estado. Esta granja de unas 40 hectáreas se ubicaba al sur de la ciudad. Aún no se perfila posibilidad de que el instituto pueda ampliar sus funciones hacia el ámbito de la investigación. Obviamente había sido concebido como un espacio para la divulgación y popularización de las ciencias naturales, sin interés de interactuar con las instituciones académicas.

El establecimiento del Instituto de Ciencias Naturales y de las iniciativas que lo precedieron fueron eventos aislados de la academia, máxime cuando ocurrieron en un tiempo en el que la Universidad del Zulia se encontraba cerrada (1904-1946). En 1960 es posible prever que el destino del ICNEZ era desaparecer. Ese año el ejecutivo estatal, orientado por intereses cada vez más políticos, vende los terrenos de la sede del ICNEZ al Ministerio de Justicia para la construcción de la sede del Sindicato de Trabajadores (Fetrazulia). Tal acción tiene dos posibles lecturas, la primera es la pérdida de interés por el proyecto cultural y científico representado en el Instituto de Ciencias Naturales, la segunda es la proyección de una mudanza del instituto a espacios más amplios, accesibles para el gran público, con un proyecto claro de expansión. El paso de pocos años definirá que no fue este último el destino de tan histórica iniciativa.

Paralelamente a la decadencia del ICNEZ se verifican iniciativas que llevarán de una u otra forma las ciencias naturales a los ámbitos académicos de la región. En 1961 José Ramón Labrador Schoonewolf funda la Cátedra de Entomología en la Facultad de Agronomía de La Universidad del Zulia y establece una colección de insectos en dicha institución. Con el apoyo definitivo de las autoridades decanales, a finales de los 1970 y principios de 1980 dicha colección devino en el actual Museo de Artrópodos de la Universidad del Zulia "Dr. Edmundo Rubio Espina". En 1962 Adolfo Pons establece la Estación Biológica de Kasmera, río Yasa, Sierra de Perijá, estado Zulia, que por un par de décadas será un importante centro de investigación para estudios de medicina tropical y ciencias naturales. También una estación de campo en Zipayare y otra en la laguna de Las Peonías. Simultáneamente funda la revista científica *Kasmera* del Departamento de Microbiología y Medicina Tropical (actualmente Departamento de Enfermedades Infecciosas y Tropicales) de la Facultad de Medicina de la Universidad del Zulia, la revista servirá de medio de comunicación y difusión de resultados de investigaciones en medicina tropical y zoología. En la estación de Kasmera se crea un museo zoológico que alojará colecciones importantes de vertebrados (aves y reptiles, principalmente) e invertebrados (artrópodos y gusanos de interés médico).

El 21 de enero de 1966, el Gobernador Octavio Andrade Delgado decreta la creación de un parque de ciencias naturales en la zona sur de la ciudad, donde funcionaba la Granja del Estado. Simultáneamente se decreta la reorganización de la Sociedad de Ciencias Naturales del estado Zulia. La integrarán José Lugo Rivas, Manuel Govea Vale, Néstor Noguera Nieto, Felipe Hernández, Marcelino Pulgar, José Asdrúbal Araujo, Jesús María Roldán, Ramón Parra Atencio, José Ramón Labrador, Pedro A. Barboza de La Torre y Agustín Pérez Piñango. Es evidente que esta organización seguiría siendo una estructura burocrática para la gestión del parque y la procura de fuentes de ingreso económico, y no una sociedad científica, a pesar de la presencia por primera vez en la junta, de Pérez Piñango (tratado inicialmente como un empleado público, administrador o director del ICNEZ, pero en realidad el alma viva del proyecto), Labrador, Barboza y Roldán.

Ese mismo año, enfrentando la instrucción gubernamental de desalojo del mobiliario y bienes del Instituto de Ciencias Naturales de su sede histórica en Los Hati-



Aviso publicitario del Instituto de Ciencias Naturales del Estado Zulia, publicado en diciembre de 1964 (meses antes de su desaparición) en el cuadernillo No. 6 del *Glosario Popular*, revista de décimas, glosas y gaitas populares publicado por el poeta y compositor Adelmo Rincón Urdaneta (ARUFA).

cos, Adolfo Pons realizó en su representación frustrantes gestiones ante personalidades políticas e instituciones del estado, tratando de influir en contra de tales disposiciones. No obstante, fue imposible revertir las acciones. Los animales del zoológico, alrededor de 700, fueron trasladados a una localidad en el sector Los Pozos, donde necesariamente dejaron de ser atendidos con la misma eficiencia. El 30 de octubre se consuma el cierre del instituto, con la mudanza desordenada de las colecciones del museo a una antigua casa situada en el centro de Maracaibo, quedando ya no para exhibición sino arrumbadas en un espacio insuficiente y en calidad de depósito.

En este ciclo de creación y destrucción al cual parece condenado el patrimonio cultural de Maracaibo, y en simultaneidad con esta tragedia, se funda el Centro de Investigaciones Biológicas de la Facultad de Humanidades y Educación de la Universidad del Zulia. En 1967 aparece el primer número de su *Boletín*, revista periódica de carácter científico que sobrevive con ingentes esfuerzos las adversidades del presente. En 1968 llega a Maracaibo el Profesor Ramón Acosta, caraqueño, quien es empleado en la Escuela de Educación e inicia en colaboración con algunos miembros del Centro de Investigaciones Biológicas el establecimiento paulatino de un laboratorio de taxidermia. Llegará a ser, a principios del siglo XXI, un organismo de alta profesionalidad.

En estado de parálisis el Instituto de Ciencias Naturales del estado Zulia durmió durante seis años a la espera de una rehabilitación que nunca llegó. La casa en la cual se depositaron sus colecciones biológicas y su biblioteca, todas de un valor incalculable por su registro histórico y geográfico, fue saqueada, vandalizada y finalmente derrumbada en 1972 durante la demolición del sector tradicional del casco histórico de Maracaibo. La zona residencial histórica, abatida con poca o nula consideración de su significado patrimonial, fue transformada en una enorme plaza o boulevard al cual se le bautizó irónicamente con el nombre de "Paseo Ciencias".

En julio de 1973, la ciudad maltratada a la que algunos bufones han querido llamar "capital científica de Venezuela", florece con la creación de la Facultad Experimental de Ciencias de la Universidad del Zulia, en ella su División de Estudios Básicos Sectoriales acogerá un incipiente Departamento de Biología. Los hechos ocurren a la par con el establecimiento e inauguración del nuevo zoológico de Maracaibo, denominado "Parque Sur", actualmente "Parque Zoológico Metropolitano del estado Zulia", un desarrollo paisajístico siempre insuficientemente dotado para su ma-

Fachada de la entrada principal del Instituto de Ciencias Naturales del Estado Zulia.

nutención, que fue concebido como un área moderna de esparcimiento y aprendizaje. Las instalaciones envejecidas y deterioradas, aún se explayan a lo ancho y largo de 40 hectáreas en el Municipio San Francisco.

La Facultad de Ciencias de la Universidad del Zulia muy pronto aglutinó a un nutrido grupo de jóvenes profesores y estudiantes de diversos orígenes y criterios, generando un inusitado enriquecimiento sinérgico de intereses. En 1976 se publica con auspicio de esta facultad, la revista *Anales de Ciencias*, modernísimo medio de divulgación científica, con trabajos importantes de ciencias naturales, que sólo alcanzará dos números. La ciudad regresa al sensacionalismo del año del pingüino, cuando en 1978 los estudiantes de ciencias, dirigidos por Ramón Acosta, rescatan el cadáver de una orca de dos toneladas en los bancos de arena de San Carlos, en plena barra del lago. Espontáneamente se levanta un campamento para la preparación del esqueleto de aquel coloso y la noticia toma posición en los diarios de la región. Finalizada la gran campaña taxidérmica y en la tribulación de las limitaciones para alcanzar los objetivos esperados, los estudiantes de ciencias promueven acciones radicales de reclamo a las autoridades universitarias. Los acontecimientos llegan hasta escalar el conflicto de una huelga de hambre, todavía en la memoria. En plena efervescencia y a mitad de la batalla llega a Maracaibo el profesor José Moscó. En 1979 su vida se comparte entre el apoyo a los huelguistas y la fundación del Museo de Biología de la Universidad del Zulia, dependencia del Departamento de Biología, que a partir de 1984 comienza a funcionar en coordinación con el Laboratorio de Taxidermia y Preparados Anatómicos de la Facultad de Humanidades y Educación (posteriormente asimilado al Centro de Investigaciones Biológicas).

El 24 de octubre de 1983, se inaugura el Jardín Botánico de Maracaibo, a través de una Fundación creada desde el Rotary Club de Maracaibo. Son 108 hectáreas de jardines y bosques naturales repartidos entre los municipios Maracaibo, Jesús Enrique Lossada y San Francisco. El diseño paisajístico es obra de Roberto Burle Marx. Contó con biblioteca y herbarios propios. Por acuerdos, convenios y comodatos de la Fundación Jardín Botánico de Maracaibo, operaron allí varias iniciativas del Centro de Estudios Botánicos y Agroforestales del Instituto Venezolano de Investigaciones Científicas (sede Zulia) desde su creación en 2008 hasta su supresión en 2022.

La presente edición de *Anartia*, conmemora con respeto y admiración la presencia, paso firme y obra civilizadora del Profesor Agustín Pérez Piñango en la ciudad de Maracaibo, y celebra el octogésimo aniversario del establecimiento y fundación de su Instituto de Ciencias Naturales, cuya efímera existencia representa un antes y un después en la cronología del accidentado tránsito histórico de las instituciones científicas locales.

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Occurrence of Anchor Coralsnake, *Micrurus ancoralis* (Jan, 1872) (Squamata: Elapidae) confirmed in the Magdalena River Valley of Colombia, with novel citizen science distribution records

Presencia de la Coral Ancla *Micrurus ancoralis* (Jan, 1872) (Squamata: Elapidae) confirmada en el valle del río Magdalena, Colombia, con novedosos registros de distribución contribuidos por la ciencia ciudadana

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RESUMEN

Confirmamos la presencia de la Coral Ancla, *Micrurus ancoralis* (Jan, 1872), en los bosques tropicales de la vertiente oriental de la Cordillera Central de Colombia en el valle del Río Magdalena. Esto se logró mediante la revisión de un ejemplar de museo proveniente del departamento del Tolima y nuevos registros en los departamentos de Antioquia y Caldas de la plataforma de ciencia ciudadana iNaturalist.

Palabras clave: ciencia comunitaria, Elápidos, nuevos registros, ocurrencia de serpientes, plataforma iNaturalist.

ABSTRACT

We confirm the occurrence of the Anchor Coralsnake, *Micrurus ancoralis* (Jan, 1872), in the tropical forests of the eastern slopes of the Central Cordillera of Colombia in the Magdalena River Valley. This was achieved through the examination of a museum specimen from the department of Tolima and new records for the departments of Antioquia and Caldas from the citizen science platform iNaturalist.

Keywords: community science, Elapids, iNaturalist platform, new records, snake occurrence.

INTRODUCTION

Most of The New World Coralsnakes (*Micrurus* spp.) are not abundant in nature, being difficult to find due to their semi-fossorial habits (Roze 1996). Information regarding the biology, venom, and distribution of several species or species groups is limited, and the knowledge of reptile distribution in Colombia is still incomplete (Campbell & Lamar 2004). The Anchor Coralsnake, *Micrurus ancoralis*, belongs to the South American triad-bearing group and is one of the largest *Micrurus* species, where lengths of up to 151 cm have been reported (Campbell & Lamar 2004). This species ranges from the Darién region in southeastern Panama to the western slopes of the Andes in southwestern Ecuador (Roze 1996), inhabiting tropical rainforest and low montane wet forest from near sea level up to about 2000 m asl (Campbell & Lamar 2004, Rodríguez-Guerra 2020). Two subspecies are recognized: *M. ancoralis ancoralis* (Jan 1872) and *M. ancoralis jani* Schmidt 1936 (see Roze 1996). *Micrurus a. jani* is found from eastern Panama through the Pacific lowlands of Colombia to the Río Saija drainage, where it intergrades with *M. a. ancoralis*, which ranges southward into northwestern Ecuador (Roze 1996, Campbell & Lamar 2004). Although, there is little knowledge about the natural history of *M. ancoralis*, it is classified as Least Concern (LC) on the IUCN Red List (Ibáñez *et al*. 2017).

The known distribution of *Micrurus ancoralis* in Colombia covers the Pacific lowlands and western slope of the Western Cordillera in the departments of Antioquia, Cauca, Chocó, Nariño, Risaralda, and Valle del Cauca (Roze 1996, Wallach *et al*. 2014). Additionally, Llano-Mejía *et al*. (2017) reported this species for the department of Tolima but gave no detailed information, i.e. without an exact date, locality, photograph, or specimen voucher. For this reason, the occurrence of this species in the Magdalena Valley was doubtful. Nonetheless, there is one specimen collected in 1990 from San Sebastián de Mariquita (Tolima) by one of us (Juan Manuel Renjifo) currently deposited in the Reptile Collection of the Instituto Humboldt. A photograph *in vivo* of this specimen appears in Campbell & Lamar (2004. Plate 219); however, they were unable to obtain much information at the time beyond the fact that it was from Colombia (William W. Lamar *com. pers*., 2024). Here, we examine that specimen and complete the gap in the distribution of *Micrurus ancoralis* in the Magdalena valley of the Central Cordillera, with new records for the departments of Antioquia and Caldas from the citizen science platform iNaturalist.

The specimen IAvH-R-7332, corresponds to a juvenile of indeterminate sex from Vereda La Maria, km 82 road Mariquita-Falan, San Sebastián de Mariquita municipality, Tolima department, Colombia (Approximate coordinates: 5.180791°N, 74.881952°W, WGS 84; ~451 m asl.), collected by Juan Manuel Renjifo on August 25, 1990. The specimen was identified as *Micrurus ancoralis* based on being the only triad-type coralsnake that has a red head with a nearby distribution with a characteristic anchor-shaped black marking in the head formed by the black nuchal band projecting onto the parietals (Fig. 1).

The four citizen science records in the iNaturalist platform clearly correspond to *Micrurus ancoralis* identified by being large coralsnakes with a pattern of triads and a red head with a characteristic anchor-shaped black marking (Fig. 2). More photographs of the individuals are available online, see appendix. The observations are:

1. Inaturalist ID: 185091716 corresponds to a female specimen of *Micrurus ancolaris* observed by Miguel Alejandro Pabon Arboleda at approximately 1648 h on 27 February 2022, in Samaná municipality, department of Caldas, Colombia (5.384627°N, 74.951486°W, WGS 84; 828 m asl.). This specimen was found road-killed (Fig. 2A) in a peri-urban zone surrounded by fragmented tropical forest.
2. Inaturalist ID: 140615670 corresponds to a male specimen (Fig. 2B) observed by Diego Rios Montoya at 1100 h on 02 October 2022, in the municipality of San Francisco, department of Antioquia, Colombia (5.948095°N, 75.080275°W, WGS 84; 1139 m asl.). The specimen appeared in a road of Vereda Cañada Honda, in a peri-urban zone surrounded by fragmented tropical forest.
3. Inaturalist ID: 139714234 corresponds to an adult specimen (Fig. 2C) observed by Juan Camilo Mora at approximately 0815 h on 22 October 2022, in the municipality of Remedios, department of Antioquia, Colombia (7.21074°N, 74.496178°W, WGS 84; 601 m asl.). The specimen was found in a peri-urban construction zone surrounded by cattle-grazed savannah and fragmented tropical forest.
4. Inaturalist ID: 186001626 corresponds to an adult specimen observed by Oscar Vergara at approximately 1900 h on 1 December 2022, in the municipality of Cocorná, department of Antioquia, Colombia (5.887225°N, 75.146622° W, WGS 84; 1044 m asl.). The specimen was killed inside a house (Fig. 2D) in Vereda Santa Rita, a place surrounded by fragmented tropical forest.

The individuals of *Micrurus ancoralis* mentioned here represent new distribution records for the Middle Magdalena basin in Antioquia department and a new departmental record for Caldas department (Fig. 3). The specimen IAvH-R-7332 aligns with the scale count variation known for *Micrurus ancoralis* as proposed by Roze (1996) and Campbell & Lamar (2004). It was also possible to count the number of triads in all specimens with additional material provided by the authors of the observations, which corresponds to the established variation of *Micrurus ancoralis* (Table 1). Additionally, these specimens correspond to *M. ancolaris jani* based on the distribution range and key to the subspecies in Roze (1996). The subspecies *M. a. jani* intergrades with the nominal species *M. a. ancoralis* in the upper Saija River drainage, Cauca department, Colombia (Roze 1996), although the diagnosis of the subspecies is poor and needs to be reviewed.

In the recent years, citizen science has been useful in expanding the knowledge of reptiles and other taxa (Angarita-Sierra *et al*. 2022). Specifically, in Colombia, it has been employed to enhance knowledge about the distribution of snakes (Angarita-Sierra *et al*. 2022, Díaz-Floréz *et*

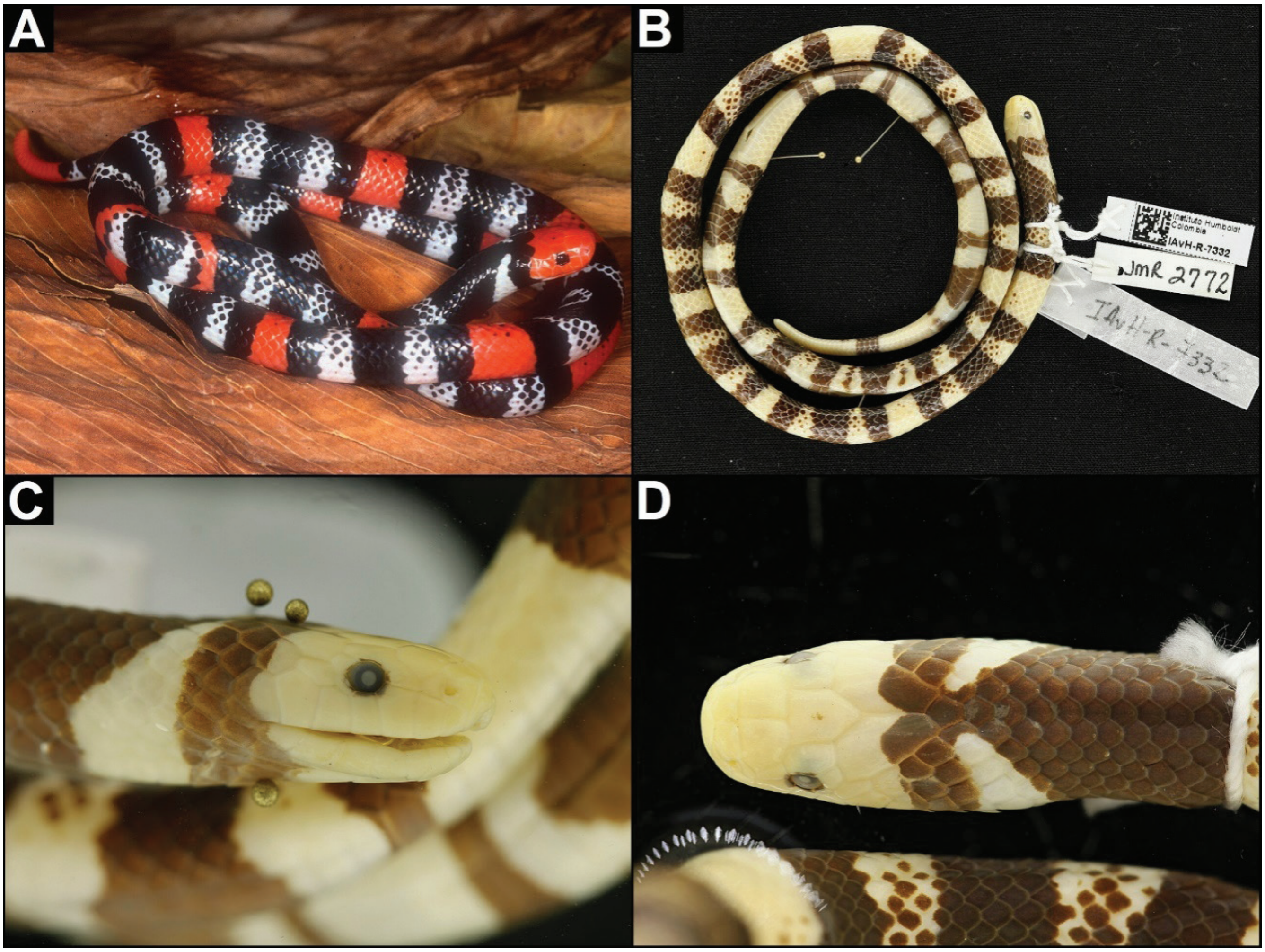

Figure 1. Specimen IAvH-R-7332, juvenile of *Micrurus ancoralis* from San Sebastián de Mariquita municipality, Tolima department, Colombia. **A.** Photograph *in vivo*. **B.** General view of the specimen deposited in the reptile collection of the Instituto de Investigaciones de Recursos biológicos Alexander von Humbolt. **C-D.** Lateral and dorsal view of the head. Photograph A by Juan Manuel Renjifo; photographs B-D Courtesy of the Reptile Collection of the Instituto de Investigaciones de Recursos biológicos Alexander von Humbolt.

al. 2022, Himes *et al*. 2022). The new records of *Micrurus ancoralis* discussed in this work indicate the presence of a fourth species of the genus *Micrurus* in the Middle and Upper Magdalena Valley, alongside *Micrurus camilae* Renjifo & Lundberg 2003*, Micrurus dumerilii* (Jan 1858) and *Micrurus mipartitus* (Duméril, Bibron & Duméril 1854) (see Campbell & Lamar 2004, Meneses-Pelayo & Caballero 2019). Llano-Mejía *et al*. (2017) reported the presence of *Micrurus bocourti* (Jan 1872) in Tolima, but without supporting information such as a photograph, specimen voucher, or locality details. Therefore, we consider it an error, as this species is only known to inhabit the Pacific lowlands of Ecuador and northwestern Peru (Campbell & Lamar 2004).

All congeners mentioned (except for *M. camilae*) occur throughout the Pacific versant and the Magdalena Valley of Colombia. Different authors have associated these areas based on biogeographical analyses of terrestrial plant and animal taxa, which helps to understand the distribution pattern of *M. ancoralis*. Hernández-Camacho *et al*. (1992), classified both as the Chocó-Magdalena biogeographic province in '*Unidades biogeográficas de Colombia*', and Morrone (2014) in '*Biogeographical Regionalization of the Neotropical region*' classified the Magdalena province as part of the Pacific dominion. The distribution pattern of *M. ancoralis* is also observed in other snakes, such as *Atractus clarki*, *Bothrops punctatus*, *Chironius grandisquamis*, *Coniophanes fissidens*, *Corallus annulatus*, *Dendrophidion clarkii*, *Enuliophis sclateri*, *Geophis nigroalbus*, *Imantodes inornatus*, *Lachesis acrochorda*, *Ninia teresitae*, *Rhadinaea decorata*, *Rhinobothryum bovallii*, *Sibon annulatus* and *Tantilla alticola* (McCranie 2004, Passos *et al*. 2009, Me-

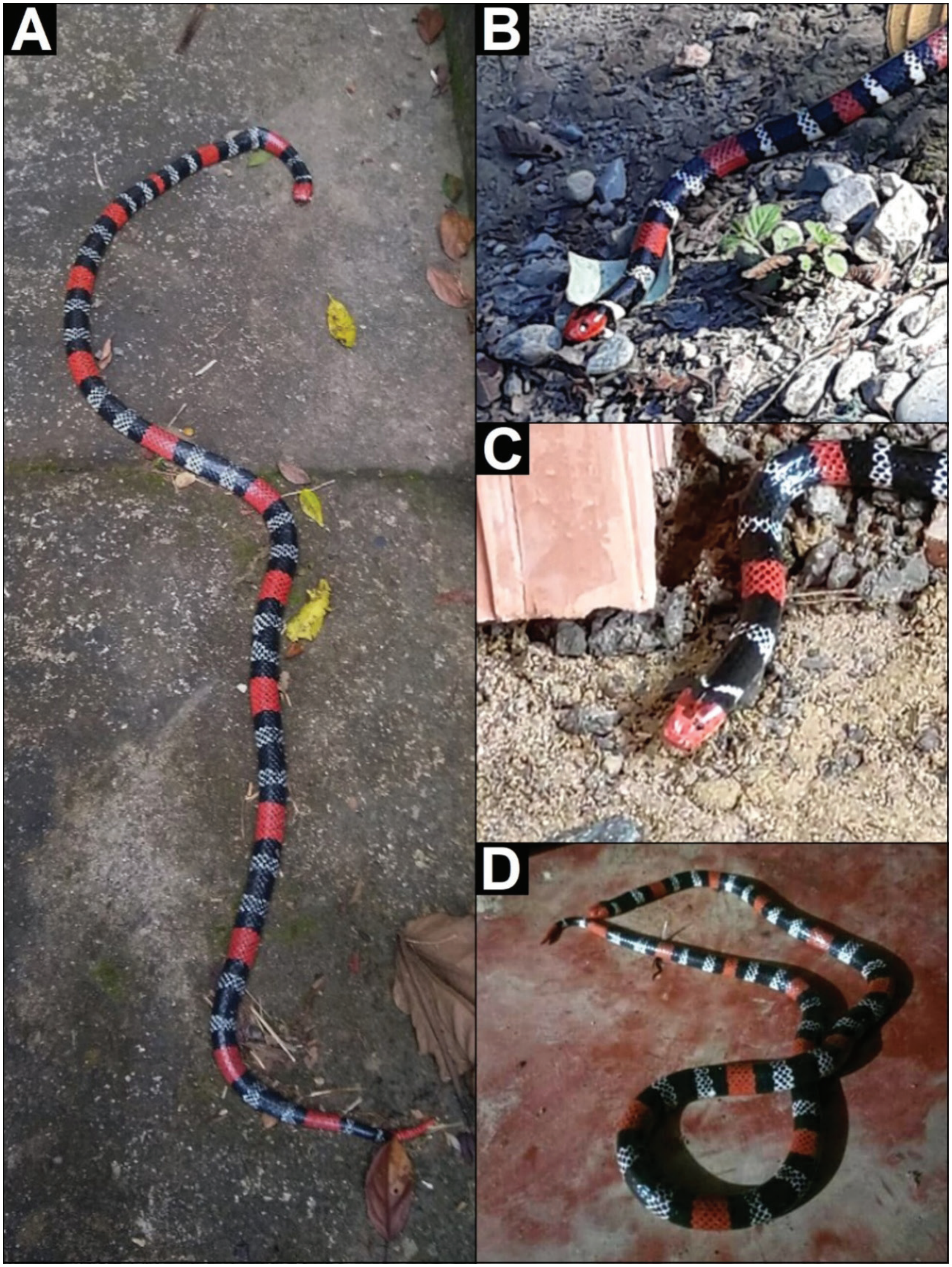

Figure 2. Citizen science records of *Micrurus ancoralis* in the Magdalena Valley. **A.** Female specimen road-killed from Samaná, Caldas. **B.** Male specimen from San Francisco, Antioquia, Colombia. **C.** Adult specimen from Remedios, Antioquia. **D.** Adult specimen killed out of fear from Cocorná, Antioquia. Photographs by Miguel Alejandro Pabon Arboleda (A), Diego Rios Montoya (B), Juan Camilo Mora (C), and Oscar Vergara (D).

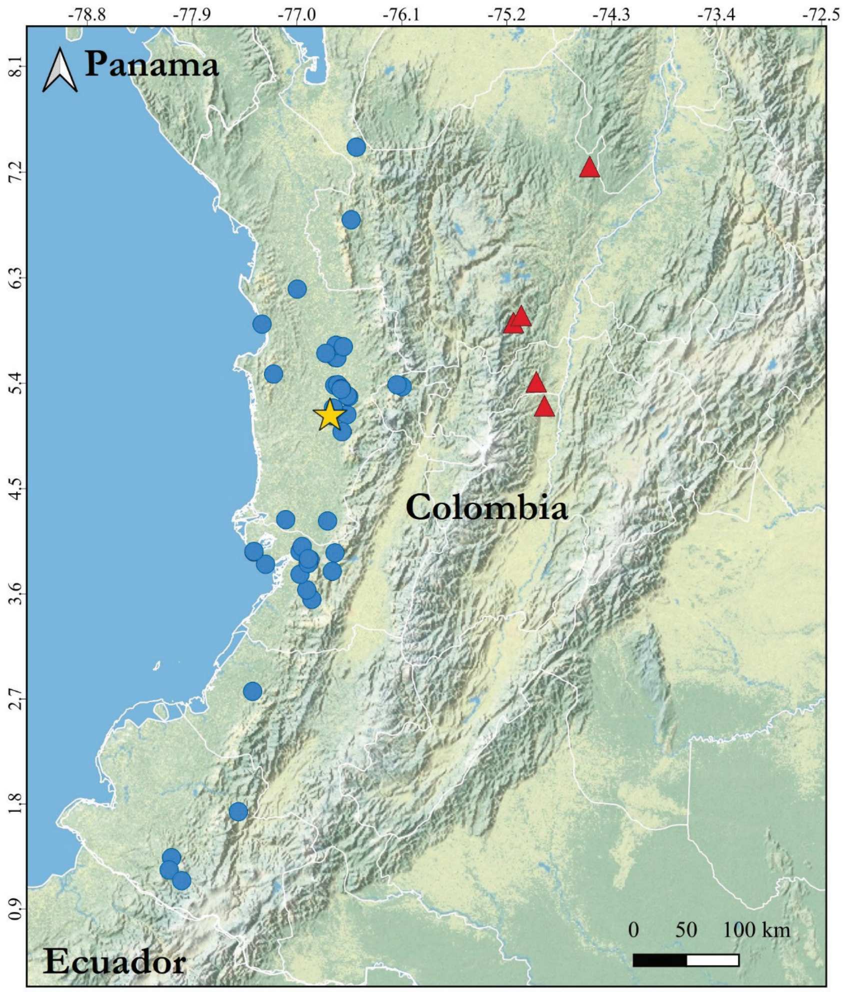

Figure 3. Distribution map of *Micrurus ancoralis* in Colombia. Red triangles correspond to records in the middle and upper Magdalena Valley discussed in this work. Blue dots correspond to collection vouchers, literature records, and citizen science records. Yellow star represents the type locality of *M. a. jani*. Basis of locality records appear in appendix.

Table 1. Morphological data of the *Micrurus ancoralis* specimens examined in this work in contrast with information from the literature.

Reference material		Sex	Ventral scales	Subcaudal scales	Temporal scales	Body triads	Tail triads
Roze (1996); Campbell & Lamar (2004)		Male	242-262	31-37	1 + 1 (rarely 1+2)	12-20	1-2 (1 + incomplete)
		Female	266-290	28-35		14-21	
This work	IAvH-R 7332	unknown	251	32	1 + 1	14 + incomplete	1
	iNaturalist ID: 185091716	Female	—	—	—	14	1
	iNaturalist ID: 140615670	Male	—	—	—	13	2
	iNaturalist ID: 139714234	Unknown	—	—	—	15	2
	iNaturalist ID: 186001626	Unknown	—	—	—	15	1

neses-Pelayo *et al*. 2016, Angarita-Sierra & Lynch 2017, Echavarria-Renteria *et al*. 2018, Parra-Hernández *et al*. 2019, Vásquez-Restrepo & Toro-Cardona 2019, García-Cobos *et al*. 2020, Santana-Londoño *et al*. 2021, Rojas & Marín-Martínez 2022, Meneses-Pelayo 2023).

The expansion of the distribution of *Micrurus ancoralis* reflects the need to preserve the tropical forests of the eastern slopes of the Central Cordillera. Nevertheless, our work indicates that this species may inhabit disturbed areas with fragmented tropical forest in Colombia. Furthermore, there is a need to raise awareness about this species. Despite being classified as Least Concern (LC) on the IUCN Red List (Ibáñez et al. 2017), it is frequently killed by humans either out of fear or in road accidents, as illustrated in this work (Fig. 2). The absence of voucher specimens in museums from the Magdalena Valley can be attributed to the general habits of coralsnakes, which makes them difficult to find and collect in nature. Nonetheless, as more fieldwork is conducted in the humid tropical forests of the middle and upper Magdalena Valley, museum vouchers of *Micrurus ancoralis* will likely increase.

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Appendix. Locality records of *Micrurus ancoralis* in Colombia. Reference and voucher/evidence data on all specimens.

Locality	Department	Latitude	Longitude	Reference	Basis of record	Voucher/Link
Cocorná, Vereda Santa Rita	Antioquia	5.887225	-75.146622	This work/ iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/186001626
Dabeiba, camino a Chontaduro	Antioquia	6.758635	-76.53181	GBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 6072
San Francisco	Antioquia	5.948095	-75.080275	This work/ iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/140615670
Remedios	Antioquia	7.210740	-74.496178	This work/ iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/139714234
Mutatá, Villa Arteaga	Antioquia	7.373472	-76.487861	GBIF [gbif.org]. 2023	Preserved specimen	FMNH 78107
Samaná	Caldas	5.384627	-74.951486	This work/ iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/185091716
Quebrada Guanguí, about 0,5 km above its junction with Río Patía, 100 - 200 m. elevation, in upper Río Saija drainage, Department of Cauca	Cauca	2.749655	-77.37261	Pérez-Santos & Moreno 1986	Literature record	—
Alto Baudó, La Victoria	Chocó	5.450278	-77.194167	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 3352
Andagoya, Medio San Juan	Chocó	5.098576	-76.697307	GBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 6770
Andagoya	Chocó	5.095460	-76.712850	Schmidt 1937	Literature record (*M. a. jani* holotype)	MCZ 32722
Andagoya	Chocó	5.096580	-76.696300	Schmidt 1936	Literature record (*M. a. jani* paratype)	MCZ 11151
Andagoya	Chocó	5.096580	-76.696300	Schmidt 1937	Literature record (*M. a. jani* paratype)	MCZ 13270
Andagoya	Chocó	5.095460	-76.712850	Schmidt 1936	Literature record (*M. a. jani* paratype)	MCZ 32720-21
Andagoya	Chocó	5.095460	-76.712850	Schmidt 1937	Literature record (*M. a. jani* paratype)	MCZ 32723
Andagoya, at junction of River Condoto and San Juan	Chocó	5.095523	-76.696583	Schmidt 1936	Literature record (*M. a. jani* paratype)	NHMUK 1946.1.21.13-15
Andagoya, Medio San Juan	Chocó	5.098576	-76.697307	GBIF. OrgGBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 6770

Appendix. (*Continuation*).

Locality	Department	Latitude	Longitude	Reference	Basis of record	Voucher/Link
Atrato, Samurindó	Chocó	5.587500	-76.654167	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 0309
Atrato, Samurindó	Chocó	5.587500	-76.654167	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 0321
Canton Del San Pablo	Chocó	5.354865	-76.672544	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/169959349
Condotó, Peña Lisa	Chocó	5.105000	-76.568000	Schmidt 1935	Literature record (M. a. jani paratype)	NHMUK 1946.1.21.31
Condotó, Peña Lisa	Chocó	5.105000	-76.568000	Schmidt 1936	Literature record (M. a. jani paratype)	NHMUK 1946.1.21.34-35
El Litoral del San Juan, Taparalito, quebrada Taparalito, a una hora arriba de comunidad taparralito	Chocó	4.200678	-76.733652	GBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 6769
El Litoral del San Juan, Taparalito, quebrada Taparalito, a una hora arriba de comunidad taparralito	Chocó	4.200678	-76.733652	GBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 6770
El Litoral del San Juan, Vereda Taparolito, bajo San Juan, región de Málaga	Chocó	4.212194	-77.090417	GBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 7360
Istmina	Chocó	5.144450	-76.683550	GBIF [gbif.org]. 2023	Preserved specimen	MHUA-R 14772
Istmina	Chocó	5.160538	-76.683971	GBIF [gbif.org]. 2023	Preserved specimen	MLS 1569
Istmina	Chocó	5.160538	-76.683971	GBIF [gbif.org]. 2023	Preserved specimen	MLS 1570
Istmina	Chocó	5.160538	-76.683971	GBIF [gbif.org]. 2023	Preserved specimen	MLS 1571
Novita, Rio San Juan	Chocó	4.960474	-76.609474	Schmidt 1936	Literature record (*M. a. jani* paratype)	NHW
Novita, Rio San Juan	Chocó	4.960474	-76.609474	Schmidt 1937	Literature record (*M. a. jani* paratype)	NHW
Nuquí	Chocó	5.873771	-77.291912	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/38878398

Appendix. (*Continuation*).

Locality	Department	Latitude	Longitude	Reference	Basis of record	Voucher/Link
Quibdó	Chocó	5.591139	-76.668526	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/22897523
Quibdó	Chocó	5.683594	-76.628346	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/71379788
Quibdó	Chocó	5.694722	-76.661111	GBIF [gbif.org]. 2023	Preserved specimen	MLS 1567
Quibdó, Pacurita (Cabí)	Chocó	5.681590	-76.597840	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 1516
Río Quito, San Isidro	Chocó	5.626390	-76.748840	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 0634
Unión Panamericana, Salero	Chocó	5.360278	-76.645833	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 1418
Unión Panamericana, Salero	Chocó	5.360278	-76.645833	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 1427
Unión Panamericana, Salero	Chocó	5.326389	-76.615000	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 2786
Unión Panamericana, Salero	Chocó	5.326389	-76.615000	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 2785
Unión Panamericana, Salero	Chocó	5.360278	-76.645833	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 1475
Unión Panamericana, Salero	Chocó	5.360278	-76.645833	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 1212
Unión Panamericana, Salero	Chocó	5.319722	-76.617778	GBIF [gbif.org]. 2023	Preserved specimen	COLZOOCH-H 2230
Tadó	Chocó	5.256917	-76.552556	Schmidt 1936	Literature record (*M. a. jani* paratype)	NHMUK 1946.1.20.28
Tadó	Chocó	5.265977	-76.564874	GBIF [gbif.org]. 2023	Preserved specimen	MLS 1568
Tadó	Chocó	5.265977	-76.564874	GBIF [gbif.org]. 2023	Preserved specimen	MLS 1852
Barbacoas, El Pangan ProAves Reserve	Nariño	1.331259	-78.064873	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/135865244
Policarpa	Nariño	1.723544	-77.49437	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/186213517
Ricaurte	Nariño	1.226632	-78.085775	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/186203188

Appendix. (*Continuation*).

Locality	Department	Latitude	Longitude	Reference	Basis of record	Voucher/Link
Ricaurte, 9 Km SE Ricaurte	Nariño	1.135222	-77.978583	GBIF [gbif.org]. 2023	Preserved specimen	KU 169965
Pueblo Rico, Santa Cecilia, pacific Side, 800 m	Risaralda	5.343056	-76.096111	GBIF [gbif.org]. 2023	Preserved specimen	FMNH 55880
Pueblo Rico, Santa Cecilia, Pacific Side, 800 m	Risaralda	5.343056	-76.096111	GBIF [gbif.org]. 2023	Preserved specimen	FMNH 55879
Pueblo Rico, Santa Cecilia	Risaralda	5.343056	-76.096111	GBIF [gbif.org]. 2023	Preserved specimen	ICN 6965
Pueblo Rico, Santa Cecilia, Vereda Piedras	Risaralda	5.359167	-76.140556	GBIF [gbif.org]. 2023	Preserved specimen	ICN 6905
San Sebastián de Mariquita, Vereda La Maria, km 82 road Mariquita-Falan	Tolima	5.180791	-74.881952	This work	Preserved specimen	IAvH-R 7332
Buenaventura, Anchicayá, central hidroeléctrica	Valle del Cauca	3.533263	-76.867508	GBIF [gbif.org]. 2023	Preserved specimen	UVC 5401
Buenaventura, Bajo Anchicayá, cerca a represa Bajo Anchicayá	Valle del Cauca	3.613741	-76.91095	GBIF [gbif.org]. 2023	Preserved specimen	UVC 13808
Buenaventura, Bajo Calima, cuartel B-V83 concesión Pulpapel, Cartón Colombia, cerca a Pulpapel	Valle del Cauca	3.942106	-76.968401	GBIF [gbif.org]. 2023	Preserved specimen	UVC 11174
Buenaventura, Bajo Calima, estación agroforestal Universidad del Tolima	Valle del Cauca	3.983336	-76.949966	GBIF [gbif.org]. 2023	Preserved specimen	UVC 5402
Buenaventura, Bajo Calima, estaciónagroforestal Universidad del Tolima	Valle del Cauca	3.983336	-76.949966	GBIF [gbif.org]. 2023	Preserved specimen	UVC 7438
Buenaventura, Bajo Calima, estaciónagroforestal Universidad del Tolima	Valle del Cauca	3.983336	-76.949966	GBIF [gbif.org]. 2023	Preserved specimen	UVC 8566
Buenaventura, Bajo Calima, estaciónagroforestal Universidad del Tolima	Valle del Cauca	3.983336	-76.949966	GBIF [gbif.org]. 2023	Preserved specimen	UVC 8567
Buenaventura, Bajo Calima, estación agroforestal Universidad del Tolima	Valle del Cauca	3.983336	-76.949966	GBIF [gbif.org]. 2023	Preserved specimen	UVC 8568

Appendix. (*Continuation*).

Locality	Department	Latitude	Longitude	Reference	Basis of record	Voucher/Link
Buenaventura, camp Cartón Colombia, km 13 car.	Valle del Cauca	3.871111	-76.882500	GBIF [gbif.org]. 2023	Preserved specimen	ICN 309
Buenaventura, Juanchaco	Valle del Cauca	3.936374	-77.360929	iNaturalist community 2023	Human observation	https://www.inaturalist.org/observations/70878977
Buenaventura, Juanchaco, Ladrilleros	Valle del Cauca	3.942153	-77.361115	Ayerbe et al. 2007	Preserved specimen	MHNUC 000067
Buenaventura, Magüipi	Valle del Cauca	3.832586	-77.261857	Ayerbe et al. 2008	Preserved specimen	MHNUC 000474
Buenaventura, Sabaletas	Valle del Cauca	3.746885	-76.96883	GBIF [gbif.org]. 2023	Preserved specimen	UVC 10770
Buenaventura, Sabaletas	Valle del Cauca	3.746885	-76.96883	GBIF [gbif.org]. 2023	Preserved specimen	UVC 10773
Buenaventura, San Cipriano	Valle del Cauca	3.839861	-76.897888	GBIF [gbif.org]. 2023	Preserved specimen	UVC 15484
Buenaventura, Río Calima, camp. Cartón Colombia, a 7 km del río.	Valle del Cauca	3.878889	-76.895833	GBIF [gbif.org]. 2023	Preserved specimen	ICN 402
Buenaventura, Río Calima, camp. Cartón Colombia, a 7 km del río.	Valle del Cauca	3.878889	-76.895833	GBIF [gbif.org]. 2023	Preserved specimen	ICN 413
Buenaventura, Río Calima, camp. Cartón Colombia, a 7 km del río.	Valle del Cauca	3.878889	-76.895833	GBIF [gbif.org]. 2023	Preserved specimen	ICN 424
Calima, Darién, Campo alegre	Valle del Cauca	3.929503	-76.669917	GBIF [gbif.org]. 2023	Human observation	FUNTROPICO_ RFPR_RIOBRAVO_ PARAGUERO 3062
Dagua, Lobo Guerrero, carretera de Buenaventura-Lobo Guerrero	Valle del Cauca	3.772889	-76.692972	GBIF [gbif.org]. 2023	Preserved specimen	IAvH-R 7354

COLZOOCH-H: Colección Científica de Referencia Zoológica del Chocó – Herpetología, Universidad Tecnológica del Chocó, Quibdó, Colombia; FMNH: Field Museum of Natural History, Division of Amphibians and Reptiles, Chicago, USA; IAvH-R: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Colección de Reptiles, Villa de Leyva, Colombia; ICN: Instituto de Ciencias Naturales, Museo de Historia Natural de la Universidad Nacional de Colombia, Universidad Nacional de Colombia, Bogotá, Colombia; KU: Kansas University Natural History Museum, Kansas, USA; MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, USA; MHNUC: Museo de Historia Natural, Universidad del Cauca, Popayán, Colombia; MHUA-R: Museo de Herpetología Universidad de Antioquia, Colección de Reptiles, Universidad de Antioquia, Medellín, Colombia; MLS: Museo de Historia Natural de La Salle, Bogotá, Colombia; NHMUK: Natural History Museum, United Kingdom, London, UK; NMW: Naturhistorisches Museum, Wien, Vienna, Austria; UVC: Colección de Anfibios y Reptiles, Universidad del Valle, Santiago de Cali, Colombia. Coordinates, when not explicit, were approximated according to the locality.

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A new subspecies of *Conepatus semistriatus* (Boddaert, 1784) (Mammalia, Carnivora, Mephitidae) from Venezuela, and the first known case of insular dwarfism in living skunks

Una subespecie nueva de *Conepatus semistriatus* (Boddaert, 1784) (Mammalia, Carnivora, Mephitidae) de Venezuela, y el primer caso conocido de enanismo insular en mofetas vivientes

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ABSTRACT

The Striped Hog-nosed Skunk, *Conepatus semistriatus* (Boddaert, 1784), is distributed from southern Mexico to northern Peru. It is one of the least studied carnivorans of the New World. Not even basic morphometric information exists for the species. This study assesses the taxonomic status of the Striped Hog-nosed Skunk occurring on Margarita Island, off the coast of eastern Venezuela. Multivariate analyses of 25 cranial measurements revealed the Margaritan skunk to be much dwarfed with respect to its nearby mainland congener, thus complying with the 'island rule', which predicts that under insular conditions large continental animals become smaller, and small continental animals become larger. The craniometric differences between the Margaritan and mainland skunks are of similar or greater magnitude to those found in interspecific comparisons within genera of several carnivoran families. Geographic variation in cranial size was not evident within the Margaritan sample, or within the mainland sample, analyzed separately. The Margaritan form is sufficiently distinct to be deemed a new subspecies, thus it is here formally described as *C. semistriatus elieceri* **ssp. nov.** This skunk becomes the seventh mammal known to be endemic to Margarita Island. Its conservation status is undetermined.

Key words: Caribbean islands, endemism, geographic variation, island rule, Margarita Island, morphometry, Striped Hog-nosed Skunk.

RESUMEN

El zorrillo rayado, *Conepatus semistriatus* (Boddaert, 1784), se distribuye desde el sur de México hasta el norte de Perú. Es uno de los carnívoros menos estudiados del Nuevo Mundo. Ni siquiera se ha publicado información morfométrica básica sobre la especie. Este trabajo evalúa el estatus taxonómico del zorrillo rayado de la Isla de Margarita, frente a la costa oriental de Venezuela. Los análisis multivariados de 25 medidas craneanas demuestran que el zorrillo margariteño es mucho más pequeño que su congénere continental más cercano, cumpliendo así con la "regla de las islas", la cual predice que bajo condiciones insulares los animales continentales grandes reducen y los animales continentales pequeños incrementan su tamaño corporal. Las diferencias craneométricas entre los zorrillos de Margarita y tierra firme son de magnitud similar o mayor a las encontradas al efectuar comparaciones interespecíficas dentro de géneros de varias familias de carnívoros. No se encontró variación geográfica evidente en el tamaño del cráneo dentro de la muestra de Margarita, ni dentro de la de tierra firme, analizadas por separado. La forma margariteña es lo suficientemente distinta para ser considerada una subespecie nueva, que aquí se describe formalmente como *C. semistriatus elieceri* **ssp. nov.** Esta mofeta se convierte en el séptimo mamífero endémico de la Isla de Margarita. Su estado de conservación es indeterminado.

Palabras clave: endemismo, Isla de Margarita, Islas del Caribe, morfometría, regla de las islas, variación geográfica, zorrillo rayado.

INTRODUCTION

The family Mephitidae accounts for 0.8% of the generic and 4.4% of the specific diversity of living carnivorans (order Carnivora); it includes two species of stink badgers (genus *Mydaus* F. G. Cuvier, 1821) occurring in insular Malaysia, Indonesia and the Philippines, and 12 species of skunks (genera *Mephitis* E. Geoffroy Saint-Hilaire & F. G. Cuvier, 1795; *Spilogale* Gray, 1865; and *Conepatus* Gray, 1837) occurring in North, Central, and South America (ASM 2024). Fossil skunks are known from the late Miocene to Pliocene (13.5–3 Mya) of Eurasia, and from the Late Miocene (9 Mya) of North America (Wang & Qiu 2004, Wang *et al.* 2005).

Skunks are charismatic mammals that are renowned for their unusual coloration, serving as a warning, and for their smelly spray, used in self-defense. They have been regarded as symbols of cuteness, confidence, pacifism, humor, and luck (Miller 2015). Descented skunks are becoming popular pets. Despite their appeal, the scientific knowledge of skunks shows substantial gaps. They have been best studied in North America, but even there major discoveries have been made in the last decades: thus, *Conepatus mesoleucus* (Lesson, 1865), long considered a separate species, was shown to be not distinct from the American Hog-nosed Skunk, *C. leuconotus* (Lichtenstein, 1832) (Dragoo *et al.* 2003); conversely, the Spotted Skunks, genus *Spilogale*, were shown to possess a greater species diversity than traditionally recognized (McDonough *et al.* 2022). In the other hemisphere, the Jaritacaca, *C. amazonicus* (Lichtenstein, 1838), long considered a subspecies of the Striped Hog-nosed Skunk, *C. semistriatus* (Boddaert, 1785) (Cabrera 1958), was shown to be more closely related to the Molina's Hog-nosed Skunk, *C. chinga* (Molina, 1782), from southern South America (Rodrigues 2013, Schiaffini *et al.* 2013); and based on morphometric and genetic analyses, *C. humboldtii* Gray, 1837 was considered a synonym of the latter (Schiaffini *et al.* 2013), though this conclusion has been disputed also based on genetic data (Rodrigues 2013). Both *C. amazonicus* and *C. humboldtii* are currently deemed conspecific with *C. chinga* (ASM 2024).

Except for *Spilogale* (McDonough *et al.* 2022) and *C. leuconotus* (Dragoo *et al.* 2003, Dragoo & Sheffield 2009), whose southern distributional limits reach Costa Rica, the skunks occurring in southern Mexico and Central America, and in South America from Venezuela and Colombia to Bolivia, have never been revised taxonomically: not even basic morphometric information exists for them. Current classifications for skunks from this ample region are largely based on the viewpoints of twentieth-century authorities (Cabrera 1958, Hall 1981), who did not use modern study methods. Such classifications remain widely used in national and regional species lists (*e.g.*, Solari *et al.* 2013, Pacheco *et al.* 2021, Boher-Bentti *et al.* 2023, Tirira *et al.* 2023), distributional analyses (Meza-Joya *et al.* 2018, Castillo & Caruso 2024), and conservation assessments (Belant *et al.* 2009, Hernández-Sánchez *et al.* 2022).

Hall (1981) assigned the populations from Veracruz and Campeche to *C. semistriatus conepatl* (Gmelin, 1788), those from Yucatan and Quintana Roo to Nicaragua to *C. s. yucatanicus* Goldman, 1943, and those from Costa Rica and western Panama to *C. s. trichurus* Thomas, 1905. Cabrera (1958) assigned the populations from Colombia and Venezuela to *C. s. semistriatus*, those from Ecuador to *C. s. quitensis* (Humboldt, 1812), those from northwestern Peru to *C. s. zorrino* Thomas, 1901, those from northeastern Peru to *C. s. taxinus* Thomas, 1924, and those from southern Peru and Bolivia to *C. rex* Thomas, 1898. Except for the reallocation of *C. rex* to *C. chinga*, this classification was maintained by Wozencraft (2005). Rodrigues (2013) departed markedly from these schemes by applying the name *C. conepatl* to the Mexican and Central American populations, and the name *C. quitensis* to Southern Colombian, Ecuadorian, and Peruvian populations. The three Central American subspecies, and three South American subspecies (*C. s. semistriatus*, *C. s. zorrino*, *C. s. taxinus*), are currently included in *C. semistriatus*; the other two (*C. s. quitensis, C. c. rex*) in *C. chinga* (ASM 2024).

Skunks are remarkable among carnivorans for their poor capacity to cross water barriers: for example, skunks do not occur to the south of the Orinoco and the north of the Amazon Rivers, and the Uruguay River has been implicated in the genetic differentiation between Argentinian and Uruguayan skunks (Rodrigues 2013); the only known insular skunks are those occurring on the Channel Islands of California (Van Gelder 1959, McDonough *et al.* 2022), and on Margarita Island of Venezuela (Bisbal 1983). The colonization of these islands by skunks likely required the formation of ecologically suitable land bridges to the mainland, which may have occurred during a glacial period (Van Gelder 1959, Molinari 2007).

As in other mammals, it is debated whether carnivorans follow the 'island rule', according to which on islands large continental animals become smaller, and small continental animals become larger (Meiri *et al.* 2004, Lyras *et al.* 2010, Molinari 2023a). The Channel Islands skunk, *Spilogale gracilis amphialus* Dickey, 1929, despite being sufficiently differentiated genetically to be deemed a full species (Floyd *et al.* 2011, McDonough *et al.* 2022), is indistinct morphometrically (Van Gelder 1959), thus it does not follow the island rule. No data exist for the Margaritan skunk, but based on this rule it could be predicted to be small because its nearby mainland relative is large.

The fauna of Margarita Island (Fig. 1) includes 16 species of bats, and 13 species of nonvolant mammals (Smith & Genoways 1974, Linares 1998). None of the bats is endemic, but specimens of the Allen's Common Moustached bat, *Pteronotus fuscus* (J. A. Allen, 1911), from the island show 'a notable reduction in overall size', and 'are somewhat paler (Sayal Brown) in color than adjacent mainland populations' (Smith 1972). Six of the nonvolant mammals are endemic, namely:

1. The Margaritan Robinson's Mouse Opossum, *Marmosa robinsoni robinsoni* Bangs, 1898, about which and other insular forms of the species it has been concluded that they are 'nothing more than large island forms with habitat-correlated coat color differences' (Rossi *et al.* 2010) [no genetic information exists for Margaritan specimens to test this hypothesis].
2. The Margaritan Cottontail Rabbit, *Sylvilagus floridanus margaritae* Miller, 1898. Unstudied taxonomically using modern methods.
3. The Margaritan Red-tailed Squirrel, *Syntheosciurus granatensis nesaeus* (G. M. Allen, 1902), which is 'easily distinguished from mainland samples' (Vivo & Carmignotto 2015).
4. The Yellow Speckled Tree-rat, *Pattonomys flavidus* (Hollister, 1914), which is 'cranially distinctive and readily diagnosable' (Emmons 2005).
5. The Margaritan Brown Capuchin monkey, *Sapajus apella margaritae* Hollister, 1914, about which based on the 800 km separation from its southern Venezuelan conspecifics, Linares (1998) and Groves (2001) suggested that it might have been introduced to the island in Pre-Columbian times. Groves also

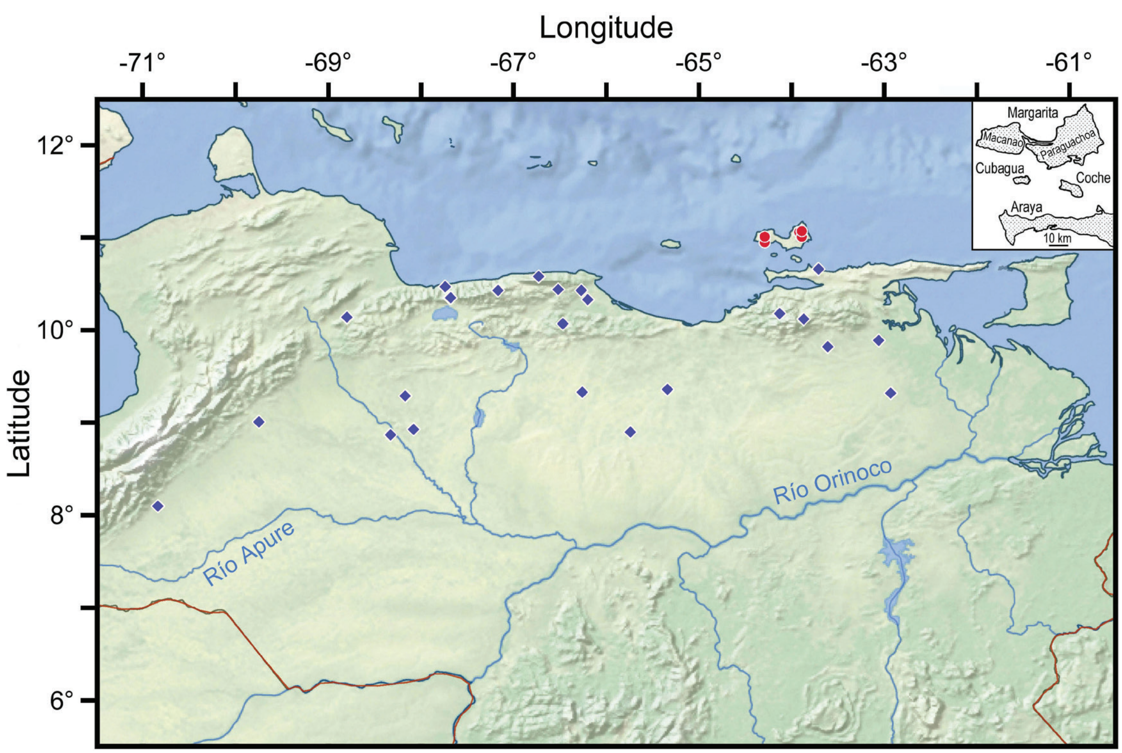

Figure 1. Map of Venezuela east of the Andes and north of the Orinoco River showing the geographic origin of the specimens of the new subspecies (red dots) and *C. s. semistriatus* (blue diamonds) included in this study. The insert in the top left shows the relative positions of Margarita Island, its two divisions (Margarita Oriental, also known as Paraguachoa; and the Macanao Peninsula), the Cubagua and Coche Islands, and the Araya Peninsula. For the geographic coordinates of localities, see Materials and methods.

thought it to be more allied to *S. a. fatuellus* (Linnaeus, 1766) from Colombia than to *S. a. apella* (Linnaeus, 1758). However, the latter subspecies is now known to occur in Guyana, and in the Orinoco Delta (Boher-Bentti & Cordero-Rodríguez 2000), thus could potentially range or have ranged more widely along the coastal forests of northeastern Venezuela, which reach the Araya Peninsula south of Margarita, making a natural colonization of the island possible through a land bridge connecting it to the mainland during a glacial period [no genetic information exists for Margaritan specimens to test these hypotheses].

6. The Margaritan White-tailed Deer, *Odocoileus margaritae* Osgood, 1910, deemed a distinct species due to its very small size and highly distinctive cranial characters (Molinari 2007). Based on D-loop sequences, the separation of this deer from its mainland congeners has been estimated to have occurred at least 118,000 years ago (Moscarella 2001).

Over the course of decades, specimens of *Conepatus* from both mainland Venezuela and Margarita Island, many of them roadkills salvaged by selfless scientific collectors, have slowly accumulated in zoological museums. The point has been reached in which the material available is satisfactory for statistical analyses. We take the opportunity that this represents to conduct the first morphological and morphometric assessment of members of the *C. semistriatus* group, with the main objective of clarifying the taxonomic status of the Margaritan populations.

MATERIALS AND METHODS

Taxonomic categories

We adhere to a version of Simpson's (1951) Evolutionary Species Concept that has been expanded to include operational criteria (Molinari 2023b), according to which a species is 'a phyletic lineage (ancestral-descendent sequence of populations) evolving independently of others, with its own separate and unitary evolutionary role and tendencies, and diagnosably distinct based on heritable morphological characters, genetic markers, or both'. We deem a subspecies to be 'a collection of populations occupying a distinct geographic range and diagnosably distinct from other such conspecific populations based on heritable morphological characters' (Patten & Unitt 2002, Molinari 2023b).

Institutions

The collection acronyms mentioned in this study are: AMNH, American Museum of Natural History, New York, USA; BMNH, Natural History Museum, London, UK; CFA, Colección de Mastozoología, Fundación de Historia Natural "Félix de Azara", Buenos Aires, Argentina; CVULA, Colección de Vertebrados de la Universidad de Los Andes, Mérida, Venezuela; EBRG, Museo de la Estación Biológica Rancho Grande, Maracay, Venezuela; FMNH, Field Museum of Natural History, Chicago, USA; IAvH, Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Villa de Leyva, Colombia; ICN, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia; MACN, Colección Mastozoología, Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina; MBUCV, Museo de Biología de la Universidad Central de Venezuela, Caracas, Venezuela; MCNG, Museo de Ciencias Naturales de Guanare, Guanare, Venezuela; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, USA; MEPN, Museo de la Escuela Politécnica Nacional, Quito, Ecuador; MHNLS, Museo de Historia Natural La Salle, Caracas, Venezuela; MHNM, Museo Nacional de Historia Natural, Montevideo, Uruguay (specimens with this acronym were obtained as an exchange and will be recatalogued in the CVULA); MNHN, Muséum national d'Histoire naturelle, Paris; MZUFV, Museu de Zoologia João Moojen, Viçosa, Brazil; QCAZ, Museo de Zoología de la Pontificia Universidad Católica del Ecuador, Quito, Ecuador; RBMC, Centro de Visitantes de la Reserva Biológica Montecano, Paraguaná Peninsula, Venezuela; USNM, National Museum of Natural History, Washington, USA; UV, Colección de mamíferos de la Universidad del Valle, Cali, Colombia. All specimens were examined physically, except for a few from the CFA, MACN, MCZ, MZUFV, and UV collections, which were examined photographically.

Measurements

Unless otherwise indicated, cranial measurements (Fig. 2A) were taken with a digital caliper. Letter and number combinations (*e.g.*, M1–M3) refer to opposite points of the skull used as landmarks. A total of 25 skull measurements were obtained, as follows:

1. Basilar length* (M1–M3), distance from the posteriormost margin of the first upper incisors to the anteriormost margin of the foramen magnum.

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* Measurements marked with an asterisk after Van Gelder (1968).

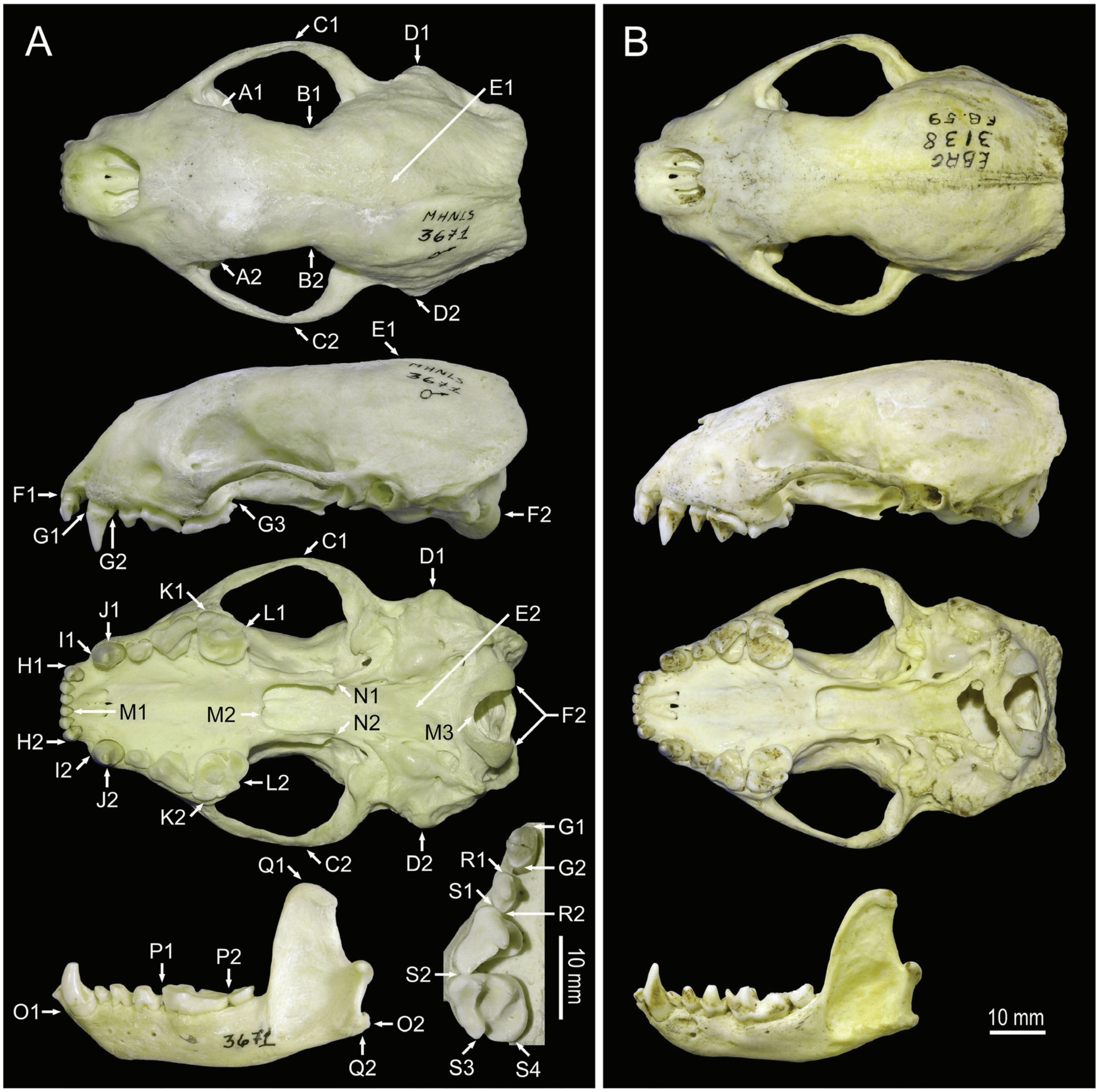

Figure 2. A) Points between which skull measurements were taken: from top to bottom, dorsal, lateral and ventral views of the cranium, and lateral view of the mandible of a specimen of *C. s. semistriatus* (MHNLS 3671), condylobasal length = 81.5 mm, and left half of the palate of a specimen of the new subspecies (CVULA 9124), condylobasal length = 73.0 mm. B) Skull of the holotype of new subspecies (EBRG 3138): from top to bottom, dorsal, lateral and ventral views of the cranium, and lateral view of the mandible. The scales are based on condylobasal lengths and zygomatic breadths (in ventral view). The horizontal scale (right) applies to MHNLS 3671 and EBRG 3138. The vertical scale (left) applies to CVULA 9124.

2. Condylobasal length* (F1–F2), distance from the anteriormost margin of the premaxillae to the posteriormost margin of both occipital condyles.
3. Zygomatic breadth* (C1–C2), maximum distance across the outer margins of the zygomatic arches.
4. Mastoid breadth* (D1–D2), maximum distance across the mastoid processes.
5. Interorbital breadth* (A1–A2), distance across the frontal bones at the level of the frontomaxillary sutures.
6. Postorbital breadth* (B1–B2), minimum distance across the frontal bones posteriorly to the frontomaxillary sutures.
7. Palatilar length* (M1–M2), minimum distance from the posteriormost margin of the first upper in-

* Measurements marked with an asterisk after Van Gelder (1968).

cisors to the posterior margin of the bony palate. If a nasal spine was present postero-centrally, this measurement was taken laterally to it.

8. Precanine length (F1 to I1–I2), minimum distance from the anteriormost margin of the premaxillae to the imaginary line connecting the anteriormost margins of the canines. This measurement is obtained digitally based on a photograph of the palate.
9. Canine to notch length (I1–I2 to L1–L2), minimum distance from the imaginary line connecting the anteriormost edges of the canines to the imaginary line connecting the vertices of the notches between the metacone and the hypocone of each molar. This measurement is obtained digitally based on a photograph of the palate.
10. Post-notch length (L1–L2 to M2), minimum distance from the imaginary line connecting the vertices of the notches between the metacone and the hypocone of each molar and the posterior margin of the bony palate. This measurement is obtained digitally based on a photograph of the palate.
11. Postpalatal length* (M2–M3), maximum distance from anteriormost posterior margin of the bony palate to the anteriormost margin of the foramen magnum.
12. 12. Heigth of the cranium* (E1–E2), distance from the basicranium at the center of the junction of the basisphenoid and basioccipital bones, and the upper surface of the parietal bones, excluding the sagittal crest.
13. Length of the maxillary toothrow* (G1–G3), distance from the anteriormost margin of the canine to the posteriormost margin of the molar at the alveolar levels.
14. Width across incisors* (H1–H2), distance across the latero-labial margins of both third upper incisors.
15. Width across canines* (J1–J2), distance across the latero-labial margins of both upper canines.
16. Width across molars* (K1–K2), distance across the latero-labial margins of both upper molars.
17. Diameter of the canine* (G1–G2), distance from the anteriormost to the posteriormost margin of one of the two upper canines at the alveolar level. On crania in which both canines were missing, this measurement was guessed based on the innermost margins of the alveolus.
18. Length of PM3 (R1–R2), distance from the antero-labial to the postero-lingual margin of the third upper premolar at the alveolar level (PM1 and PM2 are absent in *Conepatus*).
19. Length of PM4* (S1–S2), distance from the antero- to the postero-labial margin of the fourth upper premolar at the alveolar level.
20. Length of the molar (S2–S3), maximum distance from the labial junction of the fourth upper premolar (PM4) and the molar to the posteriormost margin of the molar along the parastyle-metacone axis.
21. Width of the molar (S2–S4), maximum distance from the labial junction of the fourth upper premolar (PM4) and the molar to the postero-lingual margin of the molar.
22. Width of the interpterygoid fossa* (N1–N2), maximum distance across the tips of the hamuli of the pterygoids.
23. Length of the lower carnassial (P1–P2), maximum distance from the anterior to the posterior margin of the lower carnassial.
24. Height of the coronoid* (Q1–Q2), distance from the highest point of the coronoid process to the lowest point of the angular process of the mandible.
25. Length of the mandible* (O1–O2), maximum distance from the mandibular symphysis to the posteriormost margin of the angular process.

In the case of breath measurements, when the measuring landmark was available on one side of the cranium and missing on the other, as for example in specimens with one intact and one broken zygomatic arch, the minimum distance from the available landmark to the longitudinal midline of the cranium was measured, and the resulting value was multiplied by two. This was done to minimize the proportion of missing measurements.

A posteriori, it was found that conventional linear measurements were not sufficient to reflect some visually evident shape differences, particularly with regard to the proportions of the rostrum. For this reason, an additional measurement was added, here referred to as rostral angle. Adobe Photoshop CS6 was used to measure on photographs of crania in lateral view the angle formed by two lines, both starting in the posteriormost alveolar margin of PM3, one of them crossing the antero-central margin of the nasal bones, and the other crossing the alveolar margin of the canine.

Morphometric analyses

Adult specimens of *Conepatus* have been defined as those possessing a fully erupted permanent dentition, and

* Measurements marked with an asterisk after Van Gelder (1968).

a (visibly) fused and obliterated basisphenoid-basioccipital suture (Van Gelder 1968). These simplified criteria may be insufficient. In skunks, subadult-juvenile specimens already show a permanent dentition (Van Gelder 1959), and the basisphenoid-basioccipital suture may stay unfused past and estimated age of eight months (Mead 1967, J. Molinari personal observation). Moreover, cranial sutures may appear unfused in fully adult specimens whose skeletal remains have been exposed to weather for a long time. For this reason, to judge whether specimens were adult, we added three criteria. First, as illustrated for other carnivores (García-Perea 1996), young skunks possess two ridges along the parietal surfaces that are widely apart from the dorsal midline of the cranium. During growth, these ridges migrate centrally until they converge in the sagittal line. Irrespective of whether a well-developed sagittal crest was present or not, a much reduced distance between both ridges was deemed an indicator of adulthood. Second, adult skunks score low in postorbital breadth relatively to interorbital breadth, thus a marked constriction in the postorbital region was deemed an indicator of adulthood. Third, owing to their partly hypogean diets, meaning that food often comes mixed with mineral particles; wild skunks suffer substantial dental wear along their lives. Thus the possession of markedly worn teeth, or the absence of teeth accompanied by scarring or obliteration of the alveoli, was deemed an indicator of adulthood. The morphometric analyses performed in this study include only specimens judged to be adult based on the combination of these criteria.

We divided the sample into two geographic groups: Margarita Island, and mainland (Fig. 1). In the case of the latter, we only included specimens from Venezuela east of the Andes) (note that *Conepatus* has not been recorded in cis-Andean Colombia, Venezuela south of the Orinoco, and the Guianas) under the assumption that the ancestors of the Margaritan populations came from this region. For the multivariate assessment of the data, we used Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA), which were computed using PAST, version 4.16 (Hammer 2024). For univariate tests (chi-square and correlation analysis), we used SPSS version 17.

To give equal weight to all measurements, the PCA was performed on the correlation matrix. Missing measurements were imputed through regression analysis, using known values for the same measurement as predictors. This was done separately for each geographic group. In PCA, variables often have positive loadings on Component 1 (PC1), and both positive and negative loadings in the remaining components. Thus PC1 has been interpreted as a univariate measure of multivariate size, and PC2–PC*n* as univariate measures of multivariate shape (*e.g*., Jolicoeur & Mosimann 1960, Gutiérrez & Molinari 2008, Molinari *et al.* 2023). To quantify the relative contribution of the measurements to overall differences in shape, we calculated their communalities, which equal the sum of the squared loadings of the measurement in the components of interest (McGarigal *et al.* 2000), which in our case were PC2–PC16. We excluded PC17–PC25 because they explain a very small fraction of total variance. In PCA performed on the correlation matrix, the total communality of any variable (*i.e*., the sum of its squared loadings in PC1–PC*n*) equals unity (McGarigal *et al.,* 2000).

To determine whether the western (Macanao Peninsula) and eastern (Paraguachoa) Margaritan populations differ in skull size, and whether the mainland populations show west-to-east clinal variation in skull size, we calculated the Pearson correlation coefficients (*r*) between: 1) the Component 1 (PC1) scores of the specimens in the PCA; and 2) the geographic longitudes at which they were collected. We also carried out this procedure using condylobasal lengths instead of PC1 scores.

Material examined

We carefully georeferenced specimen localities using Google Earth Pro (https://www.google.com/earth/), and the combination of various sources of information, including collector's field notes, museum databases, zoological and botanical literature, and maps. The list of specimens used in the comparisons between the new subspecies and cis-Andean *C. s. semistriatus*, and the localities (Fig. 1) in which they were collected, is as follows:

C. semistriatus elieceri **ssp. nov.** (*n* = 22).— **VENEZUELA: Nueva Esparta,** Margarita Oriental (Paraguachoa), Cerro El Tamoco, 4 km E Santa Ana, 11.07°, -63.89°, 400 m (EBRG 3138*, MBUCV 5274*); Margarita Oriental, Parque Nacional Cerro El Copey, 3 km SW La Asunción, 11.01°, -63.89°, 500 m (MBUCV 5275*); Margarita Oriental, Río Tacarigua, 1.5 km SSE Santa Ana, 11.06°, -63.92°, 35 m (EBRG 3137*); Península de Macanao, near San Francisco, 11.01°, -64.29°, 160 m (CVULA 5770*, 5771*, CVULA 8539*, 8540*, 8541*, 9121*, 9122*, 9123, 9124*, 9125*, 9126*, 9127, 9128*, 9129*, EBRG 18978*); Península de Macanao, Quebrada la Montaña, 12 km W Boca de Río, 10.95°, -64.29°, 12 m (EBRG 18981*, 18983*, 18984*).

C. s. semistriatus (*n* = 39).— **VENEZUELA: Aragua,** 0.5 km NW Cata, 10.47°, -67.74°, 35 m (EBRG 21079*); Estación Biológica Rancho Grande, Parque Nacional Henri Pittier, 14 km NW Maracay, 10.35°, -67.68°, 1150 m (AMNH 144821, EBRG 197*, 274*, 276*, 803*). **Barinas,** Reserva Forestal Ticoporo, 15 km S Socopó, 8.10°,

-70.84°, 175 m (EBRG 15721*). **Cojedes,** Hato Los Caballos, km 68 carretera Tinaco-El Baúl, 54 km SE Tinaco, 9.29°, -68.17°, 85 m (MHNLS 6496*, 6497*); Hato Piñero, near El Baúl, 8.93°, -68.08°, 68 m (MCNG 990*); Río Portuguesa, 11 km SSW El Baúl, 8.87°, -68.33°, 70 m (MHNLS 1225). **Guárico,** Chaguaramas, 9.33°, -66.26°, 183 m (CVULA 1510); Hato Santa Bárbara, 10 km S El Socorro, 8.90°, -65.74°, 135 m (MBUCV 3775); Zaraza, 9.36°, -65.34°, 75 m (AMNH 135481*). **Miranda,** Agua Blanca, Parque Nacional Guatopo, 10.07°, -66.47°, 400 m (CVULA 761*); El Junquito–Colonia Tovar road, 10.43°, -67.17°, 2075 m (MHNLS 3412*); Estación Experimental Río Negro, 5.5 km W Río Negro, 10.33°, -66.20°, 45 m (MBUCV 3032*, 3964*, 4007*, 4025*, 4145*); Near Guarenas, 10.44°, -66.52°, 280 m (MBUCV 3968*); Toma de agua, Río Marasmita, 0.3 km NE Capaya, 10.43°, -66.27°, 95 m (MHNLS 3671*). **Monagas,** Caicara de Maturín, 9.82°, -63.61°, 190 m (USNM 296626*); Hato Mata de Bejuco, 47 Km SSE Maturín, 9.32°, -62.93°, 23 m (EBRG 3190, 3190, 3191, USNM 388241, 388242, 388243, 388244*); Río Guarapiche, Cachipo sector, 9.89°, -63.06°, 20 m (MHNLS 10772*). **Portuguesa,** Autopista José Antonio Páez, 3.8 km S Guanare, 9.01°, -69.75°, 153 m (CVULA 8371). **Sucre,** 16 km Chacopata, towards Cariaco, 10.66°, -63.71°, 10 m (CVULA 8538*); Mount Turimiquire, 10.12°, -63.87°, 2300 m (FMNH 38061*); Río Neveri, 24 km WSW Cumanacoa, 10.18°, -64.13°, 425 m (AMNH 69609). **Vargas,** Canales de Naiguatá, vertiente norte del Parque Nacional El Ávila, 10.58°, -66.73°, 800 m (EBRG 3009, MHNLS 8727*). **Yaracuy,** Puente Yaracuy, Nirgua-Chivacoa road, 10.14°, -68.80°, 210 m (EBRG 490).

The specimens whose skull measurements were used for multivariate analyses are indicated with an asterisk. The remaining specimens consist of immature skulls with or without study skin, or study skins only. Many other specimens of *Conepatus* were examined for the comparisons performed in the Taxonomy section (Appendix 1).

RESULTS

Measurements

The skull (not including imputed values) measurements of the holotype, the Margarita Island sample, and the mainland sample, are provided in table 1. Except for the width of interpterygoid fossa (Fig. 2A), the new subspecies averages smaller than its mainland relative in all measurements. No overlap was observed between both forms in six measurements (basilar length, condylobasal length, mastoid breadth, interorbital breadth, postpalatal length, and width across molars). The skull of the holotype is longer than the average for its subspecies (Fig. 2B, Table 1). Expressed as the mean ± SD (min–max) [n], the rostral angle (see Methods) for the new subspecies was 43.8° ± 3.4° (38.3°–48.7) [16], and that of *C. s. semistriatus* was 52.7° ± 1.8° (50.8°–57.0°) [21].

Morphometric analyses

The summary results of the PCA performed on the correlation matrix are shown in Appendix 2. PC1 explained 69.44% of total variance. All measurements, except for the weakly negative width of interpterygoid fossa, have positive loadings. Thus PC1 can be viewed as an axis primarily reflecting multivariate size. The remaining components show even mixtures of negative and positive loadings, indicating that they can be viewed as comparisons of shape. Based on the communality values on the second to sixteenth axes, measurements weakly associated with skull volume, such as precanine length, width of interpterygoid fossa, length of PM4, and post-notch length have the greatest influence on overall differences, whereas the opposite is true for measurements strongly associated with skull volume, such as mastoid breadth, basilar length, and condylobasal length.

Based on specimen scores (Fig. 3), the two forms segregate sharply in the first axis of the PCA, with no overlap observed between the 95% confidence intervals of their scores. On the contrary, they overlap broadly in the second axis, as they do in the remaining 23 axes (not shown). To determine whether despite this finding the PCA reflects interspecific 'shape' differences, we performed a LDA on the specimen scores in the second to twenty-fifth axes. This analysis produced a single axis (eigenvalue = 0.11) explaining 100% of the variance. The resulting discriminant function was able to classify correctly 14 of the 20 specimens of the new subspecies, and 17 of the 25 specimens of *C. s. semistriatus*. A chi-square analysis revealed these proportions to differ significantly ($p < 0.05$) from the expected proportions should there be no differences between both forms. Thus the PCA did detect a differentiation in shape, albeit an incomplete and diffuse one.

For the new subspecies, the Pearson correlation coefficient between PC1 scores and geographic longitude was $r = 0.23$ ($p = 0.34$). For *C. s. semistriatus* it was $r = -0.05$ ($p = 0.80$). The results using condylobasal length instead of PC1 were similar: $r = 0.19$ ($p = 0.43$) and $r = -0.17$ ($p = 0.41$), respectively. Hence, with respect to skull size, there is not differentiation between the populations of western (Macanao Peninsula) and eastern (Paraguachoa) Margarita, which are connected by a narrow isthmus, and there is not west to east clinal variation within the populations of mainland Venezuela east of the Andes.

Table 1. Summary statistics for the skull measurements (mm) of adult *Conepatus* specimens used in this study. The values are expressed as mean ± SD (min–max) [*n*]. Only specimens from Margarita Island (*C. semistriatus elieceri* **ssp. nov.**) and the mainland of Venezuela east of the Andes (*C. s. semistriatus*) are included (Fig. 1).

Measurement (mm)	Holotype (EBRG 3138)	*C. s. elieceri* **ssp. nov.**	*C. s. semistriatus*
Basilar length	65.7	63.8 ± 2.1 (60.0–66.4) [18]	73.8 ± 3.1 (67.7–79.2) [24]
Condylobasal length	73.0	71.9 ± 2.0 (68.3–74.7) [18]	82.4 ± 3.1 (77.9–88.8) [24]
Zygomatic breadth	50.5	47.4 ± 2.4 (43.4–50.9) [15]	54.6 ± 2.8 (50.0–59.4) [24]
Mastoid breadth	39.7	38.6 ± 1.3 (36.4–40.9) [20]	45.0 ± 1.6 (42.4–47.9) [24]
Interorbital breadth	22.8	23.4 ± 0.7 (22.3–24.5) [20]	27.0 ± 1.4 (24.9–29.9) [24]
Postorbital breadth	21.3	21.3 ± 0.7 (20.1–22.5) [20]	23.3 ± 0.9 (21.8–25.5) [24]
Palatilar length	30.4	29.5 ± 1.1 (26.7–30.7) [18]	33.5 ± 1.5 (30.4–36.8) [25]
Post-notch length	5.2	4.2 ± 0.6 (3.1–5.2) [18]	4.4 ± 0.9 (2.5–5.9) [25]
Notch to canine length	22.3	21.7 ± 0.9 (19.6–23.3) [18]	25.4 ± 1.4 (23.3–28.6) [25]
Precanine length	4.7	5.4 ± 0.4 (4.7–6.2) [20]	5.8 ± 0.4 (5.0–6.9) [25]
Postpalatal length	33.9	33.4 ± 1.0 (31.5–35.1) [18]	38.8 ± 2.2 (36.0–43.8) [24]
Heigth of cranium	27.1	26.5 ± 0.7 (25.2–27.8) [19]	29.9 ± 1.9 (25.5–35.1) [24]
Length of maxillary toothrow	23.0	22.9 ± 0.8 (21.3–25.3) [20]	26.3 ± 1.0 (24.8–27.9) [25]
Width across incisors	12.1	11.7 ± 0.6 (10.0–12.7) [20]	13.1 ± 0.7 (11.4–14.6) [25]
Width across canines	19.5	18.4 ± 0.7 (17.2–19.5) [20]	21.7 ± 1.0 (19.5–23.4) [25]
Width across molars	31.1	30.3 ± 0.6 (29.2–31.6) [20]	34.9 ± 1.1 (32.6–37.5) [24]
Diameter of canine	4.8	4.4 ± 0.3 (3.8–5.1) [20]	5.4 ± 0.4 (4.5–6.2) [25]
Length of PM3	4.3	3.9 ± 0.5 (2.2–4.5) [20]	4.7 ± 0.4 (3.9–5.7) [25]
Length of PM4	7.8	7.9 ± 0.3 (7.2–8.4) [20]	8.9 ± 0.5 (7.9–9.8) [25]
Length of molar	7.7	8.0 ± 0.4 (7.3–8.6) [19]	9.5 ± 0.7 (8.5–11.7) [25]
Width of molar	10.0	10.4 ± 0.4 (9.6–11.2) [19]	11.9 ± 0.6 (10.5–12.8) [25]
Width of interpterygoid fossa	6.4	8.6 ± 0.9 (6.4–9.7) [16]	8.0 ± 1.2 (6.1–10.5) [23]
Length of lower carnassial	10.6	10.7 ± 0.3 (10.2–11.1) [12]	11.5 ± 0.3 (11.0–12.2) [23]
Height of coronoid	22.9	24.5 ± 1.3 (22.5–27.8) [19]	26.6 ± 1.9 (23.5–29.7) [21]
Length of mandible	49.0	48.8 ± 2.2 (44.6–53.0) [19]	53.9 ± 2.6 (49.8–58.7) [21]

A LDA performed directly on the skull measurements also produced a single axis (eigenvalue = 49.96), thus the results are presented as one histogram for each subspecies on the same axis (Fig. 4). A normal curve (new subspecies, mean = 7.7, SD = 0.9; *C. s. semistriatus*, mean = 6.2, SD = 1.1) was fitted to each histogram. The means are separated by more than 12 (rightwards) and 16 (leftwards) standard deviations. Hence, the discriminant function obtained should be able to classify correctly all specimens of both subspecies even if much larger samples were available.

The discriminant function is: specimen score = 68.54 + (loading 1 × measurement 1) + (loading 2 × measurement 2) + ... + (loading 25 × measurement 25). The mean of the loadings on the single axis is 0.30. The loadings below the mean are: length of pm4, 2.10; width across incisors, 1.89; basilar length, 1.27; condylobasal length, 1.19;

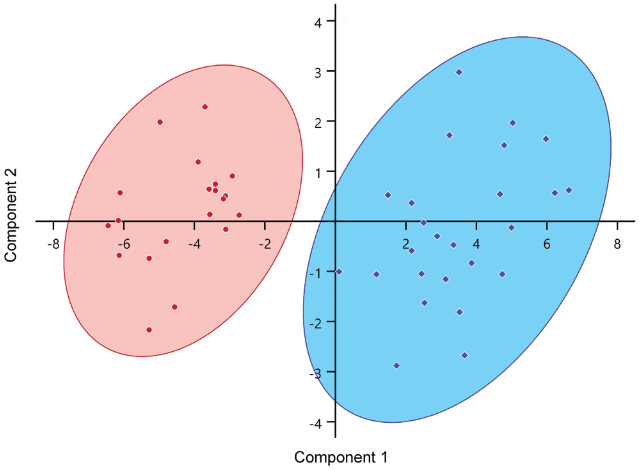

Figure 3. Specimen scores on the first two axes of the Principal Components Analysis (PCA) of the cranial measurements. New subspecies (red dots). *C. s. semistriatus* (blue diamonds). The ellipses enclosing the specimen symbols represent the 95% confidence intervals.

zygomatic breadth, 0.84; width of interpterygoid fossa, 0.75; diameter of canine, 0.51; height of coronoid, 0.47; height of cranium, 0.44; postorbital breadth, 0.36; length of lower carnassial, 0.28; length of molar, 0.24; and length of mandible, 0.28. The loadings above the mean are: notch to canine length, 0.32; width across molars, 0.54; post-notch length, 0.72; palatilar length, 1.02; length of pm3, 1.30; mastoid breadth, 1.43; width across canines, 1.59; length of maxillary toothrow, 1.69; interorbital breadth, 1.70; precanine length, 2.07; postpalatal length, 2.12; and width of molar, 2.60.

TAXONOMY

Conepatus semistriatus elieceri ssp. nov.

http://zoobank.org/urn:lsid:zoobank.org:act:3363DEF5-5EAA-4BF7-ADA4-5BF710E457B7

Margaritan Hog-nosed Skunk
Zorrillo rayado margariteño

Holotype (Figs. 2B and 5A)

An adult female (EBRG 3138), consisting of cranium, mandibles, and study skin.

Type locality

Venezuela, Estado Nueva Esparta, Margarita Island, Cerro El Tamoco, 4 km E Santa Ana, 11.07° N, 63.89° W, 400 m.

Paratypes

We designate as paratypes three specimens of unknown sex: MBUCV 5274, from the type locality; EBRG 18983, from Quebrada la Montaña, 12 km W Boca de Río, 10.946° N, 64.287° W, 12 m; and CVULA 9121, from near San Francisco, 11.01° N, 64.29° W, 160 m.

Measurements of the type material

The measurements of the holotype are provided in Table 1. The skull measurements (mm) of the paratypes (MBUCV 5274, EBRG 18983, CVULA 9121) are: basilar length, 63.4, 65.0, 62.3; condylobasal length, 71.8, 73.0, 70.6; zygomatic breadth, 46.6, 50.1, 44.0; mastoid breadth, 39.7, 40.0, 36.6; interorbital breadth, 23.5, 24.3,

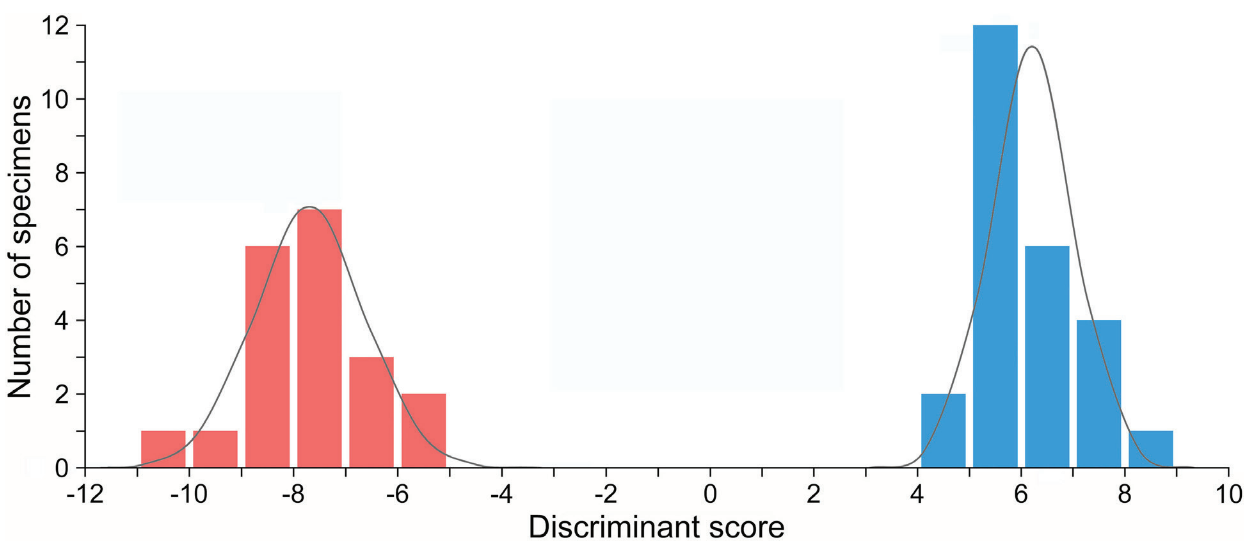

Figure 4. Results of the Linear Discriminant Analysis of the cranial measurements. A single axis explaining 100% of variance was obtained. The scores of the specimens of the new subspecies (left, red) and *C. s. semistriatus* (right, blue) are represented as two histograms along the axis.

23.0; postorbital breadth, 20.7, 22.5, 20.5; palatilar length, 29.3, 30.3, 28.7; post-notch length, 5.0, 3.9, 4.0; notch to canine length, 22.6, 23.3, 20.7; precanine length, 5.6, 5.1, 5.2; postpalatal length, 32.9, 33.5, 32.9; height of cranium, 25.6, 27.8, 25.2; length of maxillary toothrow, 22.1, 23.7, 22.4; width across incisors, 11.3, 12.1, 11.6; width across canines, 17.2, 19.3, 18.1; width across molars, 29.9, 30.8, 29.8; diameter of canine, 4.2, 5.1, 4.0; length of PM3, 3.6, 4.5, 3.2; length of PM4, 7.2, 8.0, 7.8; length of molar, 7.3, 7.8, 8.0; width of molar, 9.7, 10.2, 10.6; width of interpterygoid fossa, 8.2, 8.9, 9.7; length of lower carnassial, —, 10.6, 10.5; height of coronoid, 27.8, 25.0, 22.5; length of mandible, 49.1, 48.6, 44.6.

Diagnosis

Small for a South American member of the *C. semistriatus* group. The rostrum is relatively low (rostral angle less than 50°, see Methods) in lateral view (Fig. 2B). On dorsal view of the cranium, the anteriormost margins of the nasal bones do not project fully over the palatal plane, leaving the anterior region of the premaxillae and the incisive and interincisive foramina fully exposed. In most specimens, the anterior opening of the infraorbital foramen is single (not divided) in at least one side of the cranium. The nasal spine is short or absent, and the nasal septum (part of the vomer bone) does not extend rearwards, thus does not form a keel, past the postpalatal shelf. The hypoglossal (condyloid) foramen is well separated from the posterior lacerate foramen.

Description

As other Venezuelan, Colombian, and Central American members of the *C. semistriatus* group, the holotype possesses two white dorsal stripes, joined only on the head, each of them broader anteriorly and narrower posteriorly, and with little separation between them (Fig. 5A). The type specimen is unusual in possessing numerous dark spots on the dorsal stripes, and a fully dark tail with short hairs all along (Fig. 5A). The hairs of the dorsal stripes are longer than those of the back. The pelage is brown and the skin is yellowish. As characteristic of *Conepatus*, the area around the nose is bare, the ears are much reduced, and the claws on the forefeet are long.

The cranial size (Table 1) is medium for the genus: condylobasal length is more than 70 mm, and less than 77 mm. The skull is much higher in the temporal than in the frontal region. The rostrum is narrow and short in dorsal view (Fig. 2B). In older adults, a low (usually 1–2 mm) sagittal crest is present. The zygomatic arches vary from moderately to strongly bowed upwards. The tympanic bullae are small, and not inflated. The dental formula is: incisors 3/3, canines 1/1, premolars 2/3, and molars 1/2 on each side, for a total of 32 teeth. The single upper molar is much enlarged; P1 is absent, as in all skunks; P2 is absent, as in most *Conepatus*. There is a distinct notch between the metacone and the hypocone of the upper molars. The lower edges of the mandibles are bowed downwards. Most specimens have a single mental foramen (few have one or two small accessory foramina near the mental foramen) on each mandible. The coronoid process has a narrow tip, and is bowed forward both anteriorly and posteriorly: these characteristics of the mandible are more marked in other Margaritan specimens than in the holotype (Fig. 2B). In m1, the talonid is much longer than trigonid.

Comparisons (Table 1, Figs. 2 and 5)

We compare the new subspecies first with its geographic neighbor, and likely closest relative, then with species of *Conepatus* distributed from north to south in the Nearctic and Neotropical regions.

Compared to *C. s. semistriatus* from the Venezuelan mainland east of the Andes (this study), the new subspecies is much smaller, with no overlap in several cranial measurements. Its rostrum is proportionally shorter, narrower, and lower, with a rostral angle of less than 50°, as opposed to more than 50°. The coronoid process is narrow-tipped, and much bowed forwards, as opposed to broad tipped, and moderately bowed or straight. In the new subspecies, each mandible usually has a single mental foramen, sometimes surrounded by one or two poorly developed accessory foramina, as opposed to one mental foramen accompanied by one to four, often well-developed, accessory foramina. Little is known about the external appearance of the new subspecies, but the study skin of the holotype, which is the only one available, has two features not observed in *C. s. semistriatus*, namely numerous dark spots on the dorsal stripes, and a dark tail, as opposed to totally white stripes, and a tail having at least a white tip (in most cases the distal half or two-thirds are white). The tail also has shorter hairs.

Compared to *C. leuconotus*, the new subspecies possesses a hypoglossal foramen well separated from the posterior lacerate foramen, as opposed to confluent with it. In m1, the talonid is much longer than trigonid, as opposed to the talonid slightly longer than the trigonid. Dorsally, the pelage shows two white stripes, as opposed to a single and central white stripe.

Compared to Central American *C. semistriatus*, on dorsal view of the cranium, the incisive and interincisive foramina of the new subspecies are fully exposed, as opposed to partly covered by the nasals, which extend farther frontally. The precanine and postdental regions are pro-

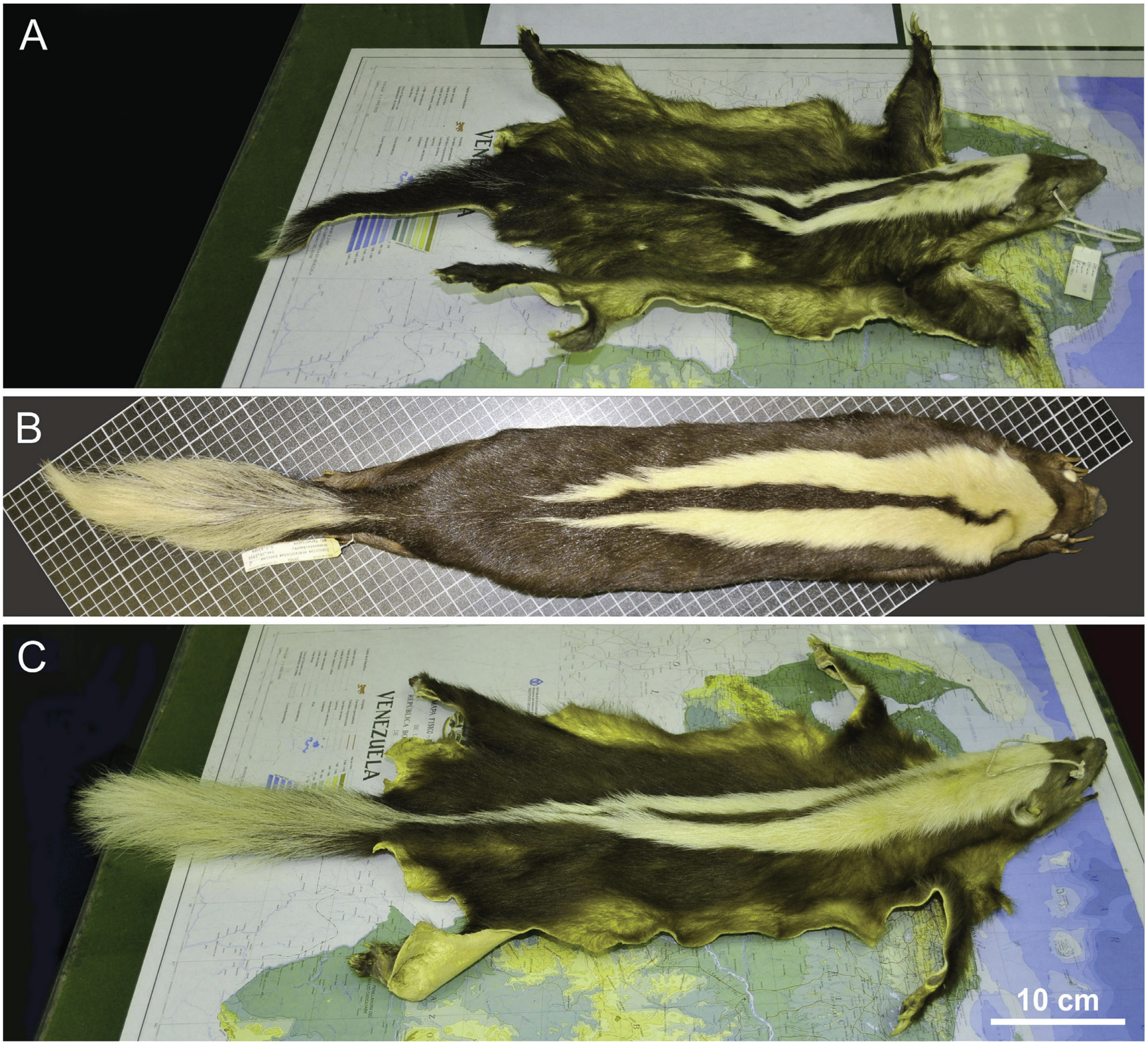

Figure 5. Comparison of study skins. A) holotype of *C. semistriatus elieceri* **ssp. nov.** (EBRG 3138). B) *C. s. semistriatus* (FMNH 38061). C) *C. s. semistriatus* (EBRG 3009). The scale (bottom) applies to the three skins. Note the uniformly dark tail, and the dark spots on the dorsal stripes of the study skin of the holotype, which is the only one available for the new subspecies.

portionally longer with respect to the rest of the palate. The anterior opening of the infraorbital foramen is usually single, as opposed to double or triple. Each mandible usually has a single mental foramen, as opposed to one mental foramen accompanied by up to six accessory foramina. In contrast with the holotype of the new subspecies, specimens of Central American *C. semistriatus* possess distally white (one-third to more than one-half the length) tails.

Compared to Ecuadorian and Peruvian *C. semistriatus* (*C. s. taxinus*, and *C. s. zorrino*) and *C. chinga* (*C. c. quitensis*, *C. c. rex*), the new subspecies is smaller. On dorsal view of the cranium, its incisive and interincisive foramina are fully exposed, as opposed to partly or totally covered by the nasals. Its postorbital region is not as narrowly constricted, its sagittal crest and nasal spine are less developed, and its upper molars and fourth upper premolars (P4) are proportionally larger. The holotype of the new subspecies has dorsal stripes that are less separated from each other than those of Ecuadorian and Peruvian specimens.

Compared to *C. chinga amazonicus* and southern South American members of the *C. chinga*-group, the new subspecies has a short or absent nasal spine with the nasal septum fully inside the nasal cavity, as opposed to a well-developed nasal spine with a nasal septum that typically (*C. c. amazonicus*), or sometimes (southern South American material), continues into a keel posterior to the nasal spine. Its zygomatic arches are from moderately to strongly bowed upwards, as opposed to moderately bowed or almost straight. It has a less inflated tympanic bulla. Compared only to *C. c. amazonicus*, the new subspecies is smaller. Unlike the holotype of the new subspecies, *C. c. amazonicus* typically has a predominantly white tail. Compared only to southern South American specimens, the new subspecies is larger. On dorsal view of the cranium, its incisive and interincisive foramina are fully exposed, as opposed to partly or, more typically, covered by the nasals, which extend anteriorly causing the nasal cavity to open frontally through a comparatively small and rounded orifice. The holotype of the new subspecies has narrowly-separated dorsal stripes, as opposed to widely-separated dorsal stripes (often reduced or absent). The *C. semistriatus* from Venezuela, Colombia, and Central America always have well-developed dorsal stripes. This seems to be also de case of *C. c. amazonicus*.

Distribution (Fig. 1)

Endemic to Margarita Island, Venezuela. Occurring in both geographic subdivisions (Macanao Peninsula, Paraguachoa) of the island.

Etymology

The epithet *elieceri*, a masculine noun in the genitive case, honors the Venezuelan researcher Eliécer E. Gutiérrez, in recognition of his outstanding contributions to Neotropical mammalogy.

DISCUSSION

Cranially, species of the genus *Conepatus* lack highly distinctive characters, and can be distinguished from each other mainly based on size and proportions. In addition, at the intraspecific level they are variable in coloration (Van Gelder 1968, Dragoo *et al.* 2003, Schiaffini *et al.* 2013, Teta *et al.* 2020, Ferguson *et al.* 2022). Perhaps it is for these reasons that Hershkovitz (1959) suggested all members of the genus to be conspecific, which the genetic data now available (Dragoo *et al.* 2003, Schiaffini *et al.* 2013, Rodrigues 2013) show not to be the case. In this context, the finding that the Margaritan skunk is 100% distinguishable from its nearby mainland congener, not only morphometrically but also to the naked eye, is remarkable. In fact, the differences in raw measurements, and PCA and LDA scores, between both forms are similar or greater to those found in interspecific comparisons within genera of several carnivoran families (*e.g*., Van Valkenburgh & Wayne 1994, Taylor & Matheson 1999, Bertrand & Morisot 2012, Bornholdt *et al.* 2013, Srinivas & Jhala 2021). We are assigning the subspecies rank to this skunk based on the findings that it is highly diagnosable, and that its morphometric differences are large; we are not assigning the species rank because such differences involve mainly size (Molinari 2023b).

Middle-sized carnivorans often evolve dwarfism after colonizing islands, either by over-water dispersal or glacial-period vicariance. Examples include insular endemics such as the Channel Islands fox, *Urocyon littoralis* (Baird, 1858) (Coonan *et al.* 2010), the Pygmy Raccoon, *Procyon pygmaeus* Merriam, 1901 (Villa-Meza *et al.* 2011), the Dwarf Coati, *Nasua nelsoni* Merriam, 1901 (Cuarón *et al.* 2009), the Cozumel Island fox, genus *Urocyon* Baird, 1857 (Gompper *et al.* 2006), and the Margaritan Hog-nosed Skunk, *C. s. elieceri* (this study). The latter is the first known case of insular dwarfism in extant skunks: a dwarfed fossil skunk, *Promephitis majori* Pilgrim, 1933, has been found on the Greek island of Samos (Pilgrim 1933). Exceptions include the Tres Marías Raccoon, *Procyon lotor insularis* Merriam, 1898 (Wilson 1991), and the extinct Falkland Islands wolf, *Dusicyon australis* (Kerr, 1792) (Lyras *et al.* 2010), which are (or were) similar-sized to their mainland ancestors. Thus, the Margaritan skunk is not alone among carnivorans in following the island rule (Foster 1964, Van Valen 1973).

The suite of morphological, functional, and behavioral changes often observed in insular organisms has been referred to as the 'island syndrome' (Adler & Levins 1994, Baeckens & Damme 2020). These changes may involve traits such as body size (considered by the island rule), cranial shape, limb proportions, coloration, diet, and escape behavior (Adler & Levins 1994, Sánchez-Villagra *et al*. 2016, van der Geer 2019, Baeckens & Damme 2020). To some degree, *C. s. elieceri* also complies with the island syndrome since it differs from *C. s. semistriatus* in a cranial shape parameter (rostral angle) that could not be quantified using linear measurements.

Along the last 500,000 years, on four times global sea level was more than 100 m below the present level: about 20,000 (Last Glacial Maximum), 140,000 (Penultimate Glacial Period), 250,000, and 340,000 YBP (Waelbroeck *et al.* 2002, Siddall *et al.* 2007, Lichter *et al.* 2010). At such times, many continental-shelf islands were connected to the mainland by land bridges, offering the opportunity of colonization to mainland populations. Animals can be expected to cross ecologically suitable land bridges every time that they are formed, and pre-established insular populations can be expected to retain at least part of their acquired differences even if genetic exchange takes place with more recent immigrants. Thus insular animals that are classifiable as endemic species or subspecies, such as the Margaritan skunk, are likely to have colonized the islands and started their separate evolution earlier than the Last Glacial Maximum. Examples exist for insular mammals of the Caribbean: the Pygmy Three-toed Sloth, *Bradypus pygmaeus* Anderson & Handley, 2001, from the Escudo de Veraguas Island (Panama) was estimated to have diverged at least 4.3 Mya (Ruiz-García *et al.* 2017); the pygmy raccoon and the dwarf coati from Cozumel Island (Mexico) were estimated to have been isolated since 50,000 YBP, and the fox from this island 'for a minimum of 5000–13000 years, and perhaps far longer' (McFadden 2004, Gompper *et al.* 2006); as already noted, the Margaritan White-tailed Deer was estimated to have diverged at least 118,000 YBP (Moscarella 2001, Molinari 2007).

As areas of endemism, the Margarita and Cozumel Islands show similarities. Both have about the same number of endemic species and subspecies, and are at a similar distances from the mainland. However, Margarita is twice as large (1,071 opposed to 478 km^2); and with mountains as high as 760 m (Cerro Macanao to the west) and 960 m (Cerro El Copey to the east) it has a greater environmental diversity than Cozumel, which has a maximum elevation of about 15 m. Margarita has a more complex biogeographic history: it has been emerged, intermittently connected to the mainland during glacial periods, for more than one million years, whereas Cozumel was under water about 120,000 YBP; relatively to the mainland, Margarita was from 20 to 50 km to the west 1 Mya, whereas Cozumel has not shifted its position over the last 200,000 years (Gompper *et al.* 2006, Molinari 2007). More attention needs to be given to the protection of the Margaritan flora and fauna. The conservation status of the Margaritan skunk is undetermined, but the abundant material of the subspecies in museum collections suggests that it is common, that it suffers a high mortality rate, or both.

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APPENDIX 1
Additional specimens of *Conepatus* examined

Specimens are grouped according to current classification (ASM 2024), which must be deemed provisional because the genus has never been reviewed. Adult specimens whose skulls were examined are indicated with an asterisk. All other specimens consist of immature skulls with or without study skin, or study skins only.

C. chinga (*n* = 272).— **ARGENTINA: Buenos Aires,** 25 de Mayo (CFA 9752); Bonifacio (BMNH 17.9.15.3); Bonifacio (Laguna Alsina) (BMNH 17.9.15.1*); Estación Ombucta (BMNH 28.12.11.9); Estancia Los Angeles, 64 Mi SE Azul (USNM 331066); Estancia Los Ingleses, near Mar de Ajó (BMNH 20.2.7.10, 20.2.7.8, 20.2.7.9, 9.12.1.16, 9.12.1.17, 9.12.1.18*); Gándara (MACN 29.912); Mar del Plata (BMNH 13.2.24.1, 16.10.3.6); N of Necochea (USNM 172792*); near Henderson (FMNH 24354*); San José Ranch, 32 km SSW San Blas (USNM 171957, 171958, 172791). **Catamarca,** 'Otro Cerro', Sierra de Ambato, aprox. 35 km N Chumbicha (BMNH 19.2.7.1*, 19.2.7.2, 19.2.7.3*, 20.3.17.2); Belén (BMNH 34.11.4.6, 34.11.4.7). **Chubut,** 100 km NW Comodoro Rivadavia (AMNH 94317*); Barrancas Blancas, 5.5 km al SW Puerto Madryn (MNHN 1897-1244*); La Concepción (Laguna) (BMNH 28.12.11.6, 28.12.11.7); Lago Colhue Huapi (AMNH 94328, 94330*); Pico Salamanca (BMNH 28.12.11.3–28.12.11.5); Rawson (MACN 28.72); Río Chubut (BMNH 99.2.22.10); Sarmiento (AMNH 94329*); unknown locality (BMNH 96.10.7.3); Valle del Lago Blanco (BMNH 3.7.9.13–3.7.9.15). **Córdoba,** Cruz del Eje (BMNH 2.2.5.2, 2.2.5.3*, 2.2.5.4–2.2.5.6, 2.2.5.9); El Carrizal, Villa Dolores (BMNH 17.6.29.5–17.6.29.7); Noetinger (BMNH 17.1.25.8, 17.1.25.9); unknown locality (AMNH 36933). **Corrientes,** Manantiales (MACN 13.714). **Entre Ríos,** Paraná (AMNH 36932). **Formosa,** 'Formosa, Paso de las Niñas, Río Teuco' [39 km SSW Ingeniero Suárez, Río Teuco-Bermejo] (MACN 47.119); Fortín Nuevo Pilcomayo (MACN 43.58). **Jujuy,** Alfarcito (BMNH 21.11.1.3); Humahuaca (MACN 26.182); Maimara (BMNH 12.12.12.1*, 12.12.12.2). **La Rioja,** Desiderio Tello (USNM 172793*, 172794). **Mendoza,** Colonia Alvear (BMNH 10.9.12.2); Tupungato (BMNH 21.7.5.3*). **Neuquén,** Chos Malal (BMNH 26.10.11.1); Collón Curá (BMNH 27.6.4.68); 16 km SE of La Rinconada (BMNH 27.5.1.1*); San Martín de los Andes (BMNH 27.5.1.119); Sierra de Pil Pil (BMNH 27.5.1.2). '**Patagonia**', unknown locality (BMNH 1899.2.41, 3.11.5.10, 3.11.5.11). **Río Negro,** Estancia Huanu-Luan (FMNH 34193*); Huanuluan (MCZ 19110–19114); Pichi Mahuida (BMNH 27.6.21.1–27.6.21.9); Pilcaniyeu (BMNH 19.1.5.2, 19.1.5.22, 20.11.4.3); S shore of Lake Nahuel Huapi (BMNH 3.11.5.9). **Salta,** Cachi (BMNH 6.5.8.12–6.5.8.14, 6.5.8.16); Metán (La Cañada) (BMNH 34.11.4.14); Metán (La Represa) (BMNH 34.11.4.10–34.11.4.12, 34.11.4.8, 34.11.4.9). **San Juan,** Pedernal (BMNH 21.6.19.2–21.6.19.4). **Santa Cruz,** 40 km SW Puerto Santa Cruz (AMNH 17446*); Estancia Alta Vista, Lago Argentino (BMNH 28.12.11.8); Puerto Santa Cruz (CFA 9926); Río Chico, Departamento Corpen Aike (AMNH 25669*); Río Gallegos (USNM 264479); Santa Cruz (BMNH 99.2.4.2); unknown locality (MNHN 1883-163*). **Santa Fe,** Esperanza (BMNH 1.2.4.5, 1.2.4.7); Las Rosas (BMNH 17.5.2.2–17.5.2.4); San Cristóbal (BMNH 17.5.3.5). **Santiago del Estero,** Clodomira (CFA 9459); Lavalle (AMNH 41530*, 41531*, 41532, 41533, 41534*); Roversi (BMNH 34.11.4.13); Villa La Punta (CFA 10803). **Tucumán,** Tafi Viejo (AMNH 41529*). **BOLIVIA: Cochabamba,** 32 km S Tiraque (USNM 271410*); 43 km ESE of Iquisivi (BMNH 2.1.1.11*); Cochabamba (BMNH 2.1.1.15*); El Choro (BMNH 2.1.1.12–2.1.1.14); Tujma, near Mizque (AMNH 39011*). **La Paz,** 34 km NNE Nevado Sajama (BMNH 98.3.16.4*); 5 km E Ulla Ulla (AMNH 247712); Nevado Sajama (BMNH 3.2.9.2). **Oruro,** Pampa Aulliaga (BMNH 2.2.2.11). **Santa Cruz,** Comarapa (BMNH 34.9.2.53). **Tarija,** Carlazo (BMNH 26.1.1.2, 26.1.1.3); Tapecua, 13.5 k, WSW Palos Blancos (AMNH 264464*). **Santa Cruz,** 5 km SE Tita (AMNH 260327*). **BRAZIL: Bahia,** Lamarão (BMNH 3.9.5.45, 3.9.5.46, 3.9.5.47*, 3.9.5.48). **Goias,** Anapolis (AMNH 133948*). **Mato Grosso do Sul,** Maracaju (AMNH 133946*). **Minas Gerais,** Arinos (MZUFV 3471*); Itapecerica (MZUFV 4422*); Rio Jordão (BMNH 1.11.3.24, 1.11.3.25*). **Piauí,** Central Piauí (MCZ 24828). **Unknown state** (BMNH 68.a*). **Rio Grande do Sul,** Quinta (AMNH 235512*, 235513*, AMNH 235514*); Santana da Boa Vista (AMNH 235993*); Uruguaiana (AMNH 235994*). **CHILE: Araucania,** 2.5 km NNE Angol (AMNH 93324); Maquehue, 9.5 km WSW Temuco (AMNH 33290*, 33291*). **Talca?,** San Rafael? (BMNH 45.11.18.17). **Arica y Parinacota,** Parinacota (USNM 391849, 391850). **Magallanes,** Punta Arenas (AMNH 130053, 130068, 130095); Strait of Magellan (BMNH

66.a). **Valdivia,** Riñihue (FMNH 24350*). **Valparaíso,** Cerro Castillo, Viña del Mar (BMNH 10.7.23.1); Curaumilla Farm-Coast Hills (BMNH 0.10.2.2). **COLOMBIA: Nariño,** Vereda El Espino, 5.2 km SW Túquerres (UV 13287*). **ECUADOR: Bolívar,** Sinche (= Hacienda Sinche), 6 km NNE Guaranda (AMNH 67085*, BMNH 99.9.9.7*). **Chimborazo,** Hacienda Alao (MCZ 52661); Volcán Chimborazo (QCAZ 642). **Imbabura,** Hacienda La Vega, 5 km ESE San Pablo del Lago (FMNH 125113*); Volcán Imbabura (QCAZ 2046*). **Napo,** Baeza (MEPN 8169*); Cuyuja (QCAZ 726* = '638'); Probably Volcán Antisana (1923 expedition, H. E. Anthony and G. H. H. Tate) (AMNH 66244*); Volcán Antisana (AMNH 66719*). **Pastaza,** Río Pastaza, Mera (MNHN 1932-2884*). **Pichincha,** 40 km S Quito (AMNH 187838*); Alóag (AMNH 66722*); Cumbre del Monte Quitoloma (QCAZ 8338); El Castillo, vía Esmeraldas (FMNH 44336*); Hacienda Antisanilla, 33 km SE Quito (AMNH 63577, 66721*); Mindo (MEPN 8305*); Northwest side of Mindo (MCZ 27341); Pichincha Volcano (AMNH 36462*, 36463*); Quito (AMNH 36464–36466, BMNH 99.2.18.13*); San José de Minas (QCAZ 640); Santa Rosa above Río Pita (AMNH 66720*); unknown locality (BMNH 34.9.10.81*). **Tungurahua,** Montaña de Runtún, near Baños de Agua Santa (MCZ 38732). **Unknown province** (AMNH 66723, 66724, MEPN 2862, 6864, MNHN 1904-774). **PARAGUAY: Boquerón,** 50 km WSW Fortín Madrejón (AMNH 248467*, 248468*, 248469*, 248470*); Guachalla, Río Pilcomayo, 5.4 km SW San Agustín (FMNH 54329*, 54330*). **PERU: Ancash,** Carpa (AMNH 238425*). **Arequipa,** 2 km NE Yura Viejo (FMNH 106007*); 2.9 km NW Sumbay (FMNH 49720*); 5.3 km NW Salinas Moche (FMNH 49732, 49733*, 49734*); Caylloma (BMNH 3.8.4.1*, FMNH 49721, 49722, 49723*); Sumbay (BMNH 0.10.1.2). **Cajamarca,** Celendín (BMNH 26.4.1.116); Hacienda Limón, 60 km NE Cajamarca (FMNH 19680*). Hacienda Taulis (AMNH 73123). **Callao,** Callao (BMNH 0.5.7.34*). **Cusco,** Chospyoc (BMNH 22.1.1.19); Chospyoc, Río Huarocondo (USNM 194322); Ocobamba Valley (BMNH 22.1.1.20, USNM 194319*, 194320*); Orca, Near Calca (USNM 194324*); San Miguel Bridge, near Matchu Picchu (USNM 194323*). **Huánuco,** 4 km E Ambo (FMNH 24355*, FMNH 24356*). **Lima,** Near Huarochiri (USNM 176320*); Surco (BMNH 0.5.7.35–0.5.7.37). **Puno,** 2.2 km ESE Huacullani (FMNH 52486); Azángaro ('Sangero') (BMNH 1.1.1.10); Hacienda Checayani, near Azángaro (MNHN 1957-1293*, 1957-1294, 1957-1295, 1957-1296, 1957-1297*, 1970-301*, 1970-302*); Hacienda Collacachi, 12 km SSE Puno (FMNH 49724*, 49725*, 49726*, 49727*, 49728, 49729*, 49730*, 49731*); West shore of Lake Titicaca (MCZ 5257–5259). **URUGUAY: Artigas,** 6 km NNW Belén (in neighboring Departamento de Salto) (AMNH 205833–205835). **Cerro Largo,** 20 km NW Paso del Dragón (AMNH 205839); Estancia Las Marías, 6 km SE Melo (AMNH 205837, 205838). **Lavalleja,** 12 km WSW Zapicán (AMNH 205843, 205844). **Paysandú,** Arroyo Negro stream, 15 km S Paysandú (AMNH 205849, 205866). **Rocha,** Rocha, 24 km N San Vicente De Castillos (USNM 259436*). **Treinta y Tres,** 16 km SSW Tacuarí River mouth (AMNH 205895). **Unknown department** (BMNH 91.4.24.4, MHNM 3382*, 4298*, 4299*).

C. leuconotus (*n* = 21).— **Honduras: Francisco Morazán,** El Caliche (AMNH 127569*). **Olancho,** Catacamas (AMNH 128125*). **MEXICO: Jalisco,** Garabatos (Tepatitlán de Morelos) (AMNH 25171*); La Estancia (Arandas) (AMNH 25178*). **Oaxaca,** La Concepción, 11 km NE San Miguel Tenango (AMNH 145973*); San Pedro Tapanatepec (AMNH 176665*, 176668*). **Sinaloa,** Escuinapa de Hidalgo (AMNH 24707*). **Veracruz,** 11 km NW Alvarado (AMNH 172187*); 39 km S Veracruz (AMNH 204288*, 204289*); Córdoba (AMNH 30526*). **NICARAGUA: Jinotega,** San Rafael del Norte (AMNH 29282). **UNITED STATES: Arizona,** Near Fort Verde (AMNH 1921*, 1922*). '**California**', erroneous state (BMNH 55.12.24.221). **New Mexico,** Cliff (Grant Co.) (AMNH 127112*); Gila (Grant Co.) (AMNH 127110*). **Texas,** Juniper Canyon, Chisos Mountains (AMNH 136415*); Rockport (Aransas Co.) (AMNH 5130, 5883).

C. semistriatus (*n* = 111).— **BELIZE: Belize District,** 3.55 mi Northern Hwy (FMNH 58560*). **Cayo,** Red Creek, Before Santa Elena (FMNH 121557). **Stann Creek,** Stann Creek Valley (FMNH 63902). **COLOMBIA: Cesar,** Colonia Agrícola de Caracolicito, 9.3 km E Pamparejo (USNM 281452*, 281453, 281454); El Orinoco, Río Cesar, 37 km SSW Valledupar (USNM 281455, 281456*). **Córdoba,** Catival, upper Río San Jorge (FMNH 68904, 68905). **Cundinamarca,** Choachí (MCZ 27218, MCZ 27219); Finca El Soche, 4.0 km E Granada (UV 8103); Laguna de Fúquene (ICN 283); Las Balsillas (currently Bogotá) (AMNH 38423*, 38424*). **La Guajira,** Las Marimondas, 4 km ESE Conejo (USNM 281464*, 281465*); Sierra Negra, 8.5 km ENE Villanueva (USNM 281457*, 281458*, 281459*, 281460*); Villanueva (USNM 281461*, 281462*, 281463*). **Magdalena,** Bonda (AMNH 14632); Cuchilla de San Lorenzo (IAvH-M 1759). **Norte de Santander,** Parque Nacional Natural El Tamá, Maraña site (IAvH-M 3117). **COSTA RICA: Cártago,** Ricardo Jiménez Ranch, Irazú Volcano (AMNH 19206*). **Limón,** Jiménez (AMNH 2794). **Puntarenas,** Pozo Azul de Pirrís, plains of the Río Grande de Pirrís

(AMNH 19205*). **San José,** Escazú (AMNH 135269, 135271*, 137282*, 137283*); La Hondura, 22.5 km NE San José (AMNH 135270*); Santa Teresa (currently San José) (AMNH 141858*). **Unknown province** (USNM 19646, 19647, 61205*, 61275*). **ECUADOR: Sto. Domingo de los Tsáchilas,** Río Palenque Science Center, 1.7 km SSE Consumulo (USNM 568103*). **MEXICO: Quintana Roo,** La Vega, on mainland coast opposite Isla Cancún (USNM 108502*, 108503*). **Unknown state** (BMNH 2001.5). **Veracruz,** Achotal (FMNH 13825*); Catemaco (USNM 65762*, 65763*, AMNH 172190); Paso Nuevo (AMNH 17201*, 17202); Pérez (USNM 132512*). **Yucatán,** Mérida (USNM 8610*). **NICARAGUA: Chontales,** Villa Somoza (= Villa Sandino) (USNM 337832*). **Jinotega,** Hacienda La Trampa, 16 km E, 5.5 km N Jinotega (USNM 338870*). **Río San Juan,** La Esperanza, 9.5 km SE San Carlos (USNM 361359*). **PANAMA: Bocas del Toro,** Sibube (USNM 335773*). **Chiriquí,** 3.2 km NE El Volcán (USNM 332037*); Boquerón (AMNH 18900); Boquete (BMNH 4.7.6.5*, MCZ 10115, 10116); Cerro Punta (USNM 324236); Progreso (USNM 363346*). **PERU: Amazonas,** Chachapoyas (BMNH 24.7.11.10*, 24.7.11.11–24.7.11.13, 24.7.11.8, 24.7.11.9). **La Libertad,** Chicama Valley (USNM 172857*); Menocucho, 23.5 km ENE Trujillo (FMNH 19976*); San Pedro de Lloc (AMNH 73220). **Lambayeque,** Eten (BMNH 0.3.1.39*). **VENEZUELA: Falcón,** 20.5 km SSE Tucacas (USNM 372745*); 3.5–6.0 km NE Capatárida (EBRG 3309*, 3310*,3311*, 3312*, 443290*, 443291*, 443295*); Capatárida (USNM 443285*, 443286*, 443289*, 443293*, 443294*, 443296*); Dabajuro to Mene de Mauroa road, 25.6 km WSW Dabajuro (CVULA 8544*); Muaco, 3.5 km ENE Vela de Coro (MBUCV 4170*); Península de Paraguaná, 5.5 km WNW Adícora (CVULA 8545*); Península de Paraguaná, Cueva de Piedra Honda (EBRG 20237*, 20241*); Península de Paraguaná, Near Moruy, 15 km SSW Pueblo Nuevo (USNM 443414*); Península de Paraguaná, Reserva Biológica de Monte Cano (RBMC unnumbered); Pueblo Nuevo to Adícora road (CVULA 8542); Urumaco to Dabajuro road, 17 km WSW Urumaco (CVULA 8543*). **Mérida,** Casa del Ángel del Sol, 9.7 km ENE Mérida (CVULA 9130*); El Mirabel, 3 km SSE La Azulita (CVULA 6210*); La Hechicera, 3 km NNW Mérida (CVULA 8537*); Mountains W of Mérida (FMNH 22202*, 22203); Near Chorrera de las González, 5.1 km WSW Jají (CVULA 1025); unknown locality (AMNH 21634, AMNH 21635, BMNH 5.2.5.10*, 5.4.5.4*, 5.4.5.5*. **Yaracuy,** El Hacha (AMNH 32073). **Zulia,** El Rosario, 39 Km WNW Encontrados (USNM 443576*); Río Aurare, 12.5 km ESE Maracaibo (FMNH 18770*).

APPENDIX 2

Results of the Principal Component Analysis (PCA). Measurement loadings and percent variance explained by components are shown. Components 17 to 25 are omitted because together they explain less than 2% of total variance and 5% of total 'shape' (PC2 to PC25) variance. The measurements are ordered according to their communality values.

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	Communality (PC2–PC16)
Precanine length	0.12	0.16	-0.52	0.58	0.05	-0.14	0.23	-0.14	0.96
Width of interpterygoid fossa	-0.07	0.15	0.70	0.50	-0.07	0.19	0.28	0.06	0.95
Length of PM4	0.20	-0.22	0.07	-0.03	-0.16	0.08	0.09	0.53	0.92
Post-notch length	0.06	0.65	0.06	-0.09	0.47	-0.08	-0.08	0.33	0.91
Heigth of cranium	0.20	0.17	0.13	-0.27	0.15	0.02	0.11	-0.35	0.91
Length of PM3	0.17	0.12	-0.11	0.23	-0.13	0.69	-0.31	-0.10	0.88
Postorbital breadth	0.19	-0.14	0.25	0.21	0.13	-0.21	-0.46	-0.26	0.87
Width across incisors	0.20	0.00	-0.08	0.23	0.19	0.03	-0.27	0.26	0.87
Height of coronoid	0.17	0.18	0.02	0.14	-0.55	-0.45	-0.07	-0.03	0.84
Length of mandible	0.20	0.23	-0.07	-0.05	-0.31	-0.15	0.13	0.22	0.79
Diameter of canine	0.21	-0.04	0.07	-0.14	-0.19	0.01	-0.34	0.17	0.72
Length of lower carnassial	0.21	-0.15	0.03	0.09	0.18	-0.07	0.40	0.17	0.67
Interorbital breadth	0.22	0.11	0.18	0.00	-0.01	-0.05	0.01	-0.23	0.60
Zygomatic breadth	0.22	0.06	0.10	-0.16	0.12	-0.10	0.02	-0.12	0.59
Width of molar	0.19	-0.35	0.07	-0.05	0.23	-0.07	0.09	0.10	0.50
Postpalatal length	0.22	-0.01	0.06	-0.15	-0.14	0.13	0.25	-0.20	0.48
Length of molar	0.19	-0.35	-0.08	0.19	0.24	-0.08	0.02	-0.08	0.46
Notch to canine length	0.22	-0.02	-0.13	-0.10	-0.13	0.17	0.04	-0.02	0.44
Length of maxillary toothrow	0.22	-0.13	0.01	-0.05	-0.04	0.12	0.05	0.12	0.43
Width across canines	0.23	0.01	0.07	0.03	0.01	-0.13	-0.18	0.14	0.34
Width across molars	0.23	-0.07	0.14	0.11	0.05	-0.05	-0.07	-0.03	0.28
Palatilar length	0.23	0.13	-0.16	-0.01	0.10	0.14	0.02	0.07	0.21
Mastoid breadth	0.23	0.06	0.03	-0.04	0.07	-0.10	0.00	-0.19	0.15
Basilar length	0.23	0.06	-0.04	-0.09	-0.04	0.16	0.14	-0.07	0.15
Condylobasal length	0.23	0.07	-0.02	-0.09	-0.01	0.08	0.17	-0.08	0.10
EIGENVALUE	17.36	1.65	1.24	0.76	0.72	0.63	0.52	0.36	
% TOTAL (PC1–PC25) VARIANCE	69.44	6.61	4.95	3.05	2.87	2.50	2.10	1.43	
% SHAPE (PC2–PC25) VARIANCE	0.00	21.63	16.18	9.98	9.38	8.20	6.86	4.68	

APPENDIX 2. (*Continuation*)

	PC9	PC10	PC11	PC12	PC13	PC14	PC15	PC16	Communality (PC2–PC16)
Precanine length	0.20	-0.28	0.29	0.08	0.03	0.07	0.07	0.08	0.96
Width of interpterygoid fossa	0.00	0.05	0.15	0.07	0.05	0.17	-0.03	0.01	0.95
Length of PM4	0.20	-0.34	-0.12	0.21	-0.09	-0.33	0.24	0.39	0.92
Post-notch length	0.23	0.20	0.00	0.03	-0.04	-0.17	-0.13	0.03	0.91
Heigth of cranium	-0.11	0.04	0.10	-0.06	0.32	0.14	0.52	0.46	0.91
Length of PM3	0.21	0.09	-0.28	-0.21	0.08	-0.09	0.06	-0.01	0.88
Postorbital breadth	0.08	0.06	0.01	0.01	-0.58	0.04	0.23	0.09	0.87
Width across incisors	-0.74	-0.06	0.01	0.11	0.18	-0.02	0.11	-0.13	0.87
Height of coronoid	-0.04	0.31	-0.16	0.00	0.23	-0.09	-0.18	0.23	0.84
Length of mandible	0.07	0.18	-0.14	-0.09	-0.20	0.16	0.46	-0.44	0.79
Diameter of canine	0.09	-0.08	0.65	-0.08	-0.05	0.16	-0.21	0.02	0.72
Length of lower carnassial	-0.23	0.03	-0.18	-0.42	-0.31	0.09	-0.14	0.14	0.67
Interorbital breadth	-0.09	-0.20	-0.12	0.53	0.03	-0.32	-0.09	-0.23	0.60
Zygomatic breadth	0.17	-0.46	-0.26	-0.02	0.06	0.33	-0.20	-0.23	0.59
Width of molar	0.28	0.30	0.16	0.10	0.28	-0.04	0.00	-0.10	0.50
Postpalatal length	-0.10	-0.01	0.27	-0.18	-0.11	-0.36	-0.01	-0.21	0.48
Length of molar	0.15	0.37	-0.08	0.06	0.12	-0.15	0.02	-0.12	0.46
Notch to canine length	-0.12	0.15	-0.10	0.20	-0.12	0.24	-0.37	0.26	0.44
Length of maxillary toothrow	0.08	0.05	-0.07	0.29	0.10	0.50	0.09	-0.13	0.43
Width across canines	0.02	-0.23	0.06	-0.35	0.28	-0.03	0.07	-0.08	0.34
Width across molars	0.07	-0.06	-0.13	-0.31	0.25	-0.04	-0.22	0.00	0.28
Palatilar length	-0.05	0.16	0.07	0.13	-0.15	0.14	-0.08	0.16	0.21
Mastoid breadth	0.03	-0.14	-0.16	-0.01	-0.11	-0.06	-0.11	0.15	0.15
Basilar length	-0.08	0.08	0.18	-0.03	-0.08	-0.14	-0.06	-0.07	0.15
Condylobasal length	-0.02	0.04	0.10	0.05	-0.10	-0.10	-0.02	-0.12	0.10
EIGENVALUE	0.32	0.26	0.20	0.18	0.16	0.15	0.12	0.12	
% TOTAL (PC1–PC25) VARIANCE	1.28	1.02	0.79	0.72	0.62	0.60	0.48	0.46	
% SHAPE (PC2–PC25) VARIANCE	4.20	3.35	2.60	2.37	2.03	1.97	1.56	1.52	

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Defective taxonomic descriptions and the electronic publication fashion. A comment on Braby *et al.* (2024) and a rectification

Descripciones taxonómicas defectuosas y la moda de la publicación electrónica. Comentario sobre Braby *et al.* (2024) y una rectificación

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ABSTRACT

Some reflections are presented on the global practice of publishing scientific works in electronic format, its demands and challenges. In this context, the recently published article by Braby *et al.* (2024) is discussed in relation to scientific best practice in the description of new zoological species. That article refers to numerous descriptive works that suffer from formal defects and irregularities that nullify the availability of the scientific names of the species described or proposed in them, due to non-compliance with the regulations established in the International Code of Zoological Nomenclature (ICZN). One such case is the description of *Redonda bordoni* Viloria & Pyrcz, 2003 (Insecta: Lepidoptera: Nymphalidae, Satyrinae), Bordón's brachypterous butterfly, a species endemic to a high Andean sector of western Venezuela, whose name would not be available because its description, together with its typification, mention of the repositories of the type specimens and the explanation of the etymology of the name, were relegated to an electronic appendix presumably inaccessible (at least for a period of time). To resolve this irregularity, the species is redescribed, complying with the fundamental recommendations of the ICZN.

Key words: Lepidoptera, Nymphalidae, Pronophilina, *Redonda bordoni*, Satyrinae, Satyrini.

RESUMEN

Se presentan algunas reflexiones sobre la práctica global de la publicación de obras científicas en formato electrónico, sus exigencias y retos. En este contexto se comenta el artículo recientemente publicado por Braby *et al.* (2024) en relación a las mejores prácticas científicas en la descripción de nuevas especies zoológicas. En dicho artículo se hace referencia a numerosos trabajos descriptivos que adolecen de defectos formales e irregularidades que anulan la disponibilidad de los nombres científicos de las especies en ellos descritas o propuestas, por incumplimiento de la normativa establecida en el Código Internacional de Nomenclatura Zoológica (ICZN). Uno de tales casos es la descripción de *Redonda bordoni* Viloria & Pyrcz, 2003 (Insecta: Lepidoptera: Nymphalidae, Satyrinae), la mariposa braquíptera de Bordón, especie endémica de un sector altiandino del occidente de Venezuela, cuyo nombre no estaría disponible debido a que su descripción, junto con su debida tipificación, la mención de los repositorios de los especímenes tipo y la explicación de la etimología del nombre, fueron relegadas a un apéndice electrónico presuntamente inasequible (al menos durante un lapso de tiempo). Para solventar esta irregularidad se redescribe la especie, cumpliendo con las recomendaciones fundamentales del ICZN.

Palabras clave: Lepidoptera, Nymphalidae, Pronophilina, *Redonda bordoni*, Satyrinae, Satyrini.

INTRODUCTION

The transition from the publication of scientific prints to the electronic publication of books, journals and specialized articles has taken nearly three decades. It has required the progressive consideration and incorporation of novel editorial aspects imposed by this fashion, as well as the implementation of new rules and practices that guarantee formality and professional ethics in the publication and dissemination processes, and above all that ensure the perpetual availability of electronic documents through their hosting in secure repositories, preferably institutional.

Many difficulties are being overcome to successfully couple numerous regulations to legitimize scientific production with the globalization of the practice of electronic publishing. However, the reduction of ecological and economic costs by decreasing the use of paper, global openness through electronic communication, as well as the reduction of time lapses in the editorial process, have been accompanied not only by the multiplication of electronic means of disseminating specialized information but also the number of people (researchers or not) who make almost frenetic use of them.

In response to the proliferation of unprofessional and irregular taxonomic work, Braby *et al.* (2024) have published an interesting, entertaining and necessarily critical essay on the formal procedures to describe animal species in the most appropriate way and in full compliance with the rules established in the International Code of Zoological Nomenclature (ICZN 1999, 2012). Not only is it an extraordinary theoretical review of the topic, which has also been previously treated by other authors, but it presents a notable number of examples of bad taxonomic practice, particularly in relation to the description of new species, providing no few recommendations to minimize the risks of making errors.

One such example refers to the publication of the first case of brachyptery in butterflies (Lepidoptera: Papilionoidea) (Viloria *et al.* 2003), represented in the female of a then undescribed species of the genus *Redonda* Adams & Bernard, 1981, which lives in the high elevations of the Andean mountains of Venezuela. Brachyptery in butterflies is a peculiar biological phenomenon, studied in the field by the authors of that article for one decade, the information about it was organized fundamentally as a descriptive ecological study, in which comparative morphology was necessary to describe the species involved, but also to carry out elementary morphometric calculations and a statistical analysis designed to mathematically demonstrate the physical limitations that prevent flight in females of said taxon, which derive from a disadvantageous relationship between wing surface and body size. In addition to the corresponding considerations on the ecological conditions of the tropical highland environment as a source of possible selective forces involved in the loss of flight capabilities, the work included the diagnosis and complete taxonomic description of the species.

The resulting study, submitted for consideration for publication in the *Proceedings of the Royal Society B: Biological Sciences*, received approval from its editorial committee and reviewers. However, making its publication conditional on a reduction in the length of the text to accommodate it in the first issue of the supplement to the *Proceedings B*, called *Biology Letters*, established in 2003 and launched as an independent journal from 2005 (https://royalsocietypublishing.org/journal/rsbl). Not only were the authors committed to reducing the length of the work to meet the editorial demands of such a prestigious journal, but they were also compromised to separate the diagnosis from the taxonomic description, relegating the latter, along with some illustrations, to form part of an electronic appendix. Unfortunately, as has been pointed out by Braby *et al.* (2024), at the time, such actions could have led to the violation of some of the rules established by the International Code of Zoological Nomenclature (ICZN 1999) to guarantee the availability of scientific names assigned to animal species.

Braby *et al.* (2024) state that the electronic appendix in which the description of the aforementioned brachypterous butterfly appeared is no longer accessible, so it was not possible for them to access the data corresponding to the series of type specimens and their repositories. Consequently, in the opinion of those authors, the provisions of Article 16.4 of the ICZN have not been complied with, which is why the name of the species, proposed in 2003, is not available.

As can be seen in the next section of this work (below), the experience of the present author regarding the accessibility of electronic documents in question contradicts the statement of Braby *et al.* (2024), in that there is an access link to them on the Royal Society of London website. However, it is not possible to assert that the appendices to the article by Viloria *et al.* (2003) have been continuously available during the 21 years since their publication.

Given this situation of relative ambiguity and in the spirit of rectifying any past, present or future irregularity, in relation to procedures or acts that may affect the availability of a scientific name proposed more than two decades ago, and ever since used with relative frequency by several authors, the decision has been made to republish the taxonomic description of the butterfly species to which said name corresponds, and in whose content the species is appropriately typified. Likewise, in compliance with the requirements of the most recent amendment to the International Code of Zoological Nomenclature (ICZN 2012), these acts are registered in ZooBank.

MATERIAL AND METHODS

Electronic Appendix A to Viloria *et al.* (2003), currently available at https://royalsocietypublishing.org/action/downloadSupplement?doi=10.1098%2Frsbl.2003.0015&file=bl030021_supp01.pdf), was retrieved by the author on May 12, 2024. The text of the primary taxonomic description of *Redonda bordoni* (Lepidoptera: Nymphalidae, Satyrinae) contained in this document was extracted for adequate electronic and printed publication in the present contribution. In this way, the transcription of full data of the type material, including its repositories, as well as the etymology of the name of the species and its registration in ZooBank solve the problem of the availability of its name.

Some collector names have been inserted into the original abbreviations (in square brackets), and an annotated synonymy is provided for this taxon.

Abbreviations

A & B: [Michael J.] Adams & [George] Bernard; BMNH: The Natural History Museum, London, UK; JFLC: Jean-François Le Crom Collection, Bogotá, Colombia; MALUZ: Museo de Artrópodos, La Universidad del Zulia, Maracaibo, Venezuela; MHN: Museo de Ciencias Naturales, Universidad Nacional de Colombia; MIZA: Museo del Instituto de Zoología Agrícola, Universidad Central de Venezuela, Maracay, Venezuela; MZUJ: Zoological Museum of the Jagiellonian University, Krakow, Poland; P & V: [T. W.] Pyrcz & [Á. L.] Viloria; V & P: [Á. L.] Viloria & [T. W.] Pyrcz.

RESULTS

Family Nymphalidae Rafinesque, 1815
Subfamily Satyrinae Boisduval, 1833
Genus *Redonda* Adams & Bernard, 1981
***Redonda bordoni*, sp. nov.**

http://zoobank.org/urn:lsid:zoobank.org:act:6D484533-A1B0-49D1-9D1D-7312461FC2E5

Original figures in Viloria *et al*., 2003: fig. 1a [male holotype, female paratype; ventral] (not reproduced here); e-Appendix A: fig 5 [female paratype, dorsal] (herein reproduced in Fig. 1), figs. 6a [male genitalia], 6b [female genitalia], 6c [female wing venation] (herein reproduced in Fig. 2), and in Viloria *et al*. 2015: figs. 14 [male, holotype], 15 [female, allotype].

Type locality

Between Laguna El Cenegón and Laguna Grande, 3200-3400 m, Páramo El Batallón, Estado Táchira, Venezuela.

[*Redonda bordoni* Viloria and Pyrcz, MS, *nomen nudum*; Viloria, 1998: 319; Ferrer-Paris, 2000: 96 (tbl. C.9)]

[*Redonda* sp. nov. 1; Ferrer-Paris, 2000: 27 (fig. 3.1, distribution), 29 (tbl. 3.1), 36, 37 (fig. 3.5), 38, 40, 41 (tbl. 3.6), 69, 91 (tbl. C.7); Viloria, 2000: 269; Ferrer-Paris & Viloria, [2004]: 628 (fig. 1); 629 (tbl. 1), 630 (fig. 3), 631]

[*Redonda bordoni* Viloria and Pyrcz, *in* Viloria *et al.*, 2003: 21–23 (figs. 1a, male, female, 2, 3, 4), e-appendices: [1], [4 (fig. 5, female)], [5 (figs. 6a male genitalia, 6b female genitalia, 6c female wing venation)]) (in part misidentifications of *R. bolivari* Adams & Bernard, 1981 and *R. lathraia* Viloria & Camacho, 2015]; [Anonymous], 2003: 24; Blackman, 2003: 26; Williams, 2003: R467; Lamas *et al.*, 2004: 215; Viloria, 2005: 459; 2008: 278; Bálint & Wojtusiak, 2006: 288; Pyrcz, 2007a: 40, 41; 2007b: 17, 18, 19; 2010a: 36 (fig. 17C, antennal club), 45 (fig. 35C, female venation), 87 (fig. 82, cladogram), 111, 179, 180 (fig. 131, wing area), 181 (figs. 132A, male; B, female, 133A, pair in copula), 182, 183, 184 (fig. 136, distribution), 244; 2010b: 265, 266 (figs. 1K male, 1L female, 267, 268 (fig. 2), 269 (figs. 3A, B, C females), 271 (fig. 5B pair in copula), 272, 273; Pyrcz *et al.*, 2007: [26] [3 figs., male & female], Łabno, 2007: 104; Davies & Butler, 2008: 33; Viloria *et al.*, 2015: 97, 105 (fig. 5 [female wing venation]), 107, 109 (figs. 14 [male, holotype], 15 [female, allotype]), 110, 111, 112, 135 (as misidentification of *R. lathraia* Viloria & Camacho, 2015), 136, 137, 138, 145 (fig. 48 [male genitalia]), 154, 160; Ferrer-Paris *et al.*, 2015: 322; Pyrcz *et al.*, 2017: 198, 221], *nomen nudum*

[*Steromapedaliodes bordoni* (Viloria & Pyrcz); Pyrcz *et al.*, 2017: 195, 197 (fig. 1B, distribution map), 200 (tbl. 1), 204 (fig. 4A [male wing venation]), 221, 222, 223, 224, 231 (figs. 10C [male], 10D [female]), 236 (fig. 15C [male genitalia]), 240 (fig. 19A [female genitalia]; Boyer, 2018: 122, 123 pl. 2 (figs. 5 [pair in copula], 6 [female]), 124, 125 pl. 3 (figs. 5, 7 [male], 6, 8 [female]), 129; 2019: 99, 104, 105 pl. 16 (fig. 14 [male], 129)], *nomen nudum*

Figure 1. *Redonda bordoni* female displaying the silvery dorsal surfaces of its wings [corresponding to original figure 5 in e-Appendix A to Viloria *et al*. 2003. Photo: J. Wojtusiak†].

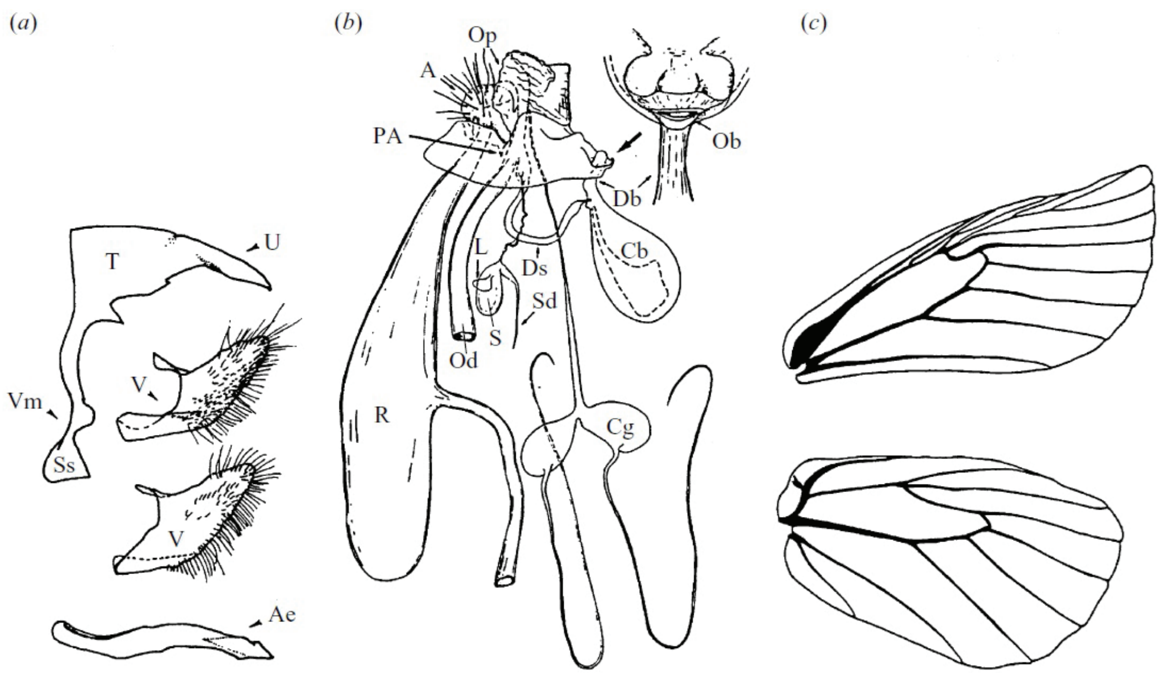

Figure 2. Morphological features of *Redonda bordoni.* **a.** Male genitalia (aedeagus and valvae removed from their natural positions: Ae, aedeagus; Ss, saccus; T, tegumen; U, uncus; V, valva; Vm, vinculum). **b.** Female genitalia (A, anus; Cb, corpus bursae; Cg, colateral gland; Db, ductus bursae; Ds, ductus seminalis; L, lagena; Ob, ostium bursae; Od, oviduct; Op, ovipore; PA, post-apophysis; R, rectum; S, spermatheca; Sd, spermathecal duct). **c.** Venation of female wings [corresponding to original figure 6 in e-Appendix A to Viloria *et al*. 2003. Female genitalia drawing (b) by J. Wojtusiak†].

Male

Forewing length: 26–32 mm; n = 123; mean = 29.56. Eyes hairy, reddish brown, circled with black and white scales. Palpi twice as long as head, light brown, flanked with white, with brown, dark brown and yellow hairs; first segment quarter length of first. Antennae up to two fifths length of costa, 32 segments; shaft orange brown, darker towards club; club 2.5-3 times longer that wide, concave (spoon-shaped). Body densely hairy, dorsally dark coffee brown, ventrally light brown, almost white on abdomen; hairs glossy light brown. Forewing triangular, tornus obtuse. Hindwing oval. Upperside ground colour shiny brown, darker towards basal half and marginal region; wing bases dark coffee brown; crossveins at distal extremity of discal cells covered by greyish white; series of five to six submarginal elongate white spots on both wings. Underside ground colour as above; forewing pattern as on upperside; hindwing veins greyish white, as well as longitudinal lines in discal and Cu2 cells, the former bifurcated near base; postdiscal series of five to six fusiform white ocellar marks; third Schwanwitsch's externa, first and second Schwanwitsch's media coffee brown (Schwanwitsch 1924); all discontinuous and dislocated to form a system of longitudinal lines parallel or oblique to veins and white marks, in basal half of wing and postdiscal-submarginal region, respectively. Genitalia illustrated in Figure 2a.

Female

Forewing length: 20–29 mm; n = 4; mean = 20.87. Wings considerably shorter and narrower than in male; apex pronounced at hindwing vein M2. Upperside ground colour silvery white; wing bases very dark coffee brown; forewing densely dusted with dark brown in apical and discal region, and within discal cell. Underside colour pattern as in male, dark coffee brown much more dense in basal half of hindwing; white lines and veins more distinct; fusiform white ocellar marks heavily elongate; costal margin dark coffee brown. Genitalia illustrated in Figure 2b.

Type material

Holotype male, taken between Laguna El Cenegón and Laguna Grande, Páramo El Batallón, Estado Táchira, Venezuela, 3200-3400 m, 28-ii-1994, A. Viloria, M. García & J. Camacho colls.; Allotype female, same data as holotype (MALUZ). Paratypes: 27 males (3 in MHN, 3 in JFLC), 1 female, same data as holotype; 19 males (2 in MZUJ, 2 in BMNH), VENEZUELA: Estado Táchira, Páramo El Batallón, entre la Antena CANTV y la Laguna El Cenegón, 3100-3250 m; 27-ii-1994, A. Viloria, M. García & J. Camacho colls.; 4 males, Estado Táchira, Municipio Jáuregui, Callejón del Cenegón, 16-xii-1994; M. García coll.; 6 males, 1 female, Estado Táchira, Parque Nacional Juan Peñaloza, Páramo El Rosal, 3000 m, 12/14-i-1995; J. Camacho & M. García colls.; 10 males, Estado Táchira, Páramo El Batallón, Entre El Cenegón y Laguna Grande, 3300-3400 m, 05-iii-1996, J. Camacho, M. García, T. Pyrcz, J. Wojtusiak colls. (MALUZ); 1 male, Estado Táchira, Páramo de La Negra, 30-ix-1951, P. Fenjues coll.; 1 male, same locality, 3200 m., 14-i-1982, C. Bordón coll. (MIZA); 51 males, 1 female, Estado Táchira, Páramo El Batallón, Vía El Púlpito, 3500-3800 m, 02/04-iii-1996, T. Pyrcz, J. Wojtusiak, J. Camacho, M. García colls.; 5 males, Estado Táchira, Páramo El Batallón, Vía El Cenegón, 04-iii-1996, T. Pyrcz, J. Wojtusiak, J. Camacho, M. García colls. (MZUJ).

Etymology

This butterfly species is named after Carlos Bordón (b. Trieste, Italy, 1921; d. Maracay, Venezuela, 2012. See Viloria 2018), prominent Italo-Venezuelan entomologist who collected the first known individual of this unusual butterfly.

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New and unusual field records of *Chelus* spp. in Venezuela (Testudines: Chelidae)

Registros nuevos e inusuales de *Chelus* spp. en Venezuela (Testudines: Chelidae)

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The genus *Chelus*, matamata turtles, is native to northern South America, being widely distributed throughout the Amazon and Orinoco Basins. It reaches the largest adult body size among the extant Chelidae, and with straight-line carapace length (SCL) ranging from 31.1-40.4 cm (Pritchard & Trebbau 1984). However, larger individuals do exist (*i.e.*, > 50 cm SCL Barrio-Amorós & Manrique 2006). Matamatas are very charismatic and easy to recognize by their unique morphological appearance (*i.e.*, extremely flat and triangular head, long and thick neck, wide mouth, long pointy snout, and a carapace with three dorsal keels). They are classified as "Least Concern" by the IUCN (2021), yet their natural history is largely unknown despite the great interest shown by the herpetological community. Likewise, the distribution range of *Chelus* species remains only partially verified, and the taxonomic revision of the genus suggesting the recognition of two extant species leaves (see below) the geographic coverage of each of them undocumented. This lack of comprehensive distribution data hampers efforts to accurately understand the biogeography and ecological niches of each species, requiring further research to delineate their ranges more precisely.

Recent genomic and morphological analyses have delineated the genus *Chelus* into two distinct lineages: *C. orinocensis* Vargas-Ramírez *et al*. 2020, inhabiting the Orinoco Basin, including the Rio Negro and Essequibo drainages, and *C. fimbriata* Schneider, 1783, found in the Amazon and Mahury Basins (Vargas-Ramírez *et al.* 2020). These findings corroborate earlier hypotheses proposed by Medem (1960), Pritchard & Trebbau (1984), Sánchez-Villagra *et al*. (1995), and Pritchard (2008). These researchers, relying on morphological evidence such as shell shape, plastron pigmentation and neck coloration patterns, suggested geographic variation between the Amazon and Orinoco Basin populations of *C. fimbriata*. Specifically, Amazonian matamatas were described as having a rectangular carapace shape (Fig. 1), a dark pigmented plastron, and bold black bands on the ventral side of the neck. In contrast, Orinoco matamatas were characterized by an oval carapace shape (Fig. 1), a light yellow-unpigmented plastron, and light coloration (often bright red-pink) on the underside of the neck. Given the new taxonomic resolution of *Chelus*, it is currently assumed that historical records from the Orinoco hydrographic system are presumed to be of *C. orinocensis*. Nonetheless, a call has been made to take caution on this hypothesis and instead advises to confirm current records (*e.g.*, museum specimen, survey, citizen science observation) and to map new sites to help distinguish more precisely the geographic distribution of matamata lineages (see Cunha *et al*. 2021). Furthermore, the potential presence of hybrids or intergrades, with anatomical intermediate morphotypes (Sánchez-Villagra *et al*. 1995, Pritchard 2008), also highlights the necessity for a more comprehensive understanding and precise delineation of *Chelus* species boundaries. Although challenging, accurate species delimitation is crucial for precise taxonomy, managing species diversity, and formulating effective conservation strategies (Zachos 2016).

Taking all together, and to aid with *Chelus* sp. scientific knowledge and conservation, I present information, new records of occurrence from matamata turtles, including some from the Lower Caura watershed (Bolivar State,

Figure 1. Shell shapes representing each of the two matamata lineages. Left: Amazonian morphotype (*Chelus fimbriata*) having a rectangular carapace shape (PCHP 39–from the vicinity of Leticia, Colombia). Right: Orinoco morphotype (*Chelus orinocensis*) having an oval carapace shape (MCNUSB 427–from the Llanos, Venezuela) (images taken and modified from Sánchez-Villagra *et al*. 1995).

Venezuela), a tributary of the middle Orinoco drainage (Fig. 2). I also comment on the specimen's habitat and provide original data on size (carapace length, width, and weight), while comparing with other published size records from the Orinoco basin.

I discuss three museum catalogued records of the matamata, two of which are from outside the Orinoco Basin, and one from the Casiquiare River Canal, which connects the Upper Orinoco and Upper Rio Negro Basins. From the former two records, one is new from the Lake Maracaibo Basin (Zulia State), and the other validates previously cited record by Pritchard & Trebbau (1984) from the Santa Rosa-Putucual region (Sucre State). The specimen from the Casiquiare River (Amazonas State) represents a new site record from this hydrographic system.

CAURA RIVER BASIN (BOLÍVAR STATE) RECORDS

New locality of occurrence

Two adult living matamatas, a female and a male, were captured and measured in the remote Nichare River, an affluent of the Lower Caura River Basin (LCR) and part of The Caura National Park (Fig. 2). These individuals were sampled by chance during the dry season of 2000 (February-April) while conducting a three-year research study (1999-2001) on the nesting ecology of another native aquatic turtle (*Podocnemis unifilis* Troschel 1848) (Escalona 2003, Escalona *et al.* 2009a). The female was caught directly by hand from a boat after being spotted moving on the surface across a narrow section of the river. Although it tried to dive, it did so very slowly, allowing it to be approached and captured rapidly. The male, on the other hand, was caught with a fishing net used in a shallow flooded lagoon to catch *P. unifilis* (Fig. 3). Location details are shown in figure 2. On the map, the Nichare River locality is indicated by black circle 6. Within this locality, the specific site for the female was recorded at (06°20'7" N, 64°57'31" W), and the male at (06°19'16" N, 64°57'12" W).

Habitat and Nichare River

It is well recognized that matamatas are highly aquatic bottom-walkers that rarely swim or float and are never seen basking. Habitats of preference are rivers and streams, mainly in areas of slower water flow or still waters such as lagoons, wells, oxbow lakes and temporary overflow pools. It inhabits all types of water: white, clear, and black (Pritchard & Trebbau 1984, Barrio-Amorós & Narbaiza 2008, Morales-Betancourt *et al.* 2020, Cunha *et al*. 2021). The Nichare is a black water meandrous river about 5 to 20 meters wide that sustains habitats of similar characteristics and conditions to those described above. It contains lateral

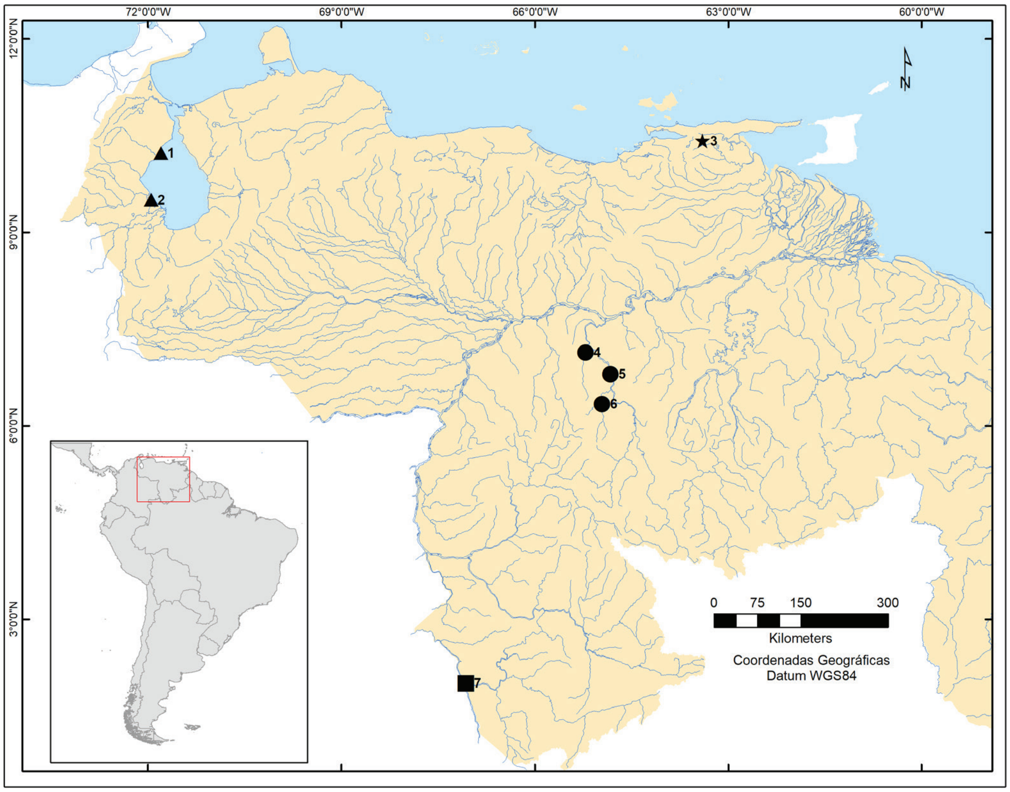

Figure 2. Hydrographic map of Venezuela showing *Chelus* record sites referenced in this study. The map highlights key localities from left to right and south. **Triangles** represent sites within the Lake Maracaibo Basin in Zulia state. Triangle 1 marks the location of a recently discovered museum specimen (MBUCV 7096) at coordinates (10°13'30" N, 71°47'45" W). Triangle 2 indicates the site observed by José L. Lira in 1974 (09°31'17" N, 71°57'25" W). **Star** marks the location of museum specimen KU 117344 from the Santa Rosa-Putucual Lagoon Swamp (10°22'12" N, 63°16'48" W), Gulf of Paria Basin, Sucre state. **Circles** denote localities in the Lower Caura River Basin, Bolívar state. Circle 4 represents the site along the Mato River (07°08'08" N, 65°12'43" W), while circles 5 and 6 indicate record sites along the Caura River (06°48'04" N, 64°49'40" W) and Nichare River (06°21'08" N, 64°58'17" W), respectively. **Black square** shows the locality for museum specimen MBUCV 7278, from the Casiquiare River Canal, Amazonas state. This specimen was found in the community of San Carlos de Rio Negro (01°55'12" N, 67°03'40" W).

and meandric sand bars, shore complexes of pools, flooded lagoons, and oxbow lakes. It is considered a "Seasonally Flooded Riparian Ecosystem" in an "Evergreen Lowland Forest" (Rosales & Huber 1996, Rosales *et al*. 2003).

Morphological characteristics (shell shape, plastron pigmentation, neck coloration, size)

Shell shape (rectangular vs oval), plastron pigmentation (dark vs light) and neck underside coloration (bold black bands vs light or red-pink color) were used as features for species diagnostic. Shell characters were measured linearly using a 50 cm caliper. This included the maximum straight carapace length (SCLmax) and straight-line carapace width (SCW), as shown in figure 4. Body mass was weighed using a 20 kg Pesola spring scale. No abnormalities were detected during measurements. After taking photographs and measurements, the matamatas were released into the same location of capture.

Sex determination

Although sexual dimorphism is not very marked in matamatas, the sex can be easily determined because females can reach larger sizes than males, and males have longer and thicker tails (Figs. 5 and 6) and seem to have a more concave plastron (Fig. 7) compared to females (Figs. 5 and 8). Differences, were also confirmed by the few available studies on matamata size, which have indicated that individuals over 40 cm in SCL tend to be females (see Pritchard & Trebbau 1984, Sánchez-Villagra *et al.* 1995, and see Figs. 3 and 4 of Morales-Betancourt *et al*. 2020).

Female: This individual is characterized by an oval shell outline, such as in the Orinoco morphotype (see Sánchez-

Figure 3. Fishing net technique in curiaras (bote) from the Lower Caura River Basin. Top left and right: Capturing *Podocnemis unifilis* in the Nichare River. Bottom left: Fisherman fishing in the Caura River and who caught two male matamata turtles. Photo: Tibisay Escalona.

Figure 4. Shell of Matamata turtle. Measurements indicated are based on a specimen of unknown provenance deposited in the Paleontological Collection of the Instituto Venezolano de Investigaciones Científicas (IVIC), Venezuela. Maximum straight-line carapace length (SCLmax; left) and width (SCW; right). Photo: Gilson Rivas.

Figure 5. Female matamata from the Nichare River (SCLmax 48.8 cm). Left: Dorsal view: Oval-carapace outline, neck, head; Middle: Ventral view: Stained plastron and thin tail; Right: Head. Based on shell shape, this female may be a representative from the Orinoco morphotype (*Chelus orinocensis*). Photo: Andres Rosenchein.

Figure 6. Male matamata from the Nichare River (SCLmax 37.7 cm). Left: Dorsal view: Oval-carapace shape, neck and head; Middle: Ventral side: Stained plastron and thick tail, and red-pink underside neck color; and Right: Dorsal view: Head and neck (features a narrow, continuous dark line along the midline, flanked by two thin dark lines on either side). Based on shell shape, this male may be a representative from the Orinoco morphotype (*Chelus orinocensis*). Photo (left): Ivonne Monge; photo (middle, right): Tibisay Escalona.

Figure 7. Ventral view (plastron) of an adult male matamata. Compare to females (see Fig. 9, ventral view), males have a thicker tail and a greater degree of concavity in the plastron, which is noticeable towards the abdominal, femoral, and anal scutes, with the concavity being most prominent in the femoral scute area. This pattern requires further investigation. Photo: Tibisay Escalona.

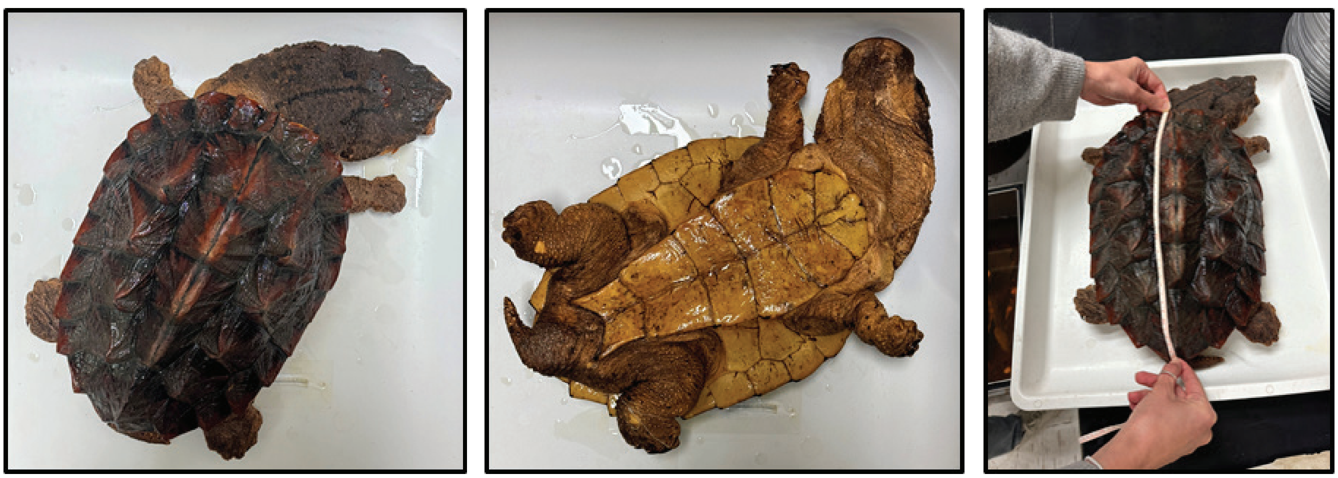

Figure 8. Validated record of occurrence for matamata turtle from Santa Rosa region, likely from Putucual lagoon swamp (Sucre State, Venezuela) deposited at Kansas Univeristy (KU) Biodiversity Institute and Natural History Museum (KU 117344). This adult female (CCL: 35.5 cm) catalogued as *Chelus fimbriata* is characterized by having from left to right: Dorsal view (oval carapace shape), ventral view (unpigmented plastron and light color on the underside of the neck). The specimen should be re-identified as *C. orinocensis* given its morphological similarities to the Orinoco morphotype. Photo: Ana Motta.

Villagra *et al.* 1995, Cadena *et al.* 2023). The plastron seems heavily stained rather than naturally pigmented, most likely due to the tannin-rich black waters typical of the Nichare ecosystem. However, further investigation is needed to confirm this observation. The underside neck coloration pattern was not possible to describe, due to lack of images (Fig. 5). This large female matamata turtle, measuring 48.8 cm in SCLmax (37.4 cm in SCW) and weighing 12.7 kg, is, to the best of my knowledge, the second-largest live matamata ever recorded in the Venezuelan Orinoquia. The largest so far was caught in Apure River and measured 52.6 cm in SCLmax with a weight of 17.7 kg (Barrio-Amorós & Manrique 2006). For Colombian Orinoquia (Bojonawi Natural Reserve - BNR), the maximum size reported is 47 cm SCLmax (37 cm in SCW) and a weight of 13.42 kg (Morales-Betancourt *et al.* 2020). Additional records of large female specimens are available in museum collections. For instance, a female with an oval shell shape from Raudales de Atures, Puerto Ayacucho (Amazonas State, Venezuela) was originally documented by Barrio-Amorós & Narbaiza (1999). This specimen, recently re-measured by T. Escalona, has an

SCLmax of 48.7 cm and an SCW of 39 cm. It is deposited at the Estación Biológica Rancho Grande in Maracay, Venezuela, under the catalog number EBRG 3596. Other museum records indicating CL larger than 40 cm are described in Pritchard & Trebbau (1984) (Deposited in Peter CH Pritchard, personal collection, Oviedo, Florida, USA as PCHP 1209) and Sánchez-Villagra *et al*. (1995) (Deposited at Colección Estación Biológica Hato Piñero, Cojedes, Venezuela as CEBHP unnumbered).

Male: This individual has an oval-shaped carapace similar to the Orinoco morphotype and a heavily stained plastron akin to that of the female described above. The ventral side of the neck is reddish-pink, while the dorsal side features a narrow, continuous dark line running along the midline, flanked by two thin dark lines on either side (Fig. 6). The size of this male, ranks among the largest ever reported. The SCLmax, SCW and weight are: 37.7 cm, 28.6 cm, and 5.7 kg. A similar maximum size but much heavier was registered by Morales-Betancourt *et al.* (2020) for Colombian Orinoquia (*i.e.*, 37.7 cm in SCLmax, 30.3 cm in SCW, and 7.6 kg). During a seven-year mark and recapture matamata population study, the latter authors found that most males examined (about 86%) had a SCLmax less than 33.1 cm, and the few larger ones (interval 36.1-39 cm) represented only 3%. The largest males ever reported in the literature include one individual living in captivity in Venezuela, measuring 39.7 cm in SCLmax (Pritchard & Trebbau 1984), and another specimen from Guyana reaching an SCLmax of 41.9 cm (Pritchard 2008).

OTHER OCCURRENCES WITHIN THE LOWER CAURA BASIN

Chelus was confirmed to inhabit the Mato (black circle 4) and Caura Rivers (black circle 5) (Fig. 2). It is important to point out that matamatas have previously been observed in both rivers, though they were referred to as *C. fimbriata* (Pritchard & Trebbau 1984, Rojas-Runjac *et al*. 2011).

Mato River

The observation was made at the locality known as Morrocoy (07°08'08" N, 65°12'43" W), where a male was captured for consumption by local hunters using an arrow and a long spear. Hunters were observed on top of trees near the river shoreline, waiting for any turtle to surface (Fig. 9). This live male, measured 36.6 cm in SCLmax, 28.6 cm in SCW, and weighted about 5 kg. Based on its oval shell shape, reddish-pink ventral neck coloration and probably stained plastron, this male appears to exhibit morphological characteristics typical of the Orinoco morphotype rather than Amazonian.

Caura River

Two males were caught with fishing nets by local fisherman near La Fortuna (06°48'04"N, 64°49'40"W) and were freed back into the river (Fig. 3). Sizes were as follows: 1) SCLmax: 32.1 cm, SCW: 23.9 cm, weight: 3.5 kg, and 2) SCLmax: 33.6 cm, SCW: 23.4 cm, weight: 3.5 kg (see Fig. 3 for fishing technique). Although no

Figure 9. Turtles collected by local hunters on the Mato River. From left to right: Hunter on top of tree (see white arrow); Hunter with spear; Turtle (*Podocnemis unifilis*) captured with spear; Collected turtles are kept inside a boat (curiara) either tied or in a bag. Male matamata can be observed in front and various *P. unifilis* behind. This individual was characterized by having an oval shell shape, stained plastron, and red-pink color pattern on the ventral side of the neck, and measuring SCLmax of 36.6 cm. Photo: Tibisay Escalona.

images were taken from these individuals, they both are described as having an oval-shell outline.

Collectively, the data confirm the presence of *Chelus* in at least three river localities (Nichare, Mato, and Caura) within the Lower Caura River Basin. Additionally, the morphological characteristics of the observed individuals suggest that they are representatives of the Orinoco morphotype (*C. orinocensis*). Nonetheless, further genetic and morphological research is needed to substantiate these findings throughout the Caura drainage, especially since previous work on the *Podocnemis unifilis* turtle documented a complex geographical pattern of genetic variation heavily influenced by landscape features (Escalona *et al.* 2009b).

The data also reinforces the notion by Pritchard & Trebbau (1984), Pritchard (2008), and studies by Morales-Betancourt *et al.* (2020) that matamata females can grow very large and attain larger sizes than males. Although there are exceptions to this pattern (see Pritchard 2008), most males are smaller than 40cm in SCLmax, indicating sexual size dimorphism. In matamatas, tail size differs between mature males and females of equal length, it remains to be explored whether there is variation in shell shape or other morphological traits (*e.g.*, skull size)between individuals shorter than 40 cm. Plastron concavity as a reliable trait for sex determination requires further research, as some females show concavity and some males have a rather flat plastron (see Sánchez-Villagra *et al.* 1995, T. Escalona pers. obs.).

Since shell shape is a key trait distinguishing the two *Chelus* lineages –*C. orinocensis* with its oval shape and *C. fimbriata* with its rectangular outline (Fig. 1)– future research utilizing geometric morphometrics is essential to enhance the identification of shape differences across various river systems. This work should also be complemented by genetic studies that prioritize comprehensive geographic sampling, especially in under-sampled regions such as Venezuela. Such sampling will facilitate the testing of genetic distinctiveness within specific watersheds and the assessment of gene flow between peripheral and central localities within the species' distributional range.

It is important to note that field records should not be forgotten, as they can still yield valuable insights despite the time since the observation. They can provide useful new knowledge, validate, and improve previous and recent records. This is particularly significant for elusive species with limited observations and remain poorly known, such as the matamata turtles.

LAKE MARACAIBO BASIN (ZULIA STATE) RECORDS

The occurrence of *Chelus* in the Lake Maracaibo Basin has remained uncertain. Previously, in this region, matamata turtle occurrences were only known from two observations dated more than 40 years ago (see Pritchard & Trebbau 1984). One of these observations has recently been validated by Gilson Rivas (Museo de Biología, Universidad del Zulia) after interviewing Professor Jose L. Lira from University of Zulia on April 18, 2024. Professor Lira recalls seeing on 1974, a live matamata (*Chelus* sp.) caught by a local fisherman in the Santa Ana River (Fig. 2; black triangle 2), a tributary on the west side of the lake (G. Rivas, pers. comm.). Furthermore, until recently (9 April 2024), museum specimens of matamata turtles from this region were not known. However, a matamata, preserved in alcohol, was discovered in the herpetological collection of Museo de Biología of Universidad Central de Venezuela (MBUCV), Caracas (deposited as MBUCV 7096, T. Escalona, pers. obs.) (Fig. 10). It is important to acknowledge, that although the hand-written catalogue provides the exact location of the specimen (*i.e.*, northwestern side of the lake; Fig. 2; black triangle 1), there is no mention of who brought it to the museum or even the date it was collected. It is only noted that it was found by local fisherman and identified by Oswaldo Fuentes in the mid-late 1990s as *Chelus fimbriata*. However, determining whether the specimen is truly a *C. fimbriata* or possibly a *C. orinocensis* or even a different species or subspecies remains uncertain, as it is a small juvenile (SCLmax: 6 cm) with an incompletely ossified shell that lacks a well-defined shape (Fig. 10). The true identity of this juvenile will require further morphological and genetic analysis.

Recent museum records and the validated observation by Professor Lira, it suggests that *Chelus* sp. may inhabit Lake Maracaibo, warranting further investigation. If confirmed, matamata turtles in this area could represent an isolated breeding population that deserves attention. This is particularly significant because the Lake Maracaibo Basin is situated in a secluded geomorphological region, surrounded by substantial physical barriers (*i.e*., to the east, is separated from the Orinoco-Amazon system by the Andean mountain range, and to the west, from the Magdalena system by the Sierra de Perijá, and to the south by the union of these). Biogeographic evidence from freshwater fishes indicates that this relative isolation of the Lake acted as a Refugia, allowing the differentiation of fish populations into distinct biotas. This differentiation

Figure 10. Newly discovered catalogued museum record of matamata turtle from the northwestern side of Lake Maracaibo, Venezuela. This new record is deposited in the Herpetological Collection of the Museum of Biology of the Universidad Central de Venezuela (MBUCV 7096). Left: Tag validating the locality and catalogue record. Middle: Dorsal view (carapace). Right: Ventral view (plastron). This very small juvenile specimen measured 6 cm in SCLmax. Photo: Tibisay Escalona.

is notable when compared to neighboring hydrological systems like the Orinoco, Amazon, and Magdalena. The lake, today harbors ancient relictual lineages, new species that arrived via coastal dispersal, and species that evolved in seclusion, leading to high levels of endemism (Rodrigues-Olarte *et al.* 2011).

SANTA ROSA RIVER–PUTUCUAL LAGOON SWAMP, GULF OF PARIA BASIN (SUCRE STATE) RECORD

To date, there is only one known record of the matamata turtle from Sucre State. This specimen is catalogued at the KU Biodiversity Institute and Natural History Museum (Lawrence, KS) under the accession number KU 117344 (see Pritchard & Trebbau 1984). To validate this record, Ana Motta, the Herpetology Collection Manager at KU, confirmed the physical existence of the specimen. She also provided information from the hand-written catalogue, and took the carapace measurement (Curved Carapace Length - CCL: 35.5 cm), and photographs from both the dorsal and ventral views (Fig. 8). According to the catalogue, this specimen, identified as *Chelus fimbriata*, was collected by James D. Smith on February 26, 1967, in the vicinity of Santa Rosa River (10°24’55” N, 63°23’29” W), located by road 20 km southeast of Casanay Village (10°30’13” N, 63°25’03” W), likely from the Putucual Lagoon Swamp (Fig. 2; black star 3). However, after analyzing the photographs, it is apparent that this individual has an oval-shaped carapace with an unpigmented yellow plastron, and having two dark fine bands running along the light color of the underside of the neck, features diagnostic of the Orinoco morphotype. Consequently, based on these characteristics the specimen appears to be instead a *C. orinocensis*, pending further investigation (T. Escalona, pers. obs.). Interestingly, the Santa Rosa River is in the lowlands and flows southeast where it merges into Putucual. This swamp drains its water eastward into the San Juan River, which eventually flows into the Gulf of Paria (Melfran Herrera, pers. comm.). This hydrographic system is part of the Gulf of Paria Basin, where some tributaries can connect with those of the Orinoco Delta during flooding. These connections may facilitate the exchange of water and aquatic species between the Orinoco and the Gulf of Paria, influencing the biodiversity and ecological dynamics of the entire region. Given this context, the presence of matamata turtles in Sucre State is plausible. Nevertheless, our current understanding of the chelonian fauna in this region remains largely unknown, highlighting the necessity for further research to explore turtle diversity in this area.

CASIQUIARE RIVER CANAL (AMAZONAS STATE) RECORD

Morphological shell shape data from museum records indicate the occurrence of both matamata lineages in the Upper Orinoco and Upper Rio Negro Basins within the Amazonas State in southern Venezuela. However, it remains unclear where along this hydrographic gradient the two lineages coexist (Pritchard & Trebbau 1984, Sánchez-Villagra *et al.* 1995, Barrio-Amorós & Narbaiza 1999, Pritchard 2008). Here, I report about one record from the Casiquiare drainage, the only contact zone between the Orinoco and Rio Negro Basins. A large-sized specimen, with burned carapace and missing plastron is documented, measuring 48.4 cm in SCLmax and 36.9 cm in SCW (Fig. 11). This incomplete shell was discovered in

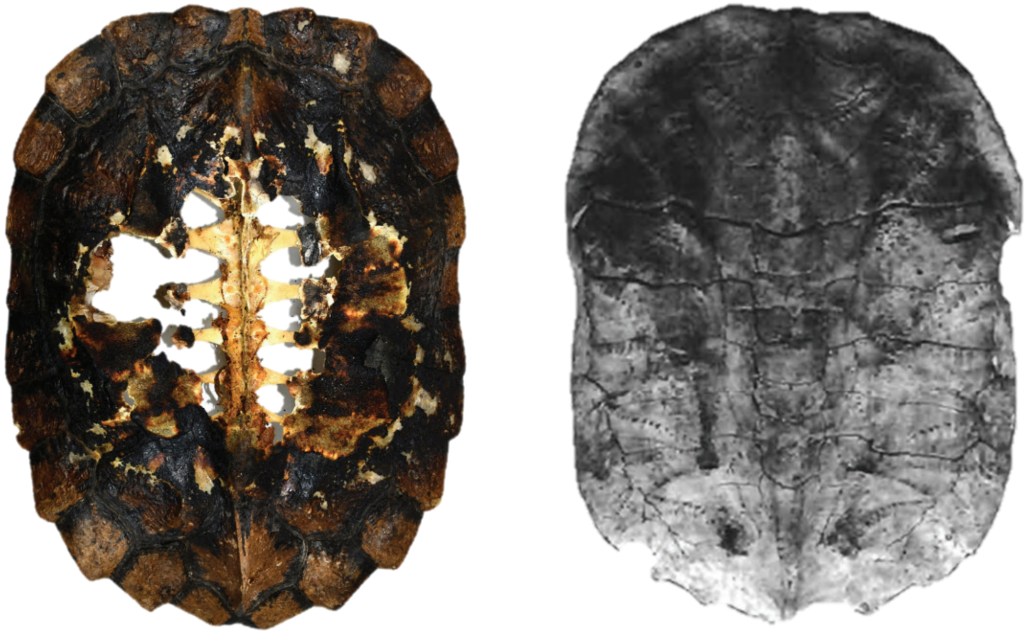

Figure 11. Dorsal view of the carapace shape from two different Amazonian *Chelus* morphotypes depicting a rectangular shell shape with parallel-sides. Left: Burned carapace of an adult female matamata turtle from the Casiquiare River (Amazonas state), southern Venezuela (catalogued originally as *C. orinocensis*, and modify tentatively to *C. fimbriata*, pending investigation, MBUCV 7278) (Photo: Tibisay Escalona). Right: from the vicinity of Leticia, Colombia (catalogued as *C. fimbriata* PCHP 39) (modified from Sánchez-Villagra *et al.* 1995).

the community of San Carlos de Rio Negro (Fig. 2; black square 7) after being consumed by locals. The locals reported capturing the turtle along the Casiquiare River, though no specific collection site was provided (C. Alvarado. pers. comm.). This matamata is housed at MBUCV with catalogue number 7278 and identified as *C. orinocensis*. A closer examination and using shell shape outline as a diagnostic character for taxon identification, indicates that the specimen has a more rectangular shape rather than oval (Fig. 10). Based on this feature, the specimen is identified tentatively as an Amazonian morphotype (*C. fimbriata*) (A. Rhodin and T. Escalona, pers. obs.) until further morphological investigation (Fig. 10). This finding is particularly intriguing, as current genetic studies restrict *C. fimbriata* to the Amazon River Basin and eastern Guianas (Vargas-Ramirez *et al*. 2020). However, before making any conclusion, caution is warranted as this specimen may also represent an interspecific hybrid or intergrade, considering it originates from a locality where both matamata lineages are suggested to co-occur. Indeed, previous investigations have mentioned that some specimens from this region exhibit a blend of traits from the two *Chelus* morphotypes, making them difficult to identify, and implying a subspecific relationship or intermediate morphotype between *C. orinocensis* and *C. fimbriata* (Sánchez-Villagra *et al*. 1995, Pritchard 2008).

Considering all these factors, it is reasonable to suggest that the Casiquiare River Canal may serve as a dispersal corridor for matamata turtles between the Orinoco and Rio Negro Basins and vice versa, facilitating habitat sharing and coexistence among *Chelus* lineages along this contact zone. The Casiquiare River's role as an important biogeographic corridor in shaping species distribution, genetic flow, and speciation processes is well-documented for diverse aquatic fauna, such as in Amazon river dolphins, Podocnemididae turtles (Emmons & Feer 1999, Pearse *et al.* 2006, Escalona *et al*. 2009b), particularly for fish species of the genus *Cichla* (Winemiller & Willis 2011). Additionally, evidence of interspecific hybridization, as seen in various fish studies (Crampton *et al.* 2003, Willis *et al*. 2010, 2012, Thomaz *et al*. 2017), underscore the river's function in facilitating genetic mixing between the Amazon and Orinoco Basins. However, the extent to which this hybridization or intergrade has occurred in other aquatic organisms, such as matamata turtles, remains understudied. It is important to emphasize, that hybridization among chelonian species have been previously reported in other hydrographic regions (*e.g.*, Lovich *et al*. 1990, Arantes *et al.* 2020). If this is the case of *Chelus* sp., it demands rigorous investigation in order to help mitigate taxonomic ambiguity, as evidenced by similar issues documented in Australian chelids (Cann & Legler 1994, Spinks *et al*. 2015).

Lastly, expanding the discovery of new matamata specimens is crucial for comprehensively understanding the distribution, genetic diversity, and morphological variation of *Chelus* lineages within and among these river basins.

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Presencia de *Agrias phalcidon penthesilea* Séraphin, 2017 en Venezuela (Lepidoptera: Nymphalidae, Charaxinae)

Occurrence of *Agrias phalcidon penthesilea* Séraphin, 2017 in Venezuela (Lepidoptera: Nymphalidae, Charaxinae)

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INTRODUCCIÓN

Un ejemplar macho (Fig. 1 a, b, c), cuyo fenotipo es similar al de *Agrias phalcidon penthesilea* Séraphin, 2017*, fue recolectado por Keyla Arana, vecina de la Comunidad Indígena Piaroa de Raudal del Danto, Municipio Autana, estado Amazonas, Venezuela. Este ejemplar, primer reporte para Venezuela, fue capturado el 20-XI-2023 en el piedemonte de la Serranía del Cuao (Fig. 2) a una altitud aproximada de 150 m snm, en un pequeño asentamiento situado a unas 3 horas de camino al sur de Raudal del Danto. En la zona baja entre la Serranía del Cuao y el Río Orinoco se desarrolla una espesa selva húmeda tropical con árboles que pueden superar los 30 m de altura y se define como "bosque estacionalmente inundable, alto, siempreverde (Penillanura Orinoco-Casiquiare)" (Berry *et al*. 1995).

La naturaleza original del color azul dorsal del único individuo conocido de *Agrias phalcidon penthesilea* en Venezuela, fotografiado en fresco con un teléfono celular, fue parcialmente alterada (Fig. 1 b) debido al prolongado almacenamiento en condiciones precarias de humedad y calor extremo; actualmente se encuentra conservado en la colección del entomólogo venezolano Mauro Costa (Caracas), quedando como registro indiscutible de la presencia de este taxón en este país. El lugar de la recolecta (Fig. 3) consiste en un claro dentro de la selva donde muchas especies de mariposas que suelen volar en el dosel pueden ser atraídas al suelo por los desechos humanos de los que allí acampan; de hecho, esta mariposa fue atraída al piso por el excremento de la pequeña hija de Keyla, quien logró su captura con una red rudimentaria improvisada.

RESULTADOS Y DISCUSIÓN

De acuerdo al primer autor, los caracteres fenotípicos del espécimen recolectado corresponden a los de "*Agrias pericles rubella* forma *latona*" descrito hace casi un siglo por Robert Biedermann (1935: 210 y 1936: 137), y que aparentemente no había sido observado después. Biedermann tenía cuatro ejemplares, 3 hembras recolectadas en Iauareté (frontera colombo-brasileña) y un macho encontrado un poco aguas arriba en el Río Kerari, del lado colombiano.

* Algunos autores, persuadidos por su cercanía genética, han puesto en sinonimia los géneros *Agrias* Doubleday, 1845, y *Prepona* Boisduval, 1836, (Escalante *et al*. 2010, Ortiz-Acevedo & Willmott 2013). Examinamos y comparamos las singularidades fenotípicas que distinguen las *Agrias* de las *Prepona*, tanto superficial como estructuralmente, y no encontramos incongruencia con las últimas filogenias moleculares disponibles (Ortiz-Acevedo *et al.* 2017, 2020), en las cuales ambos grupos quedan claramente separados por una rama anidada, correspondiente a *Prepona praeneste* Hewitson, 1859. Este último es un taxón distintivo, por lo tanto, optamos por mantener la validez plena del género *Agrias*. Esta opción supone aceptar la posible parafilia del género *Prepona*, de acuerdo con los bien conocidos principios de la sistemática filogenética (Aubert 2016).

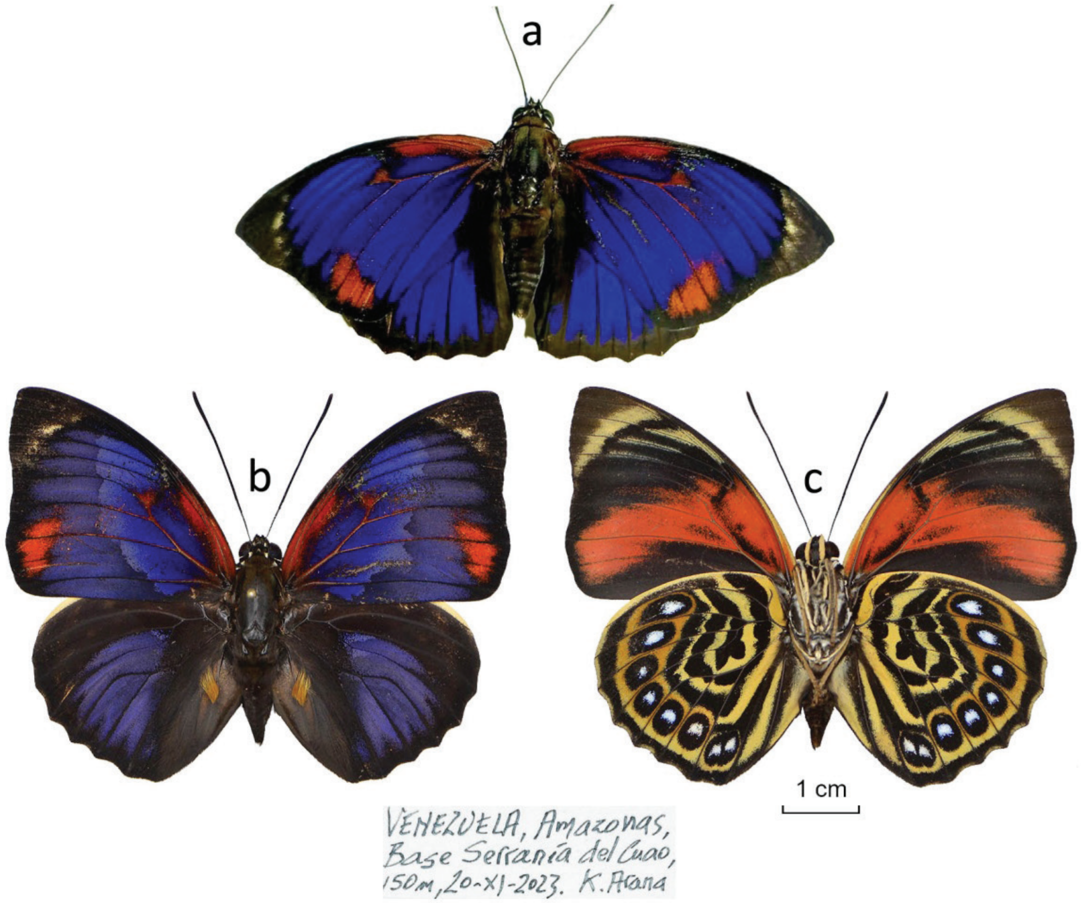

Figura 1. *Agrias phalcidon penthesilea*, ♂; **a,** ejemplar recién capturado; **b**, dorsal; **c**, ventral.

Estos especímenes fueron considerados por Séraphin (2017) como representantes de una población descrita bajo el nombre de *phalcidon penthesilea* Séraphin, 2017, (Biedermann 1935, infrasubespecífico, por tanto, taxonómicamente inválido), relacionada con, pero distinta de, *Agrias phalcidon excelsior* Lathy, 1924. Su proximidad con *excelsior*, ya mencionada por Biedermann, se nota claramente en la homología fenotípica que existe entre ellos. O sea, por un lado, el *excelsior* típico con su forma *jupiter* Sorimathi, 1998, y por el otro el *penthesilea* típico con su forma *latona* Biedermann, 1935.

El descubrimiento de *A. phalcidon penthesilea* en el noroeste del estado Amazonas, al pie de la Serranía del Cuao, además de confirmar el estatus subespecífico de este taxón, amplía considerablemente el conocimiento de su distribución geográfica (Fig. 2).

Al oeste y al suroeste de la cuenca amazónica, *A. phalcidon penthesilea* es remplazado por *A. beatifica beatifica* Hewitson, 1869, (Colombia, Putumayo) y por *A. beatifica stuarti* Godman & Salvin, 1882, (Perú, Loreto); al sureste por *A. phalcidon excelsior* (Brasil, Amazonas, Tonantins); al este por *A. pericles aurantiaca* Fruhstorfer, 1897 (Venezuela, Bolívar, Gran Sabana). Todas estas poblaciones están separadas 400/500 kilómetros de las de *penthesilea,* tal vez artificialmente debido a importantes vacíos de datos de distribución.

Por otro lado, al noroeste de Amazonas (Venezuela), al mismo lado oriental del Orinoco, *A. phalcidon penthesilea* parece ser simpátrida con una población recién descubierta (Fig. 4), atribuible *a priori* a la especie *Agrias pericles* Bates, 1860. Aún no descrita, esta última población, reportada de Los Pijiguaos (Bolívar), Gavilán y Pintado (Amazonas), por sus características fenotípicas puede vincularse provisionalmente a *A. pericles uniformis* Michael, 1930, descrita del Río Branco (Brasil, Roraima) (Neild 1996). La vicariancia de estas poblaciones, por unas atribuibles a la especie *Agrias phalcidon* Hewitson, 1855, por otras a las especies *A. pericles* y *A. beatifica* Hewitson, 1869, plantea la cuestión de sus estatus respectivos: especies vicarias distintas o subespecies estables de una sola especie.

El estudio de una zona de contacto entre *phalcidon* y *pericles* en Uypiranga, en el margen derecho del bajo Río Negro, frente a Manaus, aporta una parte de la respuesta. En este lugar, la coexistencia de formas híbridas (*aspasia*

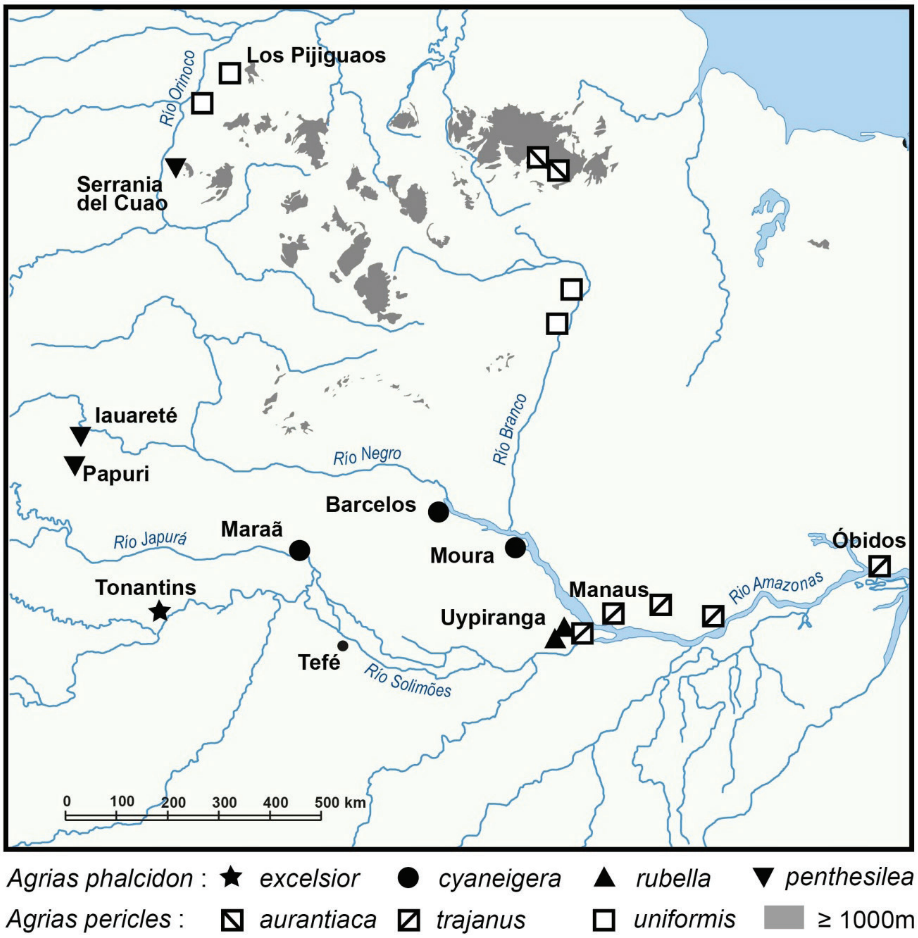

Figura 2. Distribución conocida de *Agrias phalcidon* y *Agrias pericles*.

Figura 3. El campamento Piaroa, localidad de recolecta del primer ejemplar de *Agrias phalcidon penthesilea* en Venezuela. (Foto M. Costa)

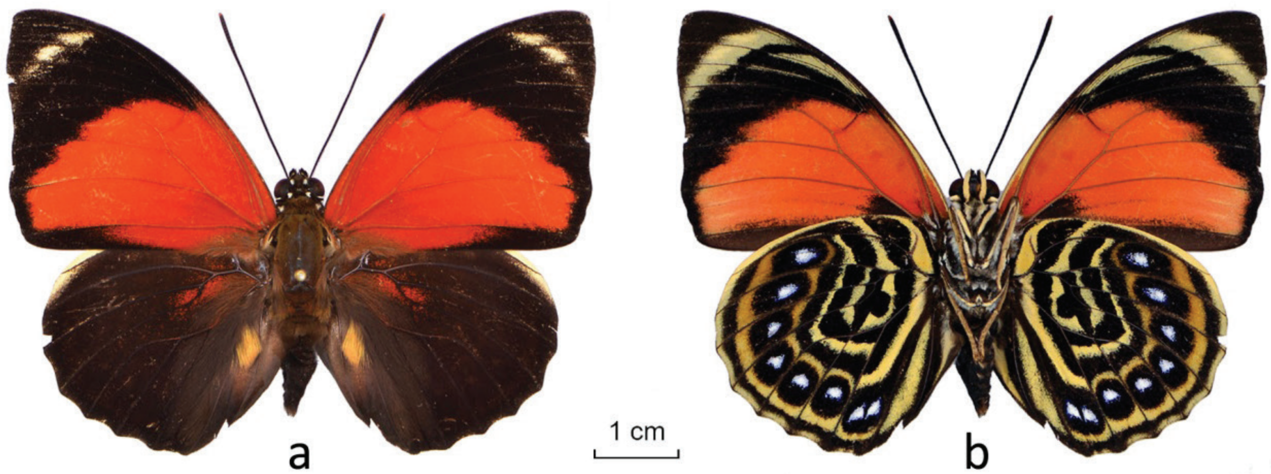

Figura 4. *Agrias pericles uniformis,* Venezuela, Bolívar, Los Pijiguaos, Bauxilúm, 600 m, 10-XII-2005. M. Costa (Col. Costa).

Biederman, 1936; *arcuatus* Michael, 1931; *modulata* Michael, 1931) con sus formas parentales *A. phalcidon rubella* Michael, 1930, y *A. pericles trajanus* Fruhstorfer, 1902, parece demostrar que estos dos taxones son parcialmente interfértiles. En este caso, se trataría de dos *quasispecies* en el sentido codificado por Bernardi (1980) o *quasi-espèces* en el sentido de Descimon (1977) en lugar de dos especies plenas. Uno de los aportes del descubrimiento al pie de la Serranía del Cuao es sugerir una nueva zona de contacto entre *phalcidon* y *pericles*, la cual podría aclarar la relación de parapatría o de simpatría que ligan los dos grupos de poblaciones. Este asunto motiva futuras investigaciones en el área incluida entre Puerto Nariño y Los Pijiguaos, separados por aproximadamente 1.200 kilómetros, donde debería ubicarse esta zona de contacto.

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Virginia Sanz D'Angelo: 1964-2024

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Gracias a la organización mancomunada de amigos y colegas pertenecientes al Centro de Ecología del Instituto Venezolano de Investigaciones Científicas, el Instituto de Zoología y Ecología Tropical de la Facultad de Ciencias de la Universidad Central de Venezuela y la Unión Venezolana de Ornitólogos, fue posible concurrir el pasado 26 de junio a los actos y ponencias del *Simposio "Homenaje a Virginia Sanz D'Angelo: Contribuciones a la ecología y conservación de la biodiversidad en Venezuela"*, merecido evento conmemorativo de la vida y obra de nuestra extraordinaria amiga y compañera de trabajo, Virginia, fallecida intempestiva y prematuramente la madrugada del 6 de enero de 2024.

Virginia Sanz D'Angelo fue la menor de tres hermanas, Elena, Marisol y Virginia. Su padre, Víctor Sanz (1917-2015), oriundo de Castellón, Valencia, España y su madre, Elena D'Angelo (1928-2011), de Campobasso, Italia, en búsqueda de la prosperidad en el continente americano, emigraron independientemente al Uruguay: ella en 1932 (con tan solo 4 años de edad) y él en 1953, 17 años después de haber sido combatiente del Ejército Republicano español. Tiempo después se conocieron y enamoraron en la biblioteca de la Facultad de Humanidades de la Universidad de la República Oriental del Uruguay, donde Víctor era administrativo y estudiante de historia y Elena bibliotecóloga. Se casaron en Montevideo en 1958, donde nacerían sus tres hijas.

Virginia Sanz en una sesión de documentación fotográfica en el bosque seco del cerro Copey, Isla de Margarita. Foto: Elysa Silva.

Virginia abrió los ojos al mundo el 12 de junio de 1964. Su niñez transcurrió en Montevideo, donde descubrió el mundo natural y comenzó su largo romance con la fauna, leyendo libros sobre animales, coleccionando insectos y conchas marinas producto de sus largos paseos por la playa. Allí nació su vocación por la biología. Pero lo que parecía un destino feliz y promisorio para la familia Sanz D'Angelo en Uruguay, cambió inesperadamente con el advenimiento de la dictadura cívico-militar en 1973 y la destitución de Víctor y Elena de sus actividades laborales. Este evento fue decisivo para que la familia se aventurara a emigrar a Venezuela, nación de gente generosa y hospitalaria, y uno de los países que entonces ofrecía mayores oportunidades en Hispanoamérica.

Víctor llegó a Venezuela en 1976 y el resto de la familia en 1977, cuando Virginia recién entraba en la adolescencia. En Caracas, Virginia ingresó al Liceo "Andrés Bello", donde realizó estudios de secundaria, graduándose de Bachiller en Ciencias en 1982. Ese mismo año se matriculó en la Universidad Central de Venezuela (UCV) para estudiar biología, graduándose de Licenciada en Biología Mención Zoología en 1991, junto con el autor principal de estas notas (JMN). Sus estudios de doctorado también los realizó en la Facultad de Ciencias de la UCV, recibiendo el título de Doctora en Ecología en 2004.

Durante su juventud, aparte de su fascinación por el mundo natural, Virginia, afecta a otras virtudes y con amplios intereses intelectuales, incursionó en el teatro, la fotografía, la costura y las artes plásticas. Pero nada fue comparable con su otra gran pasión: viajar. Virginia fue una viajera *Summa cum laude*. Llegó a visitar y conocer gran parte de Europa, casi toda América, la India, Nepal, Indonesia, parte de la Polinesia, la isla de Pascua, Australia y Nueva Zelanda, entre otros lugares. Su peregrinar geográfico no fue precisamente conforme al turismo ordinario; Virginia investigaba la historia, la cultura y la sociedad de los sitios que visitaba y fue la organizadora de muchos viajes familiares. Su familia era su Sistema Solar y a ella volvía siempre que partía, fuera trabajo o disfrute, para llenarla de amor y compartir sus aventuras. Y después de su familia, sus amigos. Supo rodearse de una amplísima constelación de amistades, con las que compartía genuina y espontáneamente en muchas formas y escenarios. Cuidó bien los afectos entre sus amigos, brindando cariño y atención. Sabía o intuía como podía estar presente si así era necesario, pero también fue capaz de llenar los pequeños espacios de amistad de manera inesperada y oportuna.

Virginia inició su contribución a la ecología y conservación de la biodiversidad en 1988, como asistente de investigación en un proyecto sobre nutrición del mono aullador (*Alouatta arctoidea*), en su querido 'Hato Masaguaral' del estado Guárico, a donde volvería muchas otras veces. Su primer artículo científico lo publicó en 1994, derivado de su tesis de licenciatura dedicada a un primate, el Mono Margariteño (*Sapajus apella margaritae*), en su amada Isla de Margarita. Esta isla se convirtió en el epicentro de muchas de sus investigaciones. En su tesis doctoral, inició estudios ornitológicos, específicamente sobre la ecología de la Cotorra Margariteña (*Amazona barbadensis*).

En 2005, ingresó como postdoctorante al Laboratorio de Biología de Organismos del Centro de Ecología del IVIC, y allí desarrolló el resto de su carrera científica, por casi 20 años, llegando a Investigadora Asociada Titular III. Se centró en el estudio de las aves, con especial énfasis en psitácidos. Estudiando aves, Virginia abrió su abanico de intereses investigativos en toda su amplitud: ecología y conservación de aves terrestres y acuáticas, parásitos en aves, ecología de aves migratorias, efecto de microplásticos en aves, redes tróficas, frugivoría y dispersión de semillas, cambio de uso del suelo, conectividad de hábitats, diseño de áreas protegidas y educación ambiental.

Al transcurrir los años, su cartera de proyectos creció notablemente. Gestionaba y conseguía financiamientos para ejecutarlos, y su energía para llevarlos a cabo incrementaba con cada nueva iniciativa; su capacidad organizativa y disciplina le permitieron coordinar acciones en varios frentes. Fue una bióloga de campo apasionada, pero igualmente metódica y organizada al momento de trabajar en los laboratorios y sobre todo al llegar la hora de sentarse a pensar para escribir. Tenía el don del sentido crítico y presciencia para juzgar las evidencias naturales en el contexto científico. El resultado de sus investigaciones se refleja en 43 contribuciones científicas de relevancia, publicadas como artículos en revistas científicas y capítulos de libros de amplia circulación mundial, además de varios artículos divulgativos. Sus trabajos fueron presentados en 100 comunicaciones científicas de distintos formatos, desde talleres hasta congresos nacionales e internacionales.

Para Virginia fue clave su elevada capacidad de trabajo en equipo. Fue una excelente colaboradora, coordinadora de proyectos, y por supuesto, tutora de estudiantes de pre y postgrado. Así se multiplicaron sus acciones, a la vez que contribuyó a la formación de una nueva generación de ecólogos, quienes actualmente se desempeñan profesionalmente con éxito dentro y fuera de Venezuela. Tuteló cinco tesis de pregrado, dos de maestría y tres de doctorado (dos de ellas aún en curso).

Su aporte a la enseñanza incluye cursos cortos y talleres, pero principalmente asignaturas completas de postgrado, en temas generales o especializados como: manejo y guardería de fauna silvestre, anillamiento de aves, ecología y conservación de aves, identificación y conservación de aves playeras, telemetría en aves, ecología de interacciones bióticas y ecología general. Muy importante para la formación de nuevos profesionales fue su contribución a la coordinación del Postgrado de Ecología del IVIC entre 2011 y 2013 y la actualización de su pensum.

Es muy importante señalar que Virginia Sanz D'Angelo fue uno de los pilares fundacionales de la Unión Venezolana de Ornitólogos (UVO), fomentando el desarrollo y la diversificación de los estudios ornitológicos en el país, ayudando a difundir la ornitología como disciplina científica, y contribuyendo a despertar el interés por las aves entre muchos jóvenes profesionales en Venezuela.

Virginia nos conmovió a todos con su súbita partida. Migró sin aviso, dejando el vacío de la extrañeza en sus familiares, colegas, estudiantes y amigos. Su alegre presencia aún se siente en el laboratorio, en el Centro de Ecología, en nuestras mentes y en nuestros corazones. A todos nos regaló grandes lecciones: la importancia de sonreír, de ser amigo y buen colega, de amar lo que se hace, vivir el presente y no perder el tiempo. Siempre supo que estaba sobre un planeta maravilloso, todavía esperando por ser descubierto, y no perdió un solo minuto para dedicarse a ello.

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Identificación de huellas de mamíferos de la Cordillera de la Costa de Venezuela

Blanco-Dávila, Alberto,
Ely D. Gómez-Fonseca &
Roberto De La Fuente, con prólogo
del profesor Salvador Boher-Bentti.

Editores: Alberto Blanco-Dávila, Norbert Flauger & Oscar Pietri Pacheco.
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Contenido: *Prólogo. La Cordillera de la Costa de Venezuela. Huellas de los mamíferos de la Cordillera de la Costa de Venezuela. Un poco sobre ecoturismo. Los 10 mandamientos del ecoturismo. Glosario. Referencias bibliográficas.*

Estamos felices de ver publicado el libro *Identificación de huellas de mamíferos de la Cordillera de la Costa*, que es una guía para identificar huellas de los mamíferos en campo. Este libro completa un vacío en este tema en Venezuela y podrá ser de mucha ayuda para varios trabajos científicos, de conservación, educación o para los que quieren aprender y disfrutar conociendo mejor la naturaleza. También, puede estimular el aumento del interés en estudiar y apreciar la naturaleza en muchas personas, especialmente entre jóvenes y público en general.

La obra comienza con una apropiada descripción geográfica y bioecológica de la Cordillera de la Costa, además de una breve reseña sobre las posadas ecoturísticas donde se desarrolló el trabajo de campo que condujo a esta obra. Además, contiene un breve resumen del número de especies de mamíferos que se han identificado en territorio venezolano y en la propia Cordillera de la Costa, así como también el sustento de la selección de especies referidas en la guía. Finalmente, en esta sección introductoria hay una explicación de cómo usar la información compilada en la guía.

Para este libro se escogieron 22 especies de mamíferos terrestres, las cuales son comunes en la región y cuyas huellas pueden ser detectadas más frecuentemente. Para cada una de estas especies se provee información breve, que incluye su nombre común y científico, la categoría de amenaza en la que se encuentra, según criterios de la UICN, una breve descripción de sus hábitos de comportamiento, dieta, hábitats que ocupa, y otros datos sobre su biología, además de un mapa representativo de su distribución en el país. Finalmente, se ofrecen la descripción e ilustraciones de las huellas correspondiente a cada especie, con indicación de sus tallas (medidas).

Al final del libro se ofrecen indicaciones que pueden ayudar a diferenciar las huellas que son más fáciles de confundir. Así mismo se abre allí una sección sobre ecoturismo y un glosario que reúne los términos empleados en la obra.

El libro es corto, pero tiene buen diseño. Las ilustraciones de las especies son especialmente hermosas y bien preparadas.

Lo novedoso de este tipo de guía para el país hace entendible que tenga algunos puntos débiles, los cuales estamos seguros serán corregidos en nuevas ediciones. Para facilitar la identificación en el campo sería importante añadir fotografías de las huellas, tomadas con alguna escala que sirva como término de referencia para estimar su tamaño. Tales fotos ayudarán enormemente, en especial a personas sin experiencia. Algunas de las ilustraciones en la edición actual no reflejan bien los detalles que son importantes para la identificación de huellas en el campo. La otra sugerencia es que se debe revisar y corregir los mapas de distribución, porque algunos de estos están equivocados o probablemente desactualizados, por ejemplo, los mapas de los felinos.

De cualquier manera, felicitamos a los autores por tan excelente libro, que será un gran aporte para estudiar y conocer a la naturaleza de Venezuela.

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Tortugueando en Venezuela

Guada, Hedelvy J. & Eneida Fajardo.

2023. [1ª ed.]. Caracas: Centro de Investigación y Conservación de Tortugas Marinas, a.c. (CICTMAR), 52 pp.
Ilustraciones: Michelle Gómez.
Distribuido por: proyectocictmar@gmail.com.

Contenido: *Te presento a una tortuga marina; Las tortugas marinas de Venezuela; Donde están las tortugas marinas en Venezuela?; Las tortugas marinas o sa'wainrü del Golfo de Venezuela; Falcón: tierra de sol y tortugas; Quizás no lo sabes, pero en Carabobo ¡hay tortugas!; Cuyagua, la playa reina de las tortugas marinas en Aragua; Un rincón de la Cordillera de la Costa para las tortugas marinas; En La Guaira abundan las tortugas marinas; En Miranda hay muchas tortugas marinas; Anzoátegui también tiene tortugas marinas; Mochima: joya del oriente del país; Playa Puipuy, paraíso para las tortugas marinas en Sucre; Querepare, una de tortugas marinas; La gran playa de las tortugas marinas en Paria; Las tortugas marinas del Parque Nacional Península de Paria; Tortugas marinas de la Costa Atlántica; Playa El Agua, un refugio para las tortugas marinas; Playa Parguito: el encanto natural de Playa Parguito y sus tortugas marinas; Las tortugas marinas del Parque Nacional Archipiélago Los Roques; El Refugio de Fauna Silvestre Isla de Aves está repleto de tortugas verdes; ¿Cuál es el ciclo de vida de las tortugas marinas?; ¿Qué puedes hacer túu para salvar a las tortugas marinas?; Conoce las ABRAE importantes para las tortugas marinas en Venezuela; Glosario; Agradecimientos.*

Este libro para colorear nos pasea por las principales áreas de alimentación y nidificación de las diferentes especies de tortugas marinas que viven y anidan en el Caribe de Venezuela, no sin antes mostrarnos qué son las tortugas marinas, dónde se les puede encontrar, cuáles son sus ciclos de vida, qué podemos hacer para proteger a estos animales, así como las diferentes áreas protegidas donde se encuentran estas especies. En cada ambiente o playa ilustrada, los protagonistas son niños, además de algunos adultos, lo que nos da una idea del propósito de las autoras de inculcar a los jóvenes el interés hacia este grupo de animales.

Las autoras son reconocidas biólogas venezolanas que han dedicado buena parte de sus vidas al estudio de estos grandes reptiles, por lo que la información plasmada en este original libro para colorear está respaldada por décadas de estudios zoológicos. En cuanto a Michelle Gómez, es una joven ilustradora y diseñadora que ya lleva varios proyectos finalizados sobre fauna venezolana y su conservación (afiches, libros para colorear, entre otros). Esperamos seguir reconociendo y disfrutando sus realizaciones artísticas en los años futuros, ya que son relativamente pocos los profesionales (¡y proyectos!) dedicados a ilustrar nuestra fauna silvestre (otros ejemplos se hallan en las obras de Roberto de la Fuente, Ángel Ulloa, Mercedes Madriz, Astolfo Mata) y llenar el vacío que dejaron otros célebres ilustradores de la fauna venezolana como lo fueron en su tiempo Alfredo Almeida, Emil Bröckl, Charles Ventrillon y Giorgio Voltolina, sólo por mencionar algunos de los más importantes.

Este libro está disponible como pdf en la página web de la Red de Conservación de Tortugas Marinas en el Gran Caribe, WIDECAST: https://www.widecast.org/Resources/Docs/Tortugueando%20en%20Venezuela%20PDF%20Final%202023.pdf.

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Juancho, el Caimán Carupanero

Gonzales, Cecilia.

2024. [2ª ed.].
Caracas: Universidad Católica Andrés Bello, 28 pp.
ISBN: 9789804391569 (tapa blanda, US$ 5).
Ilustraciones: Gabriel Moncada.
Distribuido por: Abediciones, Universidad Católica Andrés Bello (UCAB), Caracas.

Juancho no es sólo un libro para colorear, es una historia real sobre un cocodrilo del Orinoco (*Crocodylus intermedius*) encontrado aparentemente en una localidad del Oriente de Venezuela, lugar donde no debería haber caimanes del Orinoco. Esta publicación trata sobre un pequeño cocodrilo el cual fue mantenido por casi dos décadas en una especie de zoológico local, hasta que, por motivo de su gran crecimiento, la familia que lo mantenía decidió llamar a la autoridad ambiental de Venezuela para que se lo llevaran y le buscaran un mejor lugar para vivir. Y así fue.

Esta historia para niños y jóvenes está contada en versos y comienza desde que el animal llegó a manos del Señor Pedro, dueño del pequeño zoológico carupanero, hasta su destino final en el Dallas World Aquarium en los Estados Unidos, gracias a un convenio con el Ministerio del Ambiente (actualmente Ministerio del Poder Popular para el Ecosocialismo) de Venezuela, donde junto a una hembra de su especie forman un programa exitoso de cría en cautiverio. Este libro, en tamaño carta y con 28 páginas, fue concebido para el acompañamiento de diversas actividades con niños a fin de inculcarles a los jóvenes el amor por la naturaleza, además de enseñarles la importancia de los seres vivos con los que compartimos el planeta. Con una exitosa difusión estamos seguros que cumplirá bien esta misión.

La obra referida, ilustrada por Gabriel Moncada y que tuvo una primera edición en 2022, es un complemento a aquellos clásicos para colorear que sobre fauna venezolana venían siendo publicados por Ediciones Ekaré, entre ellos, *Conoce nuestras aves* (Thomas 1978), *Conoce nuestros peces* (Dearden 1978). *Conoce nuestros insectos* (Zawisza 1982) y *Conoce nuestros mamíferos* (Comerlati 1983). Numerosos venezolanos crecimos admirando la fauna silvestre a través de estos libros, qué con varias reimpresiones, se vendieron en muchas librerías de Venezuela, entre ellas las desaparecidas redes de librerías Kuai-Mare y Las Novedades.

Tuve el privilegio de conocer y observar a Juancho, el verdadero reptil que inspiró al protagonista de esta hermosa aventura y a una parte de su progenie, en el Dallas World Aquarium en dos oportunidades durante el año 2008, junto a los herpetólogos venezolanos Walter Schargel, Tito Barros y el médico veterinario Luis Sandoval. Todos quedamos gratamente impresionados por lo bien que se había adaptado a sus nuevas condiciones de cautiverio y atención en aquella institución, distante y distinta de su Carúpano originario.

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