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RESEARCH ARTICLE

Coleonyx fasciatus (Boulenger 1885): Regional, Ontogenetic, and Temporal Color Pattern Variation and a Current Summary of Geographic Distribution

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Abstract: *Coleonyx fasciatus* is a little-known eublepharid gecko endemic to northwestern Mexico. Diagnostic color pattern variation exists in this species and can be attributed to three distinct regions between northern to central Sonora, southern Sonora to central Sinaloa, and southern Sinaloa and the type locality in western Durango. We identified five variable character traits in *C. fasciatus* that are distinctly regional, in addition to varying between age class and diel activity. Herein we provide an overview of these phenotypic differences and define the abovementioned three regions with which distinct color pattern variation is correlated. Additionally, we provide a synopsis of the currently understood distribution of *C. fasciatus*, with comments on regional elevation range limits and areas of possible occurrence outside of its presently known range.

Introduction

Coleonyx fasciatus (Black Banded Gecko) is a Mexican endemic eublepharid known to occur only in the states of Sonora, Sinaloa, and Durango, the last of which is represented by a single specimen from the type locality (Grismer 1990). Described in the late nineteenth century (Boulenger 1885) from a single female specimen collected at Ventanas (= Villa Corona) within the Sierra Madre Occidental, *C. fasciatus* was the fourth species of this genus to be taxonomically defined (albeit originally placed in *Eublepharis*). Aside from this locality, a scant number of additional specimens of this banded gecko have since been reported or formally vouchered from few isolated locations and the extent of its geographic distributional limits in northwestern Mexico are approximate. Historically to the present, *C. fasciatus* has been only rarely observed or vouchered, with typically only a single specimen reported for any given locality (Taylor 1935; Grismer 1988, 1990; Brown et al. 2016; Lara-Resendiz et al. 2017). Such infrequency in field observations of this species is reflected in the fact that it is represented in only five museum collections worldwide, comprised of a mere twelve individual specimens within these collections. Further, little information exists in the literature to any significant level regarding the ecology, natural history, or other elements of the biology of this species. Following its description and an elaboration of the holotype offered by Günther (1893), the first subsequent publication with any original information on *Coleonyx fasciatus* was provided after an encounter with a second specimen found unexpectedly in a novel state: Sinaloa (Taylor 1935). Further details (i.e., meristic data) were provided for this individual soon thereafter (Taylor 1936), followed by a very detailed description of this specimen provided by Klauber (1945). Both publications by Taylor contain very limited content (representing a single individual), and this trend has remained for this banded gecko in the primary literature to the present between brief remarks and annotated or regional checklists. Within these publications, authors have historically recognized *C. fasciatus* as either a distinct species or as a form (or synonym) of *C. variegatus* (Stejneger 1893; Klauber 1945; Smith and Taylor 1950; Conant 1965; Hardy and McDiarmid 1969; Dixon 1970; Kluge 1975; Webb 1984; Smith 1989; Dial and Grismer 1992, 1994; Rorabaugh 2008; Enderson et al. 2009, 2010, 2014; Lavín-Murcio and Lazcano 2010; Wilson and Johnson 2010; Valdez-Lares et al. 2013; Wilson et al. 2013; Lemos-Espinal et al. 2018, 2019; Lemos-Espinal and Smith 2020). Exceptions elucidating phylogenetic relationships and some key aspects of biology have been provided by a single researcher (Grismer 1988; 1990). Such a scarcity of edifying material speaks to the consistently elusive nature of this enigmatic lizard.

Coleonyx fasciatus is a terrestrial and semi-saxicolous gecko that occurs from within semiarid to warm and semiwarm subhumid climates (Lemos-Espinal et al. 2018, 2019; Lemos-Espinal and Smith 2020). Throughout the expanse of its >900 km distribution, this species is known to occur from between 22.9 m (75 ft) in the southern extent of its range up to ca. 1,413 m (4,636 ft) in the Sierra Madre Occidental, inhabiting mesquite-dominated foothills thornscrub, tropical deciduous forest, tropical semiarid forest, mesquite grassland, and oak woodland communities (Hardy and McDiarmid 1969; Brown et al. 2016; Rorabaugh and Lemos-Espinal 2016; this study). The most recent and comprehensive locality-based distribution maps published for this species were provided by Grismer (1988; 1990). However, these representative range maps depict large distributional gaps due to limited sampling over the course of more than a century.

In this overview of the geographic distribution of *C. fasciatus* as currently understood, we provide information based on both voucher data and novel records of this rarely observed and poorly known species. Our review and observations of many specimens informed our understanding of regionally-, ontogenetically-, and temporally-based phenotypic variation from both material made available to us and our personal experiences in the field.

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Methods

We made field expeditions to northern and southern Sonora in 2015, 2016, 2018, and 2019 to observe *Coleonyx fasciatus* in its natural environment. We also reviewed additional material represented by voucher specimens in collections and photo vouchers

accessioned into online citizen science databases (e.g., iNaturalist.org; madreandiscovery.org). A comprehensive list of museum vouchers resulted from records retrieved from VertNet.org and GBIF.org. Lastly, we reviewed voucher photos and observation data solicited from local residents of rural Mexico. This method was implemented for this study in anticipation of supplementing a limited available data set for vast, unvouchered areas within the known range of this gecko.

Upon examination of the available material, five character traits are distinctly variable and appear to be regionally-based, in addition to varying between age class and diel activity. These five characters are 1) head coloration, 2) nuchal loop continuity and contrast, 3) number of pale transverse abdominal bands present between the nuchal loop and proximal pale caudal band, 4) body ground coloration of the dorsum, and 5) number of pale caudal bands present on original tails. Photographs of live individuals, museum material, and our own field observations were reviewed to qualify and quantify these characters. Color terminology with respect to color pattern variation follows Köhler (2012).

Results

We observed multiple (n = 6) *Coleonyx fasciatus* in Sonora, Mexico during the monsoon seasons of 2018 and 2019. All known, available museum vouchers also were reviewed (n = 10; Table 1) in addition to many individual sightings observed and reported by others that were documented with photographs (n = 45). The individual sight records and online citizen science database entries we reviewed included many previously unreported localities (two of which, however, were recently published [Brown et al. 2016; Lara-Resendiz et al. 2017]) and this culminated in an updated distribution map for this species (Fig. 1). There is an overall trend observed in *C. fasciatus* that populations at higher latitudes occur at higher elevations, and those occurring at lower latitudes are more widely dispersed to include much lower elevations (Fig. 2). This trend essentially parallels habitat availability coupled with the climatic thresholds upon which this species depends. Moreover, pattern and coloration characters expressed in *C. fasciatus* vary along a latitudinal cline encompassing approximately eight degrees. These characters were found to be consistent with respect to regionally-correlated differences, and therefore we argue are diagnosable phenotypes representative of three distinct regions of northwestern Mexico (Table 2). These regions are referred to below as northern to central Sonora (NCS), Álamos, Sonora to central Sinaloa (ACS), and southern Sinaloa, which includes the type locality in adjacent southwest Durango (SSD; Fig. 3). Phenotypic variation is qualified as being regional, ontogenetic, and/or temporal (i.e., active vs. inactive coloration).

Head Coloration.—The dorsal cephalic ground coloration of this species varies regionally and ontogenetically. In the regions where this orange-yellow to orange-rufous or flesh ochre coloration is expressed, it is most pronounced in hatchling and juvenile individuals. In the NCS region, this coloration is restricted toward the back of the head, being most apparent along the dark pigment bordering the nuchal loop. It

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Table 1. A list of the physical *Coleonyx fasciatus* museum vouchers with those being indicated that were reviewed or not reviewed for this analysis.

Voucher	Collection Locality	Reviewed
BMNH 1946.8.30.91	Ventanas (aka Villa Corona), Durango	Yes
BYU Main 40062	26 mi. SW of Gomez Palacio, Hwy 49, Durango	Yes[1]
CAS 115551	21 mi. N Rio Culiacan on Hwy 15, Sinaloa	Yes
MPM H 5392	SW corner of Cuatrocienegas Valley, N. tip of Sierra de San Marcos, Coahuila	Yes[1]
ROM 47229	Rancho San Pedro, S. of the Río Cuchujaqui, Sonora	Yes
UAZ 01186	Arizpe, Sonora	Yes
UAZ 39966	23.1 mi. NE Álamos; Cemetery by rd. to Milpillas, Sonora	Yes
UAZ 42577	23.1 mi. NE Álamos; Cemetery by rd. to Milpillas, Sonora	No[2]
UAZ 45170	Choquincahui, Sonora	Yes
UAZ 45171	Choquincahui, Sonora	Yes
UAZ 45845	11.8 mi. (by rd) on MX Hwy 16 SE Rio Yaqui Bridge above Hwy 16 Corral Represso, Sonora	Yes
UAZ 46767	Vicinity of Choquincahui, Sonora	Yes
UI 19535 (EHT 556)	ca. 10 mi. S. of Presidio, Sinaloa	Yes[3]
UI 57847	Vicinity of Mazatlan: 7.4 mi S. Jct. 40 & 15 on MX Hwy 15, Sinaloa	No[4]

Footnotes:

1. Specimen is a hatchling or juvenile example of *Coleonyx brevis* erroneously vouchered as *C. fasciatus*.
2. Specimen not found with other UAZ specimens; considered lost (M. Bucci, pers. comm.).
3. Original locality given as ca. 15 mi. S. of Presidio (Taylor 1935). Detailed description by Klauber (1945) permitted sufficient review; specimen now considered lost (D. Wylie, pers. comm.).
4. Specimen considered lost (D. Wylie, pers. comm.).

Fig. 1. Geographic distribution of *Coleonyx fasciatus* in northwestern Mexico with localities representing records reviewed for this study (some locality dots represent multiple specimens). The green dots designate populations expressing the NCS phenotype; blue dots designate populations expressing the ACS phenotype; and red dots + triangle designate populations expressing the SSD phenotype; triangle = type locality. Question marks indicate areas within this region where *C. fasciatus* is suspected to occur, or has potential to occur, based on combined biotic and abiotic (i.e., climatic) limiting factors of those areas.

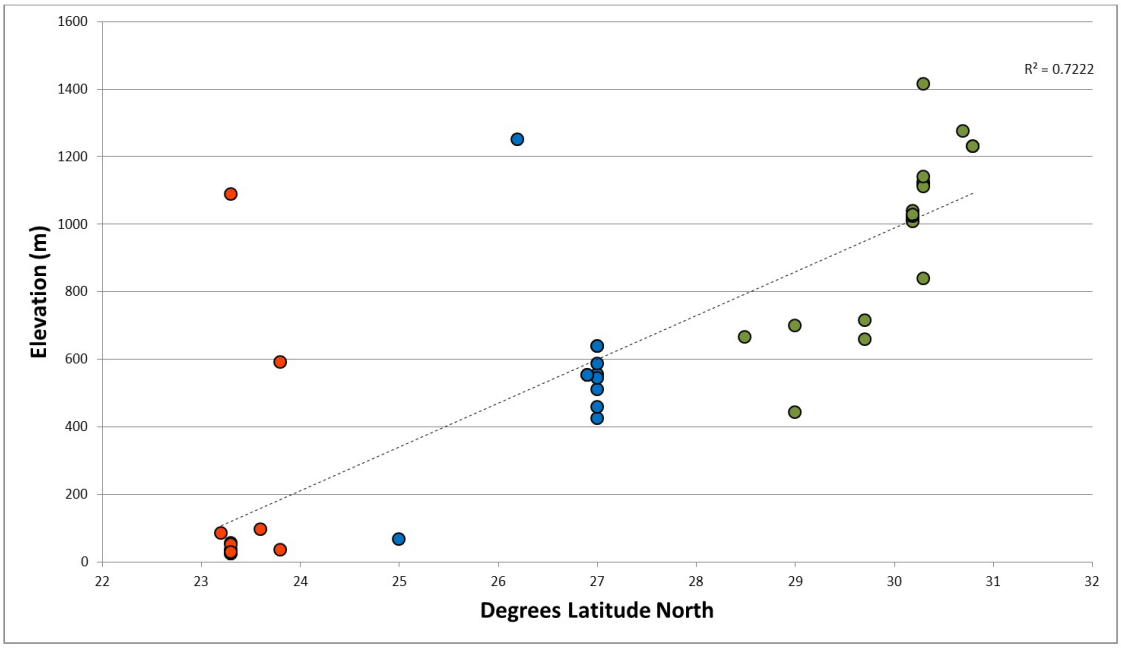

Fig. 2. Scatterplot showing a positive correlation for populations of *C. fasciatus* increasing in elevation from southern to northern latitudes. The SSD phenotype (red; *n* = 15) is known from between 23 and 24 degrees latitude and occurs in both coastal and upper elevations; the ACS phenotype (blue; *n* = 13) is known from between 25 and 27 degrees latitude; and the NCS phenotype (green; *n* = 20) is known from between 28 and 31 degrees latitude.

then fades anteriorly, transitioning to pale mauve to lavender coloration between the eyes forward, with the tops of the eyes varying shades of blue coloration. In the SSD region, this coloration may be brighter and more pronounced than that of northern populations, as well as being consistently more extensive (Fig. 4). Often, the mahogany red or raw sienna to orange-rufous or flesh ochre (to even a vibrant chrome orange in some young individuals) cephalic coloration of these populations extends from the dark nuchal loop border forward to the tip of the snout, also extending over the tops of the eyes. Conversely, populations occurring in the ACS region apparently do not express this coloration, with dorsal cephalic pigmentation being olive-brown or grayish olive, similar to the darker ground color of the body between the pale bands (Fig. 5).

Fig. 3. Type specimen of *Coleonyx fasciatus*. Note the regenerated portion of the tail lacking caudal bands. Courtesy of the Natural History Museum (formerly British Museum of Natural History). Photo by Jacobo Reyes-Velasco.

Fig. 4. Head comparisons of two adult *C. fasciatus*, one from northern Sonora representing the NCS phenotype (above; photo by Jackson Shedd) and one from southern Sinaloa representing the SSD phenotype (below; photo by Christopher Gillette). Note the difference in color above the eyes, broken vs. solid nuchal loop, and difference in head and body coloration.

Populations occurring in the ACS region apparently do not express this coloration, with dorsal cephalic pigmentation being olive-brown or grayish olive, similar to the darker ground color of the body between the pale bands (Fig. 5).

Table 2. Five character traits in *Coleonyx fasciatus* that are diagnosable with respect to three regions in northwestern Mexico: Northern to Central Sonora (NCS), Álamos, Sonora to Central Sinaloa (ACS), and Southern Sinaloa + Durango (SSD).

Character	NCS	ACS	SSD
Head coloration	orange-rufous to flesh ochre restricted to back of the head	similar to body coloration; lacks reddish-orange coloration altogether	mahogany red or raw sienna to orange-rufous to chrome orange covers top of head
Nuchal loop	narrow; weakly defined edges; often broken	broad; clean and defined edges; unbroken	broad; clean and defined edges; unbroken
No. of pale abdominal bands	4 (n = 31)	3 (n = 14)	4 (n = 16)
No. of pale caudal bands	7 to 8 (n = 15)	Unknown	5 to 7 (n = 11)
Body ground coloration	hatchlings and juveniles darker purple tones to black; adults tones of mauve/bluish purple/dark carmine; transitions to distinctly pale at night	hatchlings and juveniles black; adults tones of dark grayish olive/dusky brown/sepia/black	hatchlings and juveniles black; adults darker purple tones to black

Nuchal Loop Variation.—The nuchal loop of this species varies regionally, with two distinct diagnostic characters: 1) the degree of continual, unbroken banding of the pale nuchal loop and 2) the amount of black pigment bordering the top of the pale nuchal loop. Populations from the NCS region express a weaker and narrower nuchal loop character than southerly populations (i.e., ACS and SSD); there is less contrast between the pale loop, dark border, and pigmentation of the top of the head. The pale loop in individuals of this region is often broken laterally, above or just posterior to the ear opening (Figs. 4, 8). The black pigment bordering the top of the pale nuchal loop also is thinner in comparison to the other populations to the south, with the dark coloration being widest at the posterior end of the head and becoming narrower towards the eye on either side. This black coloration fades somewhat into the lighter dorsal head coloration, rather than there being more of a distinctly clean edge observed at the southern end of the range. Individuals occurring in the ACS region tend to express a broader nuchal loop that is solid and continuous (Fig. 5). The pale loop appears highly contrasting with the dark pigment of the neck below and top of the head above, with any dark border edge of the pale nuchal loop obscured by the medium to dark neutral gray dorsal head coloration. Populations in the SSD region also express a consistently solid, broad pale nuchal loop similar to populations of the ACS region (Figs. 4, 9). The dark, black border along the top of the pale nuchal loop is often as wide, or nearly so, as the nuchal loop itself along the entire edge from one eye to the other. This creates a strong contrast between the nuchal loop and the dorsal head coloration in individuals of these populations.

Pale Transverse Abdominal Banding.—The number of pale bands crossing the dorsum of the body positioned between the nuchal loop and the proximal pale caudal band (i.e., at the base of the tail) consistently varies regionally from between three and four bands. Populations with four pale transverse abdominal bands express one posterior-most (i.e., fourth) light band between hind limb insertions, crossing the sacrum (Fig. 6). From the northern limit

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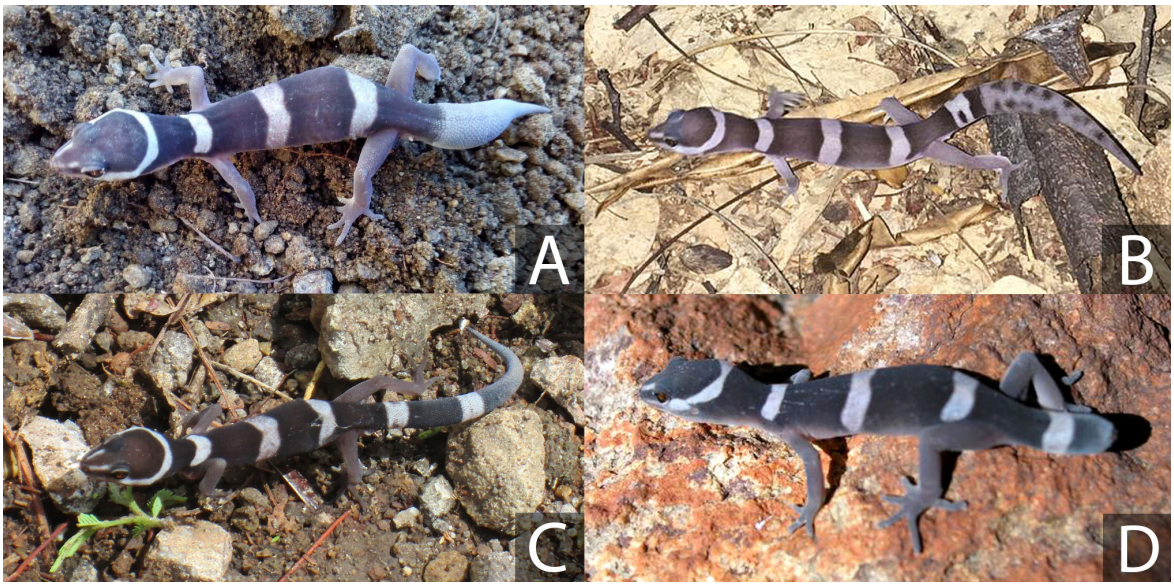

Fig. 5. Four examples of *C. fasciatus* from the vicinity of Álamos, Sonora representing the ACS phenotype that expresses three pale transverse abdominal bands and lacks an additional pale band between the hind limbs that is expressed in populations of the NCS and SSD regions. All four specimens have lost and regrown portions of the tail, or have recently autotomized the tail; the total number of pale caudal bands on original tails of the ACS phenotype is currently unknown. Photos courtesy of Rosario Jorge Sauceda (A), Yathzitl Mendoza (B), Naturaleza y Cultura Internacional – México (C), and Stephen Hale and Stephanie A. Meyer (D).

Fig. 6. Two nocturnally active adult *C. fasciatus* exhibiting strong locality-based pattern variation from the NCS region (above; photo by Sam Murray) and the SSD region (below; photo by Christopher Gillette). Note the posterior-most pale transverse abdominal band crossing the sacrum, characteristic of individuals of all ages and sexes of these two regions. The pale caudal bands of individuals of the NCS phenotype are characteristically much wider than those of both the ACS and SSD phenotypes.

of its distribution in the NCS region, south to where habitat begins to transition to tropical deciduous forest north of the Álamos region, *C. fasciatus* expresses four pale transverse abdominal bands. These pale bands are distinctly bordered by black pigment in adult individuals, this black bordering especially pronounced at night during nocturnal activity. In the Álamos region and south to at least Cerro La Cumbre and central Sinaloa (i.e., ACS), the number of pale transverse abdominal bands expressed is consistently three, with these bands being narrower than those in populations to the north (Fig. 5). The ACS phenotype exhibits a posterior-most (third) pale band crossing the abdomen just anterior to the sacrum, and there is an absence of a fourth pale band crossing the sacrum. Populations within the ACS region include one represented by a specimen collected in 1963 from the vicinity of Culiacán (CAS 115551; Fig. 7). Southernmost populations (i.e., SSD) express pale transverse abdominal bands that are notably narrower and with higher contrast against the dark ground color than the much wider pale bands and lighter ground color seen in NCS populations. However, like the NCS populations, the SSD populations express a fourth pale band crossing the sacrum (Figs. 6, 9).

Additionally, a limited number of adult specimens (n = 3) from northern and southern Sonora exhibited dark pigmentation interrupting the middle one (Álamos region) or middle two (Nacozari de García region) pale transverse abdominal bands, resulting in a single dorsolaterally positioned blotch on either side within each of those bands (Fig. 8).

Dorsal Ground Coloration of Body.—The dorsal ground coloration of the body (i.e., neck and abdomen) varies ontogenetically, regionally, and temporally. Hatchlings and young juveniles express medium

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Fig. 7. Adult male *C. fasciatus* voucher specimen from 21 miles north (via Hwy 15) of Rio Culiacán from ca. 67 m elev. (CAS 115551) expressing the ACS phenotype. This phenotype occurs from the region surrounding Álamos, Sonora south to at least central Sinaloa, based on this specimen. Photo courtesy of California Academy of Sciences.

Fig. 8. Adult female *C. fasciatus* example from the NCS region with partially regenerated tail expressing fixed dark spots within the two mid-abdominal bands. This individual was heavily parasitized by prostigmatan mites, which are the small, scattered orange-yellow flecks on the dorsum, limbs, and toes. Photo by Sam Murray.

to bluish purple to dark, solid dusky brown and black ground coloration between the pale transverse bands (Fig. 9). In the NCS populations this dark coloration transitions into a light mauve to mauve or light bluish purple to dark carmine as individuals age, with the pale bands bordered by black. One male we observed was splotched with light to medium chrome orange throughout its dorsum (Fig. 6). In ACS populations, the coloration does not appear to transition conspicuously, remaining mostly dark grayish olive to dusky brown, sepia, or black throughout development. In SSD populations, ground coloration appears to be consistently dark, with individuals varying between darker purple tones (but with broad black bordering along pale transverse bands) and black, so that an overall dark appearance is maintained.

Temporal ground coloration change is notable in northern populations; while the ground coloration of the body is consistently dark in adults of southern populations, adults of the NCS populations appear to express a distinct temporal pigment change between a lighter, nocturnal (active) color phase and a darker (inactive) phase. The light phase can exhibit tones of pale mauve to light lilac, with the pale bands remaining narrowly bordered by darker pigment (Fig. 10).

Caudal Banding.—The number and width of pale bands along the length of original tails varies regionally. The pale bands expressed on tails of NCS populations typically total seven to eight and are conspicuously wider than other populations (Figs. 6, 9). Those populations occurring at the southern end of the distribution typically express six to seven, and as few as five, narrower pale bands along the length of the tail. These tail bands are separated by wide, dark-pigmented bands that are typically two to three times the width of the pale bands. No individuals among the material examined from the ACS region possessed original tails, and thus caudal banding was not quantified for these populations. However, individuals of the ACS region retaining some portion of the original tail appeared to express narrow pale bands separated by wide, dark-pigmented bands similar to individuals of the SSD region.

Fig. 9. Two young specimens of *C. fasciatus* representing the NCS region (above; photo by Jason M. Jones) and the SSD region (below; photo by Rafael A. Lara-Resendiz). Note the variation in head coloration, nuchal loop, and width of both the pale transverse abdominal bands and caudal bands.

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Fig. 10. Light phase color pattern of a nocturnally active adult female *C. fasciatus* representing the NCS phenotype. This specimen expresses an aberrant half band among the other four normal pale transverse abdominal bands typical of this region. Photo by Jackson Shedd.

Discussion

Notable geographic variation in color pattern exists in *Coleonyx fasciatus* and this variation can be confidently diagnosed and attributed to three distinct regions of Mexico (NCS, ACS, and SSD). Although certain members of this genus can exhibit dramatic color pattern variation, both within and between populations, as well as ontogenetically and seasonally (e.g., *C. elegans*, *C. mitratus*, *C. switaki*, *C. variegatus*), other congeners exhibit only ontogenetic pattern variation, while variability in pattern among adults within or between populations is relatively limited or absent (e.g., *C. brevis*, *C. reticulatus*). While the number of dark transverse bands between front and hind limb insertions has been noted briefly as three, with exception of one specimen expressing two (Klauber 1945; Grismer 1988), pattern variation in *C. fasciatus* has never been investigated. This is primarily due to historically deficient specimen numbers. In this study, our focus on the pale rather than dark transverse abdominal bands allowed us to clearly dichotomize the banding pattern of the body from that of the tail.

It is of interest that while *C. fasciatus* shows clear geographic-based pattern variation between at least three identifiable regions throughout its known range, its closest living relative, *C. brevis* (Grismer 1988) appears to be much less variable across a broader range, albeit expressing obvious ontogenetic pattern transformation (i.e., lightening of dark transverse bands and increased spotting or speckling with age). Unlike *C. brevis*, a denizen of primarily xeric environments of the Chihuahuan Desert, *C. fasciatus* is restricted to semitropical or subtropical regions with higher annual precipitation, higher relative humidity, and plant species assemblages typically at higher densities. Moreover, it has been postulated that retaining a juvenile-like pattern into adulthood in *C. fasciatus* is reflected in another congener, *C. variegatus peninsularis,* where this taxon occurs within similar tropical deciduous forest habitat of the Baja California Sur Cape region at the same latitude as Mazatlán (Grismer 1990). Interestingly, both *C. brevis* and *C. variegatus* typically exhibit five pale transverse abdominal bands (rather than three or four expressed in *C. fasciatus*) between the nuchal loop and pale caudal bands.

Although a small number of specimens of *Coleonyx fasciatus* have been officially vouchered and accessioned into collections since the original holotype, within the last few years a number of specimens have been photographed *in situ* and entered into online citizen science databases or turned up on social media platforms. Although several of these represent duplicative data (i.e., voucher repetition of a single individual or more than one observation centered around a single localized area), citizen science databases contributed to the knowledge and understanding of the distribution of *C. fasciatus* for this analysis in as much as localities reviewed in the primary literature and museum collections. Additional specimens also were photographed by local residents and examined for this work, which were equally informative.

It is unknown if the distribution of *C. fasciatus* extends into the state of Nayarit, where there is a perceived absence of any member of this genus. *Coleonyx* vouchers are lacking from just south of Mazatlán in southern Sinaloa to the vicinity of Puerto Vallarta in Jalisco, where the westernmost distributional limit of *C. elegans* extends from southeastern Mexico. It also is unknown if insular populations of *C. fasciatus* exist; Islas de Pájaros and Venados are situated directly adjacent to the coast of Mazatlán and appear to comprise appropriate habitat. While certain gaps in sampling within the known distribution of this spe-

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cies can be attributed to large, overlapping expanses that are cartel-controlled portions of northwestern Mexico, other areas that may be suitable locations for *C. fasciatus* to occur based on habitat, elevation, annual precipitation and other limiting factors also have not produced specimens of this *Coleonyx* or its congeners. One such example is extreme southeastern Cochise County in Arizona where neither *C. fasciatus* nor *C. variegatus* have been reported or formally documented to our knowledge. *Coleonyx variegatus*, which is much more commonly encountered throughout its range than anywhere *C. fasciatus* is known to occur, appears to be absent from this area based on lacking voucher material (Bezy 2010). The U.S.-Mexico border within this specific region of Arizona lies approximately 56 km (35 miles) north (by air) of where two Sonoran *C. fasciatus* specimens (LLG 252 and 253) were reported 32 km southeast of Cananea (Grismer 1988) and approximately 70 km (44 miles) north (by air) of a more recent observation of an individual from the vicinity of Esqueda (madreandiscovery.org; record MDE-19979).

The most obvious under-sampled region of northwestern Mexico where *Coleonyx fasciatus* may occur is within barrancas of southwestern Chihuahua that serve as ephemeral tributaries draining west out of the Sierra Madre Occidental toward the Gulf of California and Pacific Ocean. There are currently no records of this *Coleonyx* species reported from this state. Another expanse of the Sierra Madre Occidental where many areas are cartel-controlled, this region of Chihuahua is contiguous with upper elevations bordered by Sonora, Sinaloa, and Durango. It is highly likely that *C. fasciatus* occurs within the Sierra of southwestern Chihuahua, but as of yet has gone undetected.

Finally, while discussing the distribution of *Coleonyx fasciatus*, it should be noted that two additional, disjunct localities in northeastern Durango and central Coahuila from where two *C. fasciatus* specimens have been reported (BYU 40062 and MPM 5392, respectively) represent misidentifications. These vouchers of very young individuals actually represent its sister taxon, *C. brevis*. Another very old record (1865; MCZ R-15469) from Costa Rica is clearly invalid and yet other specimens regarded as (putative) hybrids between *C. fasciatus* x *C. variegatus* likely require more in-depth investigation. In the interest of precluding confusion, an additional *Coleonyx* erroneously identified as *C. fasciatus* was presented in Lemos-Espinal (2015; Fig. 231 therein).

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Literature Cited

Bezy, R.L. 2010. Herpetofauna of the 100 mile circle: Western banded gecko, *Coleonyx variegatus* (Baird, 1859, "1858"). Sonoran Herpetologist 23:97-102.

Boulenger, G.A. 1885. Catalogue of the lizards in the British Museum (Natural History) I. Geckonidae, Eublepharidae, Uroplatidae, Pygopodidae, Agamidae. London, UK. 450 pp.

Brown, P.H., T.R. Van Devender, and D.S. Turner. 2016. *Coleonyx fasciatus* (Boulenger, 1885). Mexico, Sonora. Mesoamerican Herpetology 3:1045-1046.

Conant, R. 1965. Miscellaneous notes and comments on toads, lizards, and snakes from Mexico. American Museum Novitates 2205:1-38.

Dial, B.E., and L.L. Grismer. 1992. A phylogenetic analysis of physiological-ecological character evolution in the lizard genus *Coleonyx* and its implications for historical biogeographic reconstruction. Systematic Biology 41:178-195.

Dial, B.E., and L.L. Grismer. 1994. Phylogeny and physiology: Evolution of lizards in the genus *Coleonyx*. Pp. 239-254 *in:* P.R. Brown and J.W. Wright (eds.). Herpetology of North American Deserts. Special Publication No. 5. Southwestern Herpetologists Society. 311 pp.

Dixon, J.R. 1970. *Coleonyx variegatus*. Catalogue of American Amphibians and Reptiles 96.1-4.

Enderson, E.F., A. Quijada-Mascareñas, D.S. Turner, P.C. Rosen, and R.L. Bezy. 2009. The herpetofauna of Sonora, Mexico, with comparisons to adjoining states. Check List 5:632-672.

Enderson, E.F., A. Quijada-Mascareñas, D.S. Turner, R.L. Bezy, y P.C. Rosen. 2010. Una synopsis de la herpetofauna con comentarios sobre las prioridades en investigación y conservación. Pp. 357-383 *en:* F.E. Molina-Freaner y T.R. Van Devender

The most obvious under-sampled region of northwestern Mexico where *Coleonyx fasciatus* may occur is within barrancas of southwestern Chihuahua that serve as ephemeral tributaries draining west out of the Sierra Madre Occidental toward the Gulf of California and Pacific Ocean.

(eds.). Diversidad biológica de Sonora. UNAM, México.
Enderson, E.F., T.R. Van Devender, and R.L. Bezy. 2014. Amphibians and reptiles of Yécora, Sonora and the Madrean Tropical Zone of the Sierra Madre Occidental in northwestern Mexico. Check List 10:913-926.
Grismer, L.L. 1988. Phylogeny, taxonomy, classification, and biogeography of eublepharid geckos. Pp. 367-469 *in:* R. Estes and G. Pregill (eds.). Phylogenetic Relationships of the Lizard Families. Stanford University Press, Stanford, CA. xii + 631 pp.
Grismer, L.L. 1990. *Coleonyx fasciatus*. Catalogue of American Amphibians and Reptiles 463.1-2.
Günther, A.C.L.G. 1893. Reptilia and Batrachia, Pt. 108, Pp. 81-88 *in:* F.D. Godman and O. Salvin (eds.). Biologia Centrali-Americana. Dulau and Co., London, UK.
Hardy, L.M., and R.W. McDiarmid. 1969. The amphibians and reptiles of Sinaloa, Mexico. University of Kansas Publications, Museum of Natural History 18:39-252.
Klauber, L.M. 1945. The geckos of the genus *Coleonyx* with descriptions of new subspecies. Transactions of San Diego Society of Natural History 10:133-216.
Kluge, A.G. 1975. Phylogenetic relationships and evolutionary trend in the eublepharine lizard genus *Coleonyx*. Copeia 1975:24-35.
Köhler, G. 2012. Color Catalogue for Field Biologists. Herpeton, Offenbach, Germany. 49 pp.
Lara-Resendiz, R.A., B.C. Larraín-Barrios, and R.E. Felix-Burruel. 2017. *Coleonyx fasciatus* (Boulenger, 1885). Mexico, Sinaloa. Mesoamerican Herpetology 4:949-951.
Lavín-Murcio, P.A., and D. Lazcano. 2010. Geographic distribution and conservation of the herpetofauna of northern Mexico. Pp. 275-301 *in:* L.D. Wilson, J.H. Townsend, and J.D. Johnson (eds.). Conservation of Mesoamerican Amphibians and Reptiles. Eagle Mountain Publishing, Eagle Mountain, UT.
Lemos-Espinal, J.A. (ed.). 2015. Amphibians and Reptiles of the U.S.-Mexico Border States/Anfibios y Reptiles de los Estados de la Frontera México-Estados Unidos. Texas A&M University Press, College Station, TX. 614 pp.
Lemos-Espinal, J.A., and G.R. Smith. 2020. A checklist of the amphibians and reptiles of Sinaloa, Mexico, with a conservation status summary and comparisons with neighboring states. Zookeys 931:85-114.
Lemos-Espinal, J.A., G.R. Smith, H. Gadsden-Esparza, R. Valdez-Lares, and G.A. Woolrich-Piña. 2018. Amphibians and reptiles of the state of Durango, Mexico, with comparisons with adjoining states. ZooKeys 748:65-87.
Lemos-Espinal J.A., G.R. Smith, J.C. Rorabaugh. 2019. A conservation checklist of the amphibians and reptiles of Sonora, Mexico, with updated species lists. ZooKeys 829:131-160.
Rorabaugh, J.C. 2008. An introduction to the herpetofauna of mainland Sonora, Mexico, with comments on conservation and management. Journal of the Arizona-Nevada Academy of Science 40:20-65.
Rorabaugh, J.C., and J.A. Lemos-Espinal 2016. A Field Guide to the Amphibians and Reptiles of Sonora, Mexico. ECO Herpetological Publishing & Distribution. Rodeo, NM. 688 pp.
Smith, H.M. 1989. The status of the lizard *Coleonyx fasciatus* and the biological species concept. Bulletin of the Maryland Herpetological Society 25:22-24.
Smith, H.M., and E.H. Taylor. 1950. An annotated checklist and key to the reptiles of Mexico exclusive of snakes. Bulletin of the United States National Museum 199:1-253.
Stejneger, L. 1893. Annotated list of the reptiles and batrachians collected by the Death Valley expedition in 1891, with descriptions of two new species. North American Fauna 7:159:228.
Taylor, E.H. 1935. *Coleonyx fasciatus*, a neglected species of gecko. University of Kansas Science Bulletin 22:203-205.
Taylor, E.H. 1936. Notes on the Herpetological fauna of the Mexican state of Sinaloa. University of Kansas Science Bulletin 24:505-537.
Valdez-Lares, R., R. Muñiz-Martínez, E. Gadsden, G. Aguirre-León, G. Castañeda-Gaytán, and R. Gonzalez-Trápaga. 2013. Checklist of amphibians and reptiles of the state of Durango, México. Check List 9:714-724.
Webb, R.G. 1984. Herpetogeography in the Mazatlan-Durango region of the Sierra Madre Occidental, Mexico. University of Kansas Museum of Natural History Special Publications 10:217-241, figs. 1-7.
Wilson, L.D., and J.D. Johnson. 2010. Distributional patterns of the herpetofauna of Mesoamerica, a biodiversity hotspot. Pp. 31-235 *in:* L.D. Wilson, J.H. Townsend, and J.D. Johnson (eds.). Conservation of Mesoamerican Amphibians and Reptiles. Eagle Mountain Publishing, Eagle Mountain, UT.
Wilson, L.D., V. Mata-Silva, and J.D. Johnson. 2013. A conservation reassessment of the reptiles of Mexico based on the EVS measure. Amphibian and Reptile Conservation 7:1-47.

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