Herpetology Notes, Volume 17: 495–497 (published online on 20 July 2024)

Atypical scutation in the Pond Slider, *Trachemys scripta* (Schoepff, 1792), in the Central Valley of California

Alexandra von Ehrenkrook[1], Madeleine Sierra[1], Michelle Stevens[1], and Jeff A. Alvarez[2,*]

Trachemys scripta (Pond Slider) is considered native to the south-central and eastern portion of the United States, and extreme northeastern Mexico (Powell et al., 2016). However, this species has been introduced worldwide and has now been listed among the world's worst invasive species (Lowe et al., 2000). It is well established in California, inhabiting both natural and artificial habitats (Stebbins, 2003; Ernst et al., 1994). This species is often collected when it is syntopic with the declining native turtles of California: the Northwestern and Southwestern Pond Turtle (*Actinemys marmorata* and *A. pallida*) that are under study (Patterson 1996; Lambert et al. 2019). Pond sliders are often examined as a surrogate for other more rare species in so far as they may show signs of shell rot, ectoparasites, predatory attacks, etc. suggesting concerns or management needs for the native species. Herein we report on atypical carapacial scutation in the pond slider at a highly managed pond in the American River watershed of the Central Valley of California.

We conducted trapping and visual encounter surveys for the declining northwestern pond turtle in Bushy Lake, in Sacramento County, California through the spring and fall of 2020–2022. Trapping surveys included the use of five baited, hoop-style turtle traps to collect pond turtles. Trapped turtles were processed (measured, weighed, photographed, identified to species, and when possible, aged via counted annuli [Carr, 1995]). After processing, each turtle, both native and non-native species, was returned to the site of capture and released into the aquatic habitat. Release of non-natives at this site was an aspect of current and on-going research into native and non-native turtles at this location.

Over a 3-year period, we captured and marked 7 adult northwestern pond turtles, 1 peninsula cooter (*Pseudemys peninsularis*), 1 painted turtle (*Chrysemys picta belli*), and 350 pond sliders of two subspecies (*T. s. elegnns* and *T. s. scripta*). On 7 May 2022, while processing turtles, we noted a pond slider that appeared to have an atypical carapace in that the scutation pattern was subnumerary, as well as showing signs of missing portions of the carapace, and other anomalies, which we attempted to closely photograph (Fig. 1).

Figure 1. Carapacial anomalies in *Trachemys scripta* captured from a constructed pond in the American River Watershed in the Central Valley of California, June 2022. Photo by Alexandra von Ehrenkrook.

[1] Environmental Studies Department, Sacramento State University, 555B Amador Hall, 6000 J Street, Sacramento, California 95819, United States.
[2] The Wildlife Project, P.O. Box 188888, Sacramento, California 95818, United States.
[*] Corresponding author. E-mail: jeff@thewildlifeproject.com

We noted 21 marginal scutes, while typical is 24 (Zimm et al., 2017); a missing nuchal scute when there should be a single scute; approximately 9 costal scutes, while typical is 8; and 4 vertebral scutes, with 5 being typical. We also noted 13 additional scutes that could not be attributed to a specific carapacial region. Additionally, the plastron, which would typically have 6 paired scutes had 7 paired scutes, with 14 anomalous scutes that were unpaired (Fig. 3).

The turtle that was captured could not be accurately aged but was in the size range of other turtles aged approximately 10 years or more, based on counting plastron annuli. This would suggest that the carapace and plastron anomalies have had a sublethal effect on this individual. Achrai et al. (2014) suggested that the arrangement of alternating zones of scutes (sutures and ribs) comprising the typical carapace represents a way to achieve high stiffness and toughness, which may be beneficial to withstanding predator attacks. The population of pond sliders we work with is not likely subject to the same kinds of predators that this species may face in its native range (American Alligator [*Alligator mississippiensis*], Black Bear [*Ursus americanus*], etc.). This may mean that individuals with carapace and plastron anomalies in this portion of California may survive and thrive in habitats free of these types of predators (i.e., North American River Otter [*Lontra canadensis*]), despite a potential decrease in carapace strength.

Lynn and Ullrick (1950) reported a single wild pond slider of the *T. s. troostii* subspecies (Cumberland Slider), from Wisconsin, with supernumerary vertebral scutation. The majority of their experimental work to produce carapacial anomalies was with painted turtles (*Chrysemys picta*) and snapping turtles (*Chelydra serpintina*). Others have reported these anomalies in the Diamond-back Terrapin (*Malaclemys terrapin*) (Hildebrand, 1930), box turtles (*Terrapene carolina*), and sea turtles (*Chelonioidea*) (Babcock, 1930). Newman (1906) reported supernumerary scutation in at least 13 species of turtles in and around Indiana, suggesting that the condition had, “a marked degree of regularity”. Although our experience suggests that it is not very common in California, Alvarez et al. (in press)

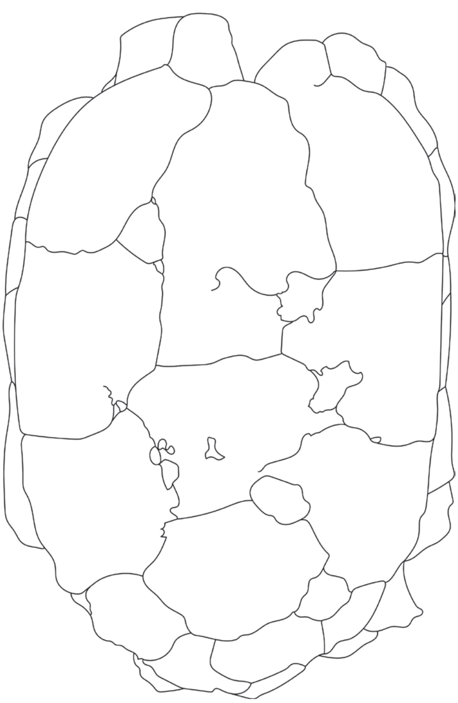

Figure 2. Illustration of carapacial anomalies from a *Trachemys scripta* for clarity. Illustration by Jeff Alvarez.

Figure 3. Scute anomalies in the plastron of *Trachemys scripta* captured from a constructed pond in the American River Watershed in the Central Valley of California, June 2022. Photo by Alexandra von Ehrenkrook.

recently found two northwestern pond turtles with supernumerary scutation in Central California.

Researchers have reported various causes for supernumerary and sub-numerary scutation, including the atavistic reappearance of scutes previously lost during phylogeny (Newman, 1906); changes in temperature (Yntema and Mrosovsky, 1982) or oxygen (Hildebrand, 1938) during incubation; recovery from injuries (Parker, 1901); undetermined genetic influences (Velo-Antón et al., 2011); and excessive pressure on and among eggs within the nest (Coker, 1910). A useful postulation of the general cause was promoted by Lynn and Ullrich (1950), who suggested it might include many factors, some of which they tested. Their experimental research reported that moisture changes in the nest could impact anatomical development. More recently, Zimm et al. (2017) tested this theory more closely and found that higher temperature and drier conditions in the nest will produce anomalies in the scute pattern of turtles. This may in fact be supporting the contention of Lynn and Ullrich (1950). We suggest turtle researchers be aware of these anomalies and quantify them whenever possible, and more importantly, assess climatic conditions surrounding nesting, if possible.

Acknowledgments. We acknowledge that the land on which Bushy Lake is located, was and continues to be occupied by the Indigenous people of this area, the Miwok, Maidu, and Nisenan. Funding for this project was provided by the California Wildlife Conservation Board for project funding under the Bushy Lake Conceptual Restoration Plan Grant WC-1943CA. Additional funding was provided by the Bushy Lake President's Circle Restoration Fund; the Sacramento Zoo; the Sierra Club; and the FY22/23 Anchor University Strategic Investment Grant Award. Cal Expo and Sacramento County Regional Parks granted permission to access the site, for which we are grateful. We also thank project collaborators Area West Environmental, Inc. and The Wildlife Project. Mahmood "Noon" Mokhayesh offered a pre-peer review and constructive comments on the manuscript. We are also grateful to Kathleen Colima Aguirre, Joel Craven, Risa Fackler, Dustin Ho, Dereck Martinez-Goodwin, Maria Mauricio, Gunner Michaelson, Karen Peng, and Kevin Sanchez for their valuable field assistance. Sampling was conducted under a state permit from the California Department of Fish and Wildlife held by Michelle Stevens (SCP-210390001).

References

Achrai, B., Bar-On, B. Wagner, H.D. (2014): Bending mechanics of the red-eared slider turtle carapace. Journal of the Mechanical Behavior of Biomedical Materials **30**: 223–233.

Babcock, H.L. (1930): Variations in the number of costal shields in *Caretta.* The American Naturalist **64**: 95–96.

Carr, A. (1995): Handbook of turtles: the turtles of the United States, Canada, and Baja California. Ithaca, New York. Cornell University Press.

Coker, R.E. (1910): Diversity in scutes of Chelonia. Journal of Morphology **21**: 1–75.

Ernst, C.H., Lovich, J.E., Barbour, R.W. (1994): Turtles of the United States and Canada. Washington, D.C. Smithsonian Institution Press.

Hildebrand, S.F. (1930): Duplicity and other abnormalities in diamondback terrapins. Journal of the Elisha Mitchell Scientific Society **46**: 41–53.

Hildebrand, S.F. (1938): Twinning in turtles. Journal of Heredity **29**: 243–253.

Lambert, M.R., McKenzie, J.M., Screen, R.M., Clause, A.G., Johnson, B.B., Mount, G.G., Shaffer, H.B., Pauly, G.B. (2019): Experimental removal of introduced slider turtles offers new insight into competition with a native, threatened turtle. PeerJ **7**: e7444.

Lowe, S., Browne, M., Boudjelas, S., De Poorter, M. (2000): 100 of the world's worst invasive alien species: a selection from the global invasive species database. Auckland, New Zealand, Invasive Species Specialist Group.

Lynn, G.W., Ullrich, M.C. (1950): Experimental production of shell abnormalities in turtles. Copeia, **1950**: 253–262.

Newman, H.H. (1906): The significance of scute and plate abnormalities in Chelonia. Biological Bulletin **10**: 68–114.

Parker, G.H. (1901): Correlated abnormalities in the scutes and bony plates of the carapace of the sculptured tortoise. American Naturalist **34**: 17–24.

Patterson, L.C. (2006): Life history and ecology of an introduced population of red-eared sliders (*Trachemys scripta elegans*) in the Central Valley of California with implications for the conservation of the western pond turtle (*Emys marmorata*). M.S. Thesis, University of California, Davis California.

Powell, R., Conant, R., Collins, J.T. (2016): Peterson field guide to reptiles and amphibians of eastern and central North America, fourth edition. New York, New York, Houghton Mifflin Harcourt.

Stebbins, R.C. (2003): A field guide to western amphibians and reptiles. Boston, Massachusetts, Houghton Mifflin Company.

Velo-Antón, G., Guilherme Becker, C., Cordero-Rivera, A. (2011): Turtle carapace anomalies: the roles of genetic diversity and environment. PLoSONE **6**: e18714.

Yntema, C.L., Mrosovsky, N. (1982): Critical periods and pivotal temperatures for sexual differentiation in loggerhead sea turtles. Canadian Journal of Zoology **60**: 1012–1016.

Zimm, R., Bentley, B.P., Wyneken, J., Moustakas-Verho, J.E. (2017): Environmental causation of turtle scute anomalies in ovo and in silico. Integrative and Comparative Biology **57**: 1303–1311.

Accepted by Eric Munscher