# KYPHOSIS IN THE POND TURTLE *ACTINEMYS PALLIDA* (EMYDIDAE) FROM BAJA CALIFORNIA, MEXICO

## CIFOSIS EN LA TORTUGA DE POZA *ACTINEMYS PALLIDA* (EMYDIDAE) DE BAJA CALIFORNIA, MÉXICO

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**Resumen.**– La cifosis es una condición física definida como una deformidad dorsalmente convexa de la columna en el plano sagital del animal, y en el caso de tortugas, se observa una curvatura o joroba en el caparazón. Durante los estudios de monitoreo de la tortuga de poza *Actinemys pallida* en el Arroyo San Rafael, Baja California, encontramos dos individuos con cifosis. De 220 tortugas capturadas en este sitio en varios años, estas dos tortugas fueron las únicas que hemos encontrado con este tipo de malformación, lo que representa una prevalencia alta de esta condición.

**Palabras Clave**.– Caparazón, malformaciones, tortugas.

**Abstract.**– Kyphosis is a physical condition defined as a dorsally convex deformity of the spine in the sagittal plane of the animal, and in turtles, an exaggerated forward rounding or hump is observed in the turtle´s shell. During monitoring surveys of the southwestern pond turtle *Actinemys pallida* in Arroyo San Rafael, Baja California, we found two kyphotic individuals. Of 220 pond turtles captured at this site in several years, these two turtles were the only ones found with this type of malformation, representing a high prevalence of this condition.

**Keywords**.– Carapace, malformations, turtles

Among the osteological malformations of vertebrates, kyphosis is a physical condition defined as a dorsally convex deformity of the spine in the sagittal plane of the animal, commonly known as a "hump-back" (Rhodin et al., 1984). Even though osteological abnormalities are rare in wild reptiles (Telemeco et al., 2013; Löwenborg & Hagman, 2017; Valdeón et al., 2020), they are more frequent in captivity as a consequence of deficient care, especially related to nutrition and UV deficiencies (Mendyk, 2008).

However, kyphosis, as well as other spinal malformations can develop at any time in wild animals (Frye, 1991) and can be caused by teratogenic and environmental agents, such as exposure to chemicals, abnormal temperatures, insufficient nutrients during embryonic development, genetic predisposition, errors during vertebral segmentation or ossification, among others (Frye, 1991; Rothschild, 2009; Martin-del Campo et al., 2021). Kyphosis has been recorded in many species of turtles from different families, including marine (Martin-del Campo et al., 2021) and terrestrial species (Wendolleck, 1904), but more frequently in freshwater turtles. Within the family Emydidae it has been reported in at least 30 species (Plymale et al., 1978; Harding & Bloomer, 1979; Mitchell et al., 2019; Jackson & Zappalorti, 2020). Here we report the first case of kyphosis in *Actinemys pallida* from Baja California, Mexico.

The southwestern pond turtle (*A. pallida*) is the only native freshwater turtle in the state of Baja California. This species ranges from the central coast south of San Francisco Bay area in California to the northwestern Baja California (Legler & Vogt, 2013). Within Baja California, it is found in riparian habitats from the US-Mexico border to Arroyo El Rosario (Grismer, 2002), with a disjunct population in the central desert of Baja California (Valdez-Villavicencio et al., 2016). It is a small to medium-sized freshwater turtle with an average carapace length of 150–160 mm (Holland, 1994).

During monitoring surveys of *A. pallida* in Arroyo San Rafael, Baja California (31.11893, -115.97129, 220 m elevation), a kyphotic female turtle was captured on 17 March 2023. The specimen

**Figura 1.** Ejemplares con cifosis de *Actinemys pallida*, hembra adulta (izquierda) y juvenil (derecha) del Arroyo San Rafael, Baja California, México. Fotos: Jorge H. Valdez.
**Figure 1.** Kyphotic adult female *Actinemys pallida* (left), and a juvenile (right), from Arroyo San Rafael, Baja California, Mexico. Photos by: Jorge H. Valdez.

had the following measurements: carapace length = 120.3 mm, carapace width = 93.8 mm, plastron length = 107.7 mm, and the kyphotic carapace height was 52.0 mm (Fig. 1, Table 1).

On 09 June 2023, a second individual was captured. The juvenile turtle had the following measurements: carapace length = 67 mm, carapace width = 59.3 mm, plastron length = 62.7 mm, and the kyphotic carapace height = 30.2 mm (Fig. 1). Later, this same individual was recaptured on 24 June 2023 in the same pond, and the measurements were: carapace length = 69.6 mm, carapace width = 60.6 mm, plastron length = 64.0 mm, and the kyphotic carapace height = 30.6 mm (Table 1). Except for the shell, the head, limbs, and tail of each of the specimens, appeared to be normal, and when they were released into the water, they swam normally.

Apparently, this condition does not affect the turtles in terms of reproduction (in the case of females) or even their mobility, both in water and on land (Moldowan et al., 2015). For example, reproduction has been reported in *Trachemys scripta* with severe kyphoscoliosis (Enge et al. 2022b) and several egg clutches in kyphotic *Chrysemys picta* was also documented (Moldowan et al. 2015). Both kyphotic specimens of *Actinemys pallida* found in this study appeared to be healthy and possessed a body mass like other turtles with similar carapace length (Enge et al., 2022a; Table 1). An increase in length and body mass in kyphotic turtles could be slower in some species (Selman & Jones, 2012), or more rapid in others (Wilhoft, 1980). In this report, the recaptured juvenile *A. pallida* in our study site showed a growth similar to non-kyphotic turtles, with a weight and carapace length similar to other turtles of similar size (Table 1).

Of 220 pond turtles captured at this site in several years, these two turtles were the only ones found with kyphosis, representing an incidence of this condition of 0.9%. Previous records on turtles have found prevalence's range from 0.04 to 1% (Rhodin et al., 1984; Trembath, 2009; Moldowan et al., 2015). The incidence at our site is consider high and warrant a need to monitor the population. When reviewing the literature, 18 reports were found where cases of kyphosis had a higher incidence in females than in males (19 and 6 respectively). Lynn & Ullrich (1950) suggested multiple potential causes for shell anomalies, due to moisture changes in the late stages of development in the nest, which can cause significant changes in the anatomy of the plastron, the carapace, and even the shape of the head.

Other causes may lead to deformed, raised plaques that form due to an excess of protein in the diet, or raised plates that form due to renal or nutritional osteodystrophy (Rothschild et al., 2013). Although it is not known if there is a direct relationship between this malformation and sex, it is likely that females are more susceptible to suffering from these malformations related to development during incubation in the nest, since being at higher temperature, the eggs may suffer from desiccation (Lynn & Ullrich, 1950). However, we cannot be sure which variables cause kyphosis on turtles at this site, so if more individuals appear, it will be necessary to determine its cause and effects in the population.

**Tabla 1.** Datos morfométricos de *Actinemys pallida* en condición normal y con cifosis en el Arroyo San Rafael, Baja California, México. Medidas de altura del caparazón de tortugas con cifosis en negrita. El asterisco indica la recaptura del segundo ejemplar capturado.

**Table 1.** Morphometrics of normal and kyphotic *Actinemys pallida* from Arroyo San Rafael, Baja California, Mexico. Carapace height measurements of kyphotic turtles in bold. The asterisk indicates the recapture of the second captured specimen.

| Sex | Carapace length (mm) | Carapace with (mm) | Carapace height (mm) | Plastron Length (mm) | Mass (g) |
|---|---|---|---|---|---|
| Female | 120.3 | 93.8 | **52** | 107.7 | 267.2 |
| Female | 119.2 | 87.3 | 39.5 | 105.1 | 221.7 |
| Male | 120.0 | 86.5 | 36.1 | 101.1 | 211.6 |
| Male | 120.3 | 90.2 | 35.5 | 102 | 215.1 |
| Female | 122.1 | 94 | 40.4 | 109.6 | 254.4 |
| Female | 123.2 | 90.9 | 40.1 | 111.6 | 272.4 |
| Female | 124.7 | 90.8 | 42.2 | 108.4 | 251.5 |
| Male | 125.5 | 88.8 | 39 | 106.6 | 218.9 |
| Juvenile | 67.0 | 59.3 | **30.2** | 62.7 | 55.4 |
| Juvenile | 68.6 | 59.4 | 23.5 | 63.3 | 50.5 |
| Juvenile | 68.1 | 56.8 | 23.3 | 58.7 | 45 |
| Juvenile* | 69.6 | 60.6 | **30.6** | 64 | 60.5 |
| Juvenile | 71.6 | 58.6 | 24.7 | 60.9 | 54.8 |

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