The evolution of the fifth cervical vertebrae in Pelomedusoides (Testudines, Pleurodira): a preliminary analysis

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Background. Crown-Pleurodira (i.e.: Cheloides and Pelomedusoides) possess a side-necked retraction mode with specialized cervical vertebrae (CV) anatomy. Moreover, there are distinctive ecological features among its lineages, as the convergent long neck in species of Chelidae and in the extinct pelomedusoid Araripemydidae. Also, the CV5-CV6 articulation is the major point of flexure in neck retraction and reflects a key point for the evolution of Pleurodira. Here we evaluated CV5 shape variation within some Pleurodira groups with emphasis on some Brazilian fossil species.

Methods. We analyzed the fifth CV of eight species and 14 specimens comprising four pleurodiran clades (Chelidae, Araripemydidae, Bothremydidae and Podocnemididae) in order to assess the shape variation via geometric morphometry. All specimens were photographed in caudal view under the same protocol, and eight landmarks (LM) were picked at the left side of each vertebrae using TPSDig2. Data were Procrustes superimposed and a Relative Warps Analysis (RWA) was performed using TPSRelw v1.49.

Results. RW1 and RW2 summarized 68.63% of the shape variance. The scatter of the specimens revealed distinctiveness between Podocnemidoidea (Podocnemididae+Bothremydidae) and *Araripemys*+Chelidae paraphyletic group. Such variation is due to (1) a medial contraction of the surface of the postzygapophysis, (2) a taller neural spine and (3) a more rounded vertebral condile towards Podocnemidoidea. Podocnemididae showed greater variation: a *Podocnemis sextuberculata* specimen (MZSP3218) is more alike to *Cearachelys placidoi* (Procrustes Distances, PD=0.17) than other podocnemidids and *Bauruemys elegans* resembles *P. unifilis* (PD=0.11). Also, other *P. sextuberculata* specimen (MZSP3217) is more alike to the *Araripemys*-Chelidae group.

Discussion. Previous works have noticed the anatomical similarities between both long-necked chelids and *A. barretoi*, considering it as a convergence since they are from different clades. Our data showed the same pattern and, assuming the current phylogenetic

relationships of Pleurodira, this might indicates similar feeding behavior between living *Hydromedusa* and *Chelus* and *Araripemys*. The Podocnemidoidea morphospace variation is consistent with the phylogeny, since *C. placidoi* is nested among *Podocnemis* spp., and this might indicate a more specialized CV5 for the former and a possible convergence with some *Podocnemis* species. Also, the resemblance of *P. unifilis* CV5 with *B. elegans* seems to indicate a morphotype similar to the podocnemidid ancestor for this living species. Despite our scanty sample, it shows a notable variation in *Podocnemis* spp. and at least two convergences among CV5 within Pleurodira. Further studies with additional sampling might shed light on a more complex evolution of CV specializations in side-necked turtles than previously assumed.

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