The evolution of the flippers and the paleoecology of Panchelonioidea (Testudines, Cryptodira)

Isadora Gerheim*[1], Pedro S. R. Romano[1]

(1) Universidade Federal de Viçosa, Departamento de Biologia Animal, MG, Brazil.

* *isagvm@gmail.com*

Background. The recent data on Panchelonioidea's phylogeny suggested the family level relationships as (Toxochelyidae, (Cheloniidae, (Protostegidae, Dermochelyidae))). Despite the similarity between their limbs, it is known that the flippers morphology on marine turtles evolved independently in these clades. A remarkable feature is the presence of phalangeal condyles in Toxochelyidae and basal Protostegidae, a plesiomorphic state that allows the movement of the hand. On the other hand, the apomorphic state of having a rigid paddle is found in modern turtles (Cheloniidae and Dermochelyidae). Also, living Chelonioidea (Cheloniidae and Dermochelyidae) has the longest length of the hand and the shortest length of the humerus compared to other Testudines, as analyzed by Joyce and Gauthier (2004, Proc. R. Soc. Lond. B, 271).

Methods. We took measurements of the forelimb (the length of humerus, ulna and digit III) from five Panchelonioidea fossil species (*Protostega gigas, Toxochelys latiremys, Allopleuron hoffmanni, Eochelone brabantica* and *Archelon ischyros*) using ImageJ 1.48v. The percentages of the length of the hand and the humerus with respect to the whole limb were then calculated. The percentages of the five species were added to the two-dimension ternary diagram made by Joyce and Gauthier (2004) in order to evaluate the plot of these species and compare them to other turtles.

Results. *Archelon ischyros* was plotted near *Toxochelys latiremys*. The Toxochelidae are the sister group of Chelonioidea and they are known to have a poor development of the limbs into flippers and a preference for shallow and benthic habitat. Both were located near non-marine turtle species, showing that they had the relatively shortest hand within Panchelonioidea, whereas *Protostega gigas, Allopleuron hoffmanni and Eochelone brabantica* was plotted close to the recent Cheloniidae.

Discussion. The results suggest a less pelagic habitat for *Protostega gigas* and *Archelon ischyros*, resembling a hypothesis formulated by Hay (1905, Bull. Am. Mus. Nat. Hist., 21)

PeerJ PrePrints | https://dx.doi.org/10.7287/peerj.preprints.1039v1 | CC-BY 4.0 Open Access | rec: 4 May 2015, publ: 4 May 2015

that *Archelon* was not as pelagic as *Dermochelys* and by Wieland (1909, Am. Jour. Sci., 27) that this species did not have a powerful type of muscular insertion, maybe indicating a less strong swimming power. These results together with the fact that basal species of Protostegidae retain the phalangeal condyles, suggests that after the split between these families, the flippers retained the primitive length of limbs. It also brings back a Zangerl's hypothesis (1980, Amer. Zool., 20) of a Chelydra-like ancestor for Panchelonioidea, with unspecialized limbs. As conclusion, we suggest that Panchelonioidea ancestor flipper condition would last in stem Toxochelyidae and stem Chelonioidea and then get independently specialized in Cheloniidae and Dermochelyidae.