

On the origin of the great white shark *Carcharodon carcharias*

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The great white shark *Carcharodon carcharias* is known since the late Miocene, a period in which a number of big lamniform sharks occurred, i.e., †*Otodus megalodon*, †*Cosmopolitodus hastalis* and †*Carcharodon hubbelli*. The evolutionary origin of the great white shark remains highly debated and two hypotheses have been proposed: (1) *C. carcharias* is closely related to the megatoothed sharks, including †*O. megalodon*; (2) *C. carcharias* shares a more recent common ancestor with mako sharks (*Isurus*) and descended from the broad toothed mako shark †*C. hastalis* (Ehret et al., 2012). Unfortunately, sharks exhibit a fossil record that mainly consists of isolated teeth due to their poorly mineralized cartilaginous endoskeleton, hampering comprehensive phylogenetic analyses and thus the reconstruction of their evolutionary history.

Here we report of an exceptional find of two well preserved shark skeletons of a juvenile (TL ~1.7m) and an adult (TL ~5m) †*Cosmopolitodus hastalis* from the late Miocene Pisco Formation of Peru. We conducted a phylogenetic analysis (with a molecular backbone constraint) based on previously published dental characters for lamniform sharks (Shimada, 2005). Additionally, morphometric analyses were performed to visualize the morphospace occupation of *Isurus*, †*Cosmopolitodus* and *Carcharodon*. Our combined approach allowed us to reconstruct the evolutionary history of *Carcharodon carcharias* and the dental transition from fossil mako sharks to the extant great white shark, and thus strongly favours the hypothesis that *Carcharodon carcharias* descended from broad toothed mako sharks.

References

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- SHIMADA, K. (2005): Phylogeny of lamniform sharks (Chondrichthyes: Elasmobranchii) and the contribution of dental characters to lamniform systematics. *Paleontological Research*, 9/1, 55-72.