# ANATOMICAL NETWORKS REVEALS NEW ADAPTIVE STRATEGIES OF CETACEAN FLIPPERS

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Previous studies of the anatomical network analyses (AnNA) of pectoral fins of tetrapods that have been secondarily adapted to the marine environment identified two main strategies: most limbs have superficial and interdigital connective tissue which gives to the limb the shape of a "baby mitten" (observed in marine mammals and most reptiles), whereas ichthyosaurs are characterized by a homogeneous reintegration of the limb. That initial sample included only two extant cetaceans, which did not show a clear tendency to follow any of the defined adaptation paths. Cetacean flippers evolved from the forelimbs of a group of terrestrial artiodactyls. The transition to the aquatic environment entailed multiple morphological changes in the bone anatomy and the limb´s soft tissues. As a consequence of these transformations, there is interspecific variation (e.g., the number of phalanges and carpals and their connections). In order to know the adaptive tendencies of the flippers in extant cetaceans and the group´s morphological diversity, an AnNA was carried out with a larger sample. The anatomical networks of pectoral fins of 44 cetaceans were constructed from dissected specimens, radiographs of museum collections and figures from literature. They represent 11 families, 9 corresponding to the Order Odontoceti and 2 to Mysticeti, being the largest sample of an AnNA study on tetrapod limbs. By incorporating these samples into the morphospace established for tetrapods adapted secondarily to water, we observed an expansion of the "mitten" morphospace, allowing the identification of new adaptive strategies in cetaceans. A new trend towards a disintegration of the flippers with higher heterogeneity is observed, bifurcated into two different paths of heterogeneity: one towards complex heterogeneity and the other towards modular heterogeneity. Likewise, the expanded sample identified some cetaceans that clearly fit in two of the three previously established adaptive pathways towards a modular disintegration and complex reintegration respectively. The expanded and more representative sampling confirms that there were disparate trends in the strategies of ichthyosaurs and cetaceans, with homogeneous and heterogeneous forefins respectively. Future objectives include exploring in detail the networks within the cetaceans at the individual bone level and investigate how their connectivity patterns influence the morphological diversity of the group and their possible taxonomic and/or environmental correlations.

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