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Title: Fish scales as non-lethal analogues to otoliths: reconstructing migrations across salinity gradients with geochemical proxies in alternative structures

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Abstract

The use of scales as a non-lethal alternative to otoliths for reconstructing migration and dietary histories of mobile fishes is gaining popularity across the world and in numerous taxa. However, the complexity of scale growth geometry is an important determinant for the potential utility of sequential analyses of both inorganic (e.g. strontium and barium concentrations) and organic (e.g. carbon and nitrogen isotope ratios) proxies. We present results investigating both types of proxies in scales of a highly migratory euryhaline predator, the Atlantic tarpon, *Megalops atlanticus*. This species supports a valuable recreational fishing industry within the Gulf of Mexico and is currently listed as vulnerable under the International Union for the Conservation of Nature (IUCN). There is thus an urgent need to understand essential habitat requirements for this species using non-lethal techniques. Consistency in both organic and inorganic proxies among multiple non-regenerated scales from the same individual indicated these proxies provide reliable information about movements across salinity gradients and associated trophic shifts across different life history stages. Stable isotope and trace element results together indicate that trans-haline migratory behavior is facultative and highly variable among individuals, with some but not all fish transiting estuarine gradients into oligohaline waters. Trans-haline migrations were also associated with ontogenetic trophic shifts, as indicated by progressive shifts in dietary isotope signatures concordant with marine migrations. Our findings highlight novel opportunities to use scales as non-lethal alternative to monitor fish migrations across chemical gradients in species where sequential sub-sampling is made possible by scale architecture.

Keywords: migration, scales, isotopes, trace elements, biominerals

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