Unravelling the Life History and Origin of Fish using Strontium Isotope Laser Ablation Analysis

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Laser ablation analysis of strontium isotope ratios ($^{87}Sr/^{86}Sr$) of otolith (fish ear bones) is a powerful and well-established tool to determine life history patterns and origins of fish. Other calcified fish tissues such as scales, spines, and fin rays can also be used to extract valuable chemical information and are useful as a non-lethal alternative for endangered or threatened fish species. However, unlike otoliths that are predominantly aragonite, these tissues are comprised of biological apatite. Analyses of biological apatite using in situ laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS) is complicated by polyatomic interferences on mass 87, which can cause inaccurate $^{87}Sr/^{86}Sr$ measurements.

We tested the effect of these interferences on a variety of samples including pectoral fin rays of green sturgeon (*Acipenser medirostris*) and white sturgeon (*Acipenser transmontanus*), a salmon shark (*Lamna distropis*) tooth, and otolith, scales and spines collected from freshwater walleye (*Sander vitreus*). We observed elevated $^{87}Sr/^{86}Sr$ isotope ratios in the bioapatite samples, likely related to a polyatomic interference ($^{40}Ca^{31}P^{16}O$ or $^{40}Ar^{31}P^{16}O$). Instrument conditions that either reduce oxide production levels, or switching the instrument to medium resolution (~7500) mode, successfully removed the effect of the polyatomic interference, and resulted in consistent $^{87}Sr/^{86}Sr$ isotope values across all sample types.

This provides fish ecologists with a powerful new tool to reconstruct life histories and origins for threatened or endangered fish species where otolith extraction is not a viable option. Furthermore, our findings are also applicable to other bioapatite samples such as teeth and bones for archaeological and forensic applications.