

Reconstructing fish life history using strontium isotope laser ablation MC-ICP-MS analysis of scales, spines, and fin rays as a non-lethal alternative to otolith

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Strontium isotope ratios ($^{87}\text{Sr}:^{86}\text{Sr}$) in otoliths are a well-established tool to determine origins and movement patterns of fish. Alternative sample tissues (scales, spines, fin rays) may also provide valuable geochemical information and are particularly useful as a non-lethal alternative for endangered fish species. 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 $^{87}\text{Sr}:^{86}\text{Sr}$ measurements. To quantify this interference, we applied LA-MC-ICP-MS to three marine samples including a white seabass (*Atractoscion nobilis*) otolith, green sturgeon (*Acipenser medirostris*) pectoral fin ray, and salmon shark (*Lamna distropis*) tooth, as well as freshwater walleye (*Sander vitreus*) otoliths, scales, and spines from Boysen Reservoir, Wyoming. These samples were selected because they originate from homogenous $^{87}\text{Sr}:^{86}\text{Sr}$ isotope reservoirs, allowing us to decouple potential analytical interferences from actual mobility and habitat change of the fish. Instrument conditions that maximize signal intensity resulted in elevated $^{87}\text{Sr}:^{86}\text{Sr}$ isotope ratios in the bioapatite samples, related to the polyatomic interference ($^{40}\text{Ca}^{31}\text{P}^{16}\text{O}$, $^{40}\text{Ar}^{31}\text{P}^{16}\text{O}$). Instrument conditions that reduce oxide levels successfully removed the effect of the polyatomic interference and resulted in consistent values across all tissue types. This provides fish ecologists with a powerful new tool to reconstruct life histories for threatened or endangered fish species where otolith extraction is not a viable option.