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Environmental reconstructions from fish otoliths indicate change over decadal and centennial time scales

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Aquatic ecosystems have shifted from prehistoric baseline states due to anthropogenic impacts, but we generally lack long-term data to understand such change. The chemical and growth properties of calcified structures provide information that reflects the biology and ecology of the organism and their habitats. Such structures can help elucidate the degree, direction and scale of shifts in aquatic ecosystems. We use otoliths of two estuarine fish species to investigate how environmental archives of different temporal resolution can be developed. Elemental profiles (Ba:Ca and Sr:Ca) of fish otoliths were related to growth increments on a seasonal (*Acanthopagrus butcheri*; Sparidae) or annual (*Argyrosomus japonicus*; Sciaenidae) time scale depending on the species. Mixed effects models were used to investigate biological, temporal and environmental factors influencing otolith elemental profiles. The resultant seasonally resolved chemical chronologies were correlated with environmental data to develop element-environment regression functions. These functions were used to reconstruct environmental based on elemental information from archaeological otoliths allowing change over decadal and centennial time scales to be ascertained. The application of mixed effect models to develop chemical chronologies provides unprecedented information on drivers of elemental profiles that allow a range of ecological and management questions to be addressed. This approach may be further adapted and employed on a range of taxonomic groups and environments.

Keywords: Chemical chronology, palaeoenvironmental reconstruction, element, otoliths; LA ICP-MS

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