Life history of abyssal and hadal fishes from otolith growth zones and oxygen isotopes

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Hadal trenches are isolated habitats that cover the greatest ocean depths (6,500–11,000 m) and are believed to host high levels of endemism across multiple taxa. A group of apparent endemics are the snailfishes (F. Liparidae), found in at least five geographically separated trenches. Little is known about their biology, nor the reasons for their success at hadal depths. This study investigated the life history of hadal liparids using sagittal otoliths of two species from the Kermadec (*Notoliparis kermadecensis*) and Mariana trenches (Liparidae *sp. nov.*) in comparison to successful abyssal macrourids found at the hadal/abyssal transition zone. All species showed opaque growth zones that could be quantified. Assuming these annuli represent annual growth, ages were estimated for the two hadal species between five and 16 years old. Age estimates were compared to the shallower-living (bathyal) liparid *Careproctus melanurus*, which were older than described in previous studies, expanding the potential maximum age for the family to near 25. Comparative age estimates were made for deep abyssal macrourids, and ranged from eight to 29 for *Coryphaenoides armatus* and six to 16 for *C. yaquinae*. Age estimates for these hadal and abyssal fishes do not conform to the deeper-older trend that has been observed for some fishes. In addition, $^{18}O/^{16}O$ isotopic compositions ($\delta^{18}O$) were measured across the otolith using an ion microprobe to investigate the thermal history of the three liparids, and two macrourids. Changes in $\delta^{18}O$ were observed across the otoliths of *C. melanurus*, *C. armatus*, and both hadal liparids, the latter of which may represent a change of >5°C in habitat temperature through ontogeny. The results suggest a pelagic larval stage above 1000 m followed by a return as they grow to the hadal environment. This result was unexpected for the hadal liparids given their isolated environment and large, presumably demersal eggs. Alternative explanations are discussed. This study presents a first look at the life history of some of the deepest-living fishes though otolith analyses.