Retrospective time-series nitrogen isotope analysis of fish otoliths

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Fish otoliths that allow both age estimation and retrospective isotope analysis are a powerful tool for investigating life and movement histories of fish. Nitrogen isotopes that vary spatially in the ocean are useful for tracking fish migration, but fish otoliths that consist of calcium carbonate deposited within a proteinaceous matrix, generally do not contain enough nitrogen to allow retrospective δ^{15}N comparisons with the conventional elemental analyzer/isotope ratio mass spectrometry (EA IRMS) system. To achieve retrospective time-series nitrogen isotope analysis of otoliths from individual fish, an EA-IRMS system that was optimised for microscale isotope analysis was used. Otoliths from commercially important fish such as japanese sardine (*Sardinops melanostictus*), chub mackerel (*Scomber japonicus*), pacific saury (*Cololabis saira*), and jack mackerel (*Trachurus japonicus*) contained 0.31, 0.28, 0.26 and 0.18 % of nitrogen by weight, respectively. The weight of the otoliths were 2.7, 6.4, 0.7 and 22.9 mg, respectively. Although pacific saury had the smallest otolith, we were able to achieve retrospective bulk ^{15}N analysis with the δ^{15}N values ranging from 5.3 to 6.6‰ and recreated a known migration route of pacific saury in North west pacific. Retrospective time-series ^{15}N analysis of otoliths can be used with other isotopes, for example, oxygen isotopes that are used to estimate experienced water temperatures to improve the estimation of fish migration.

Keywords: isotope, nitrogen, fish, otolith