

# Tracking long-distance migration of marine fish using compound-specific stable isotope analysis of amino acids

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## Abstract

Long-distance migrations by marine fish have long fascinated scientists, but are difficult to track by visual surveys. Here, we propose a new method to easily and precisely track such migrations using stable nitrogen isotopic composition at the base of the food web ( $\delta^{15}\text{N}_{\text{Base}}$ ), which can be estimated by using compound-specific isotope analysis.  $\delta^{15}\text{N}_{\text{Base}}$  exclusively reflects the  $\delta^{15}\text{N}$  of nitrate in the ocean at a regional scale and is not affected by the trophic position of sampled organisms. We initially constructed a  $\delta^{15}\text{N}_{\text{Base}}$  isoscape in the northern North Pacific, and determined retrospective  $\delta^{15}\text{N}_{\text{Base}}$  values of chum salmon (*Oncorhynchus keta*) from their vertebral centra. Then, we estimated the migration routes of chum salmon during their skeletal growth by using a state-space model. Our isotope tracking method successfully reproduced a known chum salmon migration route between the Okhotsk and Bering seas, and indicates the presence of a novel migration route to the eastern Bering Sea Shelf during a later growth stage.

## Hosted file

Isotope tracking 191115.pdf available at <https://authorea.com/users/285382/articles/409269-tracking-long-distance-migration-of-marine-fish-using-compound-specific-stable-isotope-analysis-of-amino-acids>

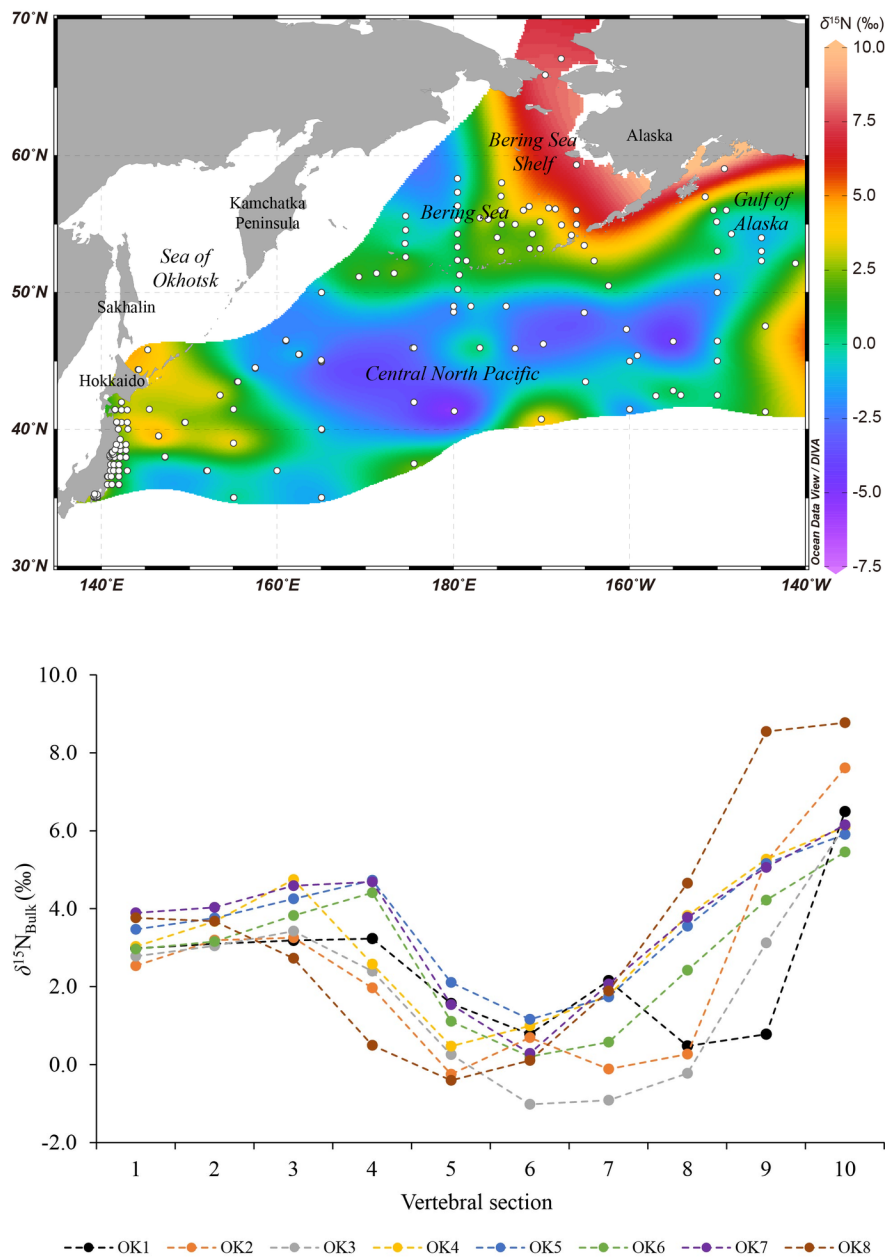
## Figure legends

**Fig. 1.** Map of the estimated  $\delta^{15}\text{N}_{\text{Base}}$  isoscape showing the location of zooplankton sampling sites (white circles).

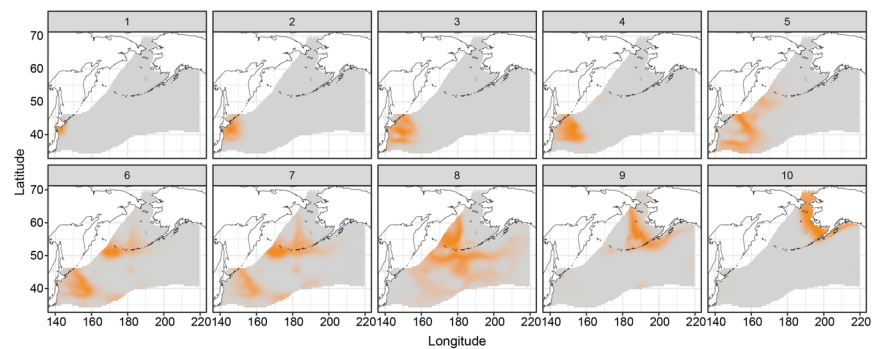
**Fig. 2.** Patterns in  $\delta^{15}\text{N}_{\text{Bulk}}$  along the vertebral sections of sampled Japanese chum salmon (IDs: OK1–8).

Vertebral bone sections ( $x$ -axis) are numbered from the center of the vertebral centrum and increase toward the margin.

**Fig. 3.** Estimated chum salmon migration areas. Mean presence probabilities for two salmon individuals (IDs: OK2 and OK8) at growth stages 1–10 (panels 1–10, respectively). The color gradients (tints of orange) indicate presence probability (low to high). The grey area shows the extent of the isoscape.



ID: OK2



ID: OK8

