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Testing early life connectivity using particle tracking simulations and otolith chemistry

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Large-scale circulation may structure populations of oceanic fish, and hence distributions of chemistry in their otoliths. We applied a combination of Lagrangian modelling and otolith chemistry of Scotia Sea icefish (Chaenocephalus aceratus), a species with a long pelagic larval phase found along the Antarctic Circumpolar Current, to test connectivity previously predicted between the Antarctic Peninsula and South Georgia. Material laid down in the otolith nucleus during early life showed evidence of heterogeneity between sampling areas on the northern Antarctic Peninsula, whereas similar nucleus chemistry at sampling areas off South Georgia suggested a discrete, locally-recruiting population, consistent with observed larval assemblages. Strong evidence of a population boundary discounted hypotheses of early life connectivity between the two regions. This was consistent with particle simulations of the large-scale circulation, which predicted that particles released deep on the Antarctic Peninsula shelf during late winter, corresponding to hatching of icefish larvae from benthic nests, are transported close to the ACC southern boundary, missing South Georgia but following trajectories along the south Scotia Ridge. Used together, the two techniques promise an innovative approach to generate and test predictions, and resolve early dispersal and connectivity related to the physical circulation of oceanic systems.