

Impacts of interannual ocean circulation variability on Japanese eel larval migration in the western North Pacific Ocean

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The Japanese eel larvae hatch near the West Mariana Ridge seamount chain and travel through the North Equatorial Current (NEC), the Kuroshio, and the Subtropical Countercurrent (STCC) region during their shoreward migration toward East Asia. The interannual variability of circulation over the subtropical and tropical regions of the western North Pacific Ocean is affected by the Philippines–Taiwan Oscillation (PTO). This study examines the effect of the PTO on the Japanese eel larval migration routes using a three-dimensional (3D) particle tracking method, including vertical and horizontal swimming behavior. The 3D circulation and hydrography used for particle tracking are from the ocean circulation reanalysis produced by the Japan Coastal Ocean Predictability Experiment 2 (JCOPE2). Our results demonstrate that bifurcation of the NEC and the strength and spatial variation of the Kuroshio affect the distribution and migration of eel larvae. During the positive phase of PTO, more virtual eels (“v-eels”) can enter the Kuroshio to reach the south coast of Japan and more v-eels reach the South China Sea through the Luzon Strait; the stronger and more offshore swing of the Kuroshio in the East China Sea leads to fewer eels entering the East China Sea and the onshore movement of the Kuroshio to the south of Japan brings the eels closer to the Japanese coast. Significant differences in eel migration routes and distributions regulated by ocean circulation in different PTO phases can also affect the otolith increment. The estimated otolith increment suggests that eel age tends to be underestimated after six months of simulation due to the cooler lower layer temperature. Underestimation is more significant in the positive PTO years due to the wide distribution in higher latitudes than in the negative PTO years.

Keywords: Japanese eel larvae, 3D particle tracking, Western Pacific, PTO, JCOPE2