

## **Horizontal and vertical migration behaviors during all phases of the Japanese eel spawning migration revealed by pop-up satellite archival tagging**

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The long spawning migration of the Japanese eel, *Anguilla japonica*, that swims from temperate growth habitats to a tropical reproductive area is an essential event for the success of their reproduction. However, the behaviors and routes during their spawning migrations have been unclear. In this study, 27 silver Japanese eels attached with pop-up satellite archival tags (PSATs) were released from the coast of Japan (21 eels), adjacent to the Ogasawara Islands (3 eels), and within their spawning area along the southern West Mariana Ridge (3 eels) to examine their spawning migration behavior. Their swimming depth and experienced water temperatures along the coast of Japan (12 eels), adjacent to the Ogasawara Islands (1 eel) and in the spawning area (1 eel) were analyzed using data from the PSATs, to document the diel vertical migration of Japanese eels. Based on the travel directions, the spawning migration routes indicated that Japanese eels appear to first move along Kuroshio, and then turn south to migrate towards their spawning area. Nine of 23 eels were estimated to be ingested by predators such as tunas and swordfishes. Recorded data that included long and clearly diel vertical migrations were the focus of the analyses. At night, the swimming depths had significant positive correlations with lunar age and moon altitude in all 3 areas. During daytime, Japanese eels swam at different deep layers among the 3 areas. Temperature appeared to be the determinant of the daytime swimming depths because the eels experienced almost the same lowest water temperatures (5°C) among the 3 areas. The daily experienced temperature change-ranges became gradually bigger according to the progress of the spawning migration from the temperate growth habitat to the tropical reproductive area. Therefore, Japanese eels have a diel vertical migration with the controlling factors of their swimming depths being light intensity from both the sun and moon and also temperature at their deepest daytime depths. Their diel vertical migration may be a survival strategy behavior for avoidance of predators, and the changes of temperature they experience may help to regulate their sexual maturation while swimming towards their spawning area.

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