A challenge to evaluate effect of climate change on Japanese anchovy (*Engraulis japonicus*) in the East China Sea II

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We have evaluated climate change (global warming) effects on Japanese anchovy in the East China Sea by integrating a fish-migration and growth model using environmental conditions derived from simulations of a coupled ocean circulation and ecosystem model with current and future climate forcing. For the ocean circulation model, CHOPE (Max-Planck-Institute Ocean Model) was used. For the marine ecosystem model, eNEMURO, an extended version of NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography) was used.
The initial spawning grounds were assumed in the area which depth is less than 1000 m and the sea surface temperature (SST) is between 15.6 and 27.8 degC in the previous study. However, a new analysis of water temperature of egg distribution showed higher probability in the region which SST is between 14.1 and 20.1 degC and 27.2 and 27.8 degC. The spawning area was estimated using the new temperature criteria and the fish growth and migration model was integrated for one year since the spawning. In addition, although the spawning timing was assumed in March in the previous study, we conducted the simulations for anchovy spawned in April and May and investigated the dependency on the spawning timing.
Under the contemporary condition, the number of anchovy larvae advected to the northwestern side of Kyushu (NWK) showed the maximum in April, while it showed the maximum in March in the southwestern side of Kyushu (SWK). However, under the future climate, it showed the maximum in March both in the NWK and SWK. Therefore, the peak timing was advanced in the NWK under the future condition. Regarding the body size, larvae advected to the NWK showed the maximum mode body length in May, while those advected to the SWK showed it in April under the contemporary condition. Under the future condition, the timing was advanced by one month (April in the NWK and March in the SWK). Under the future condition, the number of larvae advected to the SWK in April and May and those advected to the NWK in May were drastically decreased. This result heavily depends on the assumption that the spawning ground is not formed in the region which SST is between 20.2 and 27.1 degC. Under the future condition, the spawning ground was disappeared in the East China Sea. As a future work, the reason the spawning probability becomes lower in the region which SST is between 20.2 and 27.1 degC should be elucidated.

Keywords: ecosystem model, fish growth-migration model, Japanese anchovy, climate change

