

A growth-migration model for evaluating environmental effects on growth and migration of Pacific chub mackerel *Scomber japonicus* in the Northwest Pacific

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Pacific chub mackerel (*Scomber japonicus*) is a small pelagic and important commercial fish species widely distributed throughout the coastal areas of subtropical and temperate transition waters in the Indo-Pacific. Previous studies indicated that changing environmental variables including sea surface temperature, prey availability and ocean currents potentially influence the recruitment and stock structure, which resulted in the large inter-annual variations in previous decades but the mechanisms remain largely unknown. To quantify the effects of those environmental factors on chub mackerel, we developed a growth-migration model. Growth characteristics were evaluated by a bioenergetics model, which parameters were estimated by reviewing previous studies and newly conducted swimming ability and metabolic measurement experiment. In the migration model, cruising speed was defined based on the parameterization of swimming performance experiments while the direction was decided as towards the one of the eight grids surround the initial location which achieved highest growth rate. As an application example, the developed growth-migration model was used to simulate the early life history of 2010-year class individuals hatched at Apr 15th, 2010 in the Northwest Pacific under satellite derived environments. The model results showed the migration routes of larval and juvenile chub mackerel were highly characterized by the main flow of the Kuroshio and Kuroshio Extension, which lead to significant difference of growth characteristic, indicating the importance of surface current on the distribution and fitness of chub mackerel in the early stage. The individuals experienced rich prey condition but relative low water temperature, showed intermediate growth at first but being the highest growing ones after the water temperature increased, indicating that good prey availability and the high temperature are the important factors determining growth rate in early life history of chub mackerel, which consistent with the previous studies.

Keywords: chub mackerel, model, growth, migration