

Fig. S1. Number of chlorophyll (OC-CCI) data in each grid from 1994 to 2015 (24 years). Grids less than 24 indicate an extrapolating grid.

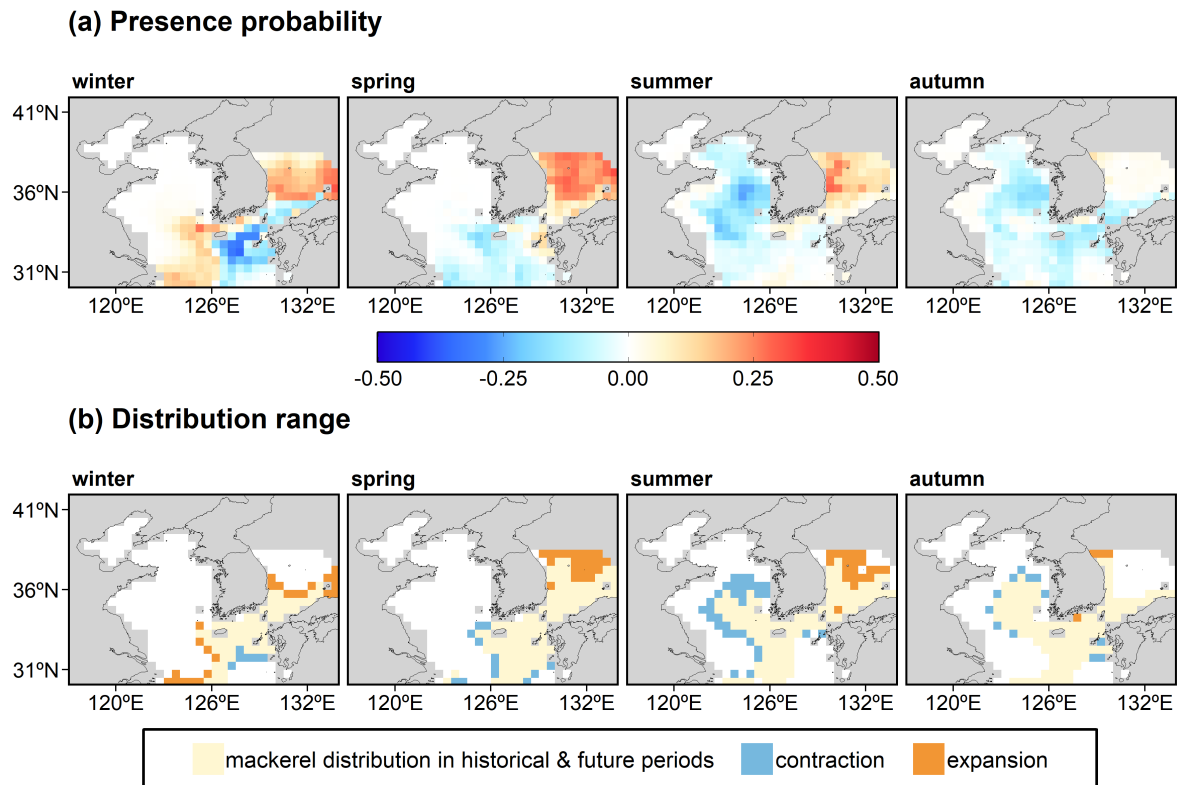


Fig. S2. Future seasonal changes in (a) presence probability and (b) spatial distribution range of the chub mackerel (*Scomber japonicus*) in the 2050s under SSP1-2.6. In (a), the changes are simple subtraction of the mackerel presence probability in the historical period (1998–2015) from the future period—the multi-model ensemble for the probability projected using five CMIP6 models. In (b), the distribution was defined as areas with the presence probabilities above thresholds. Ivory is distribution in the historical and future periods; blue, contraction; orange, expansion area.

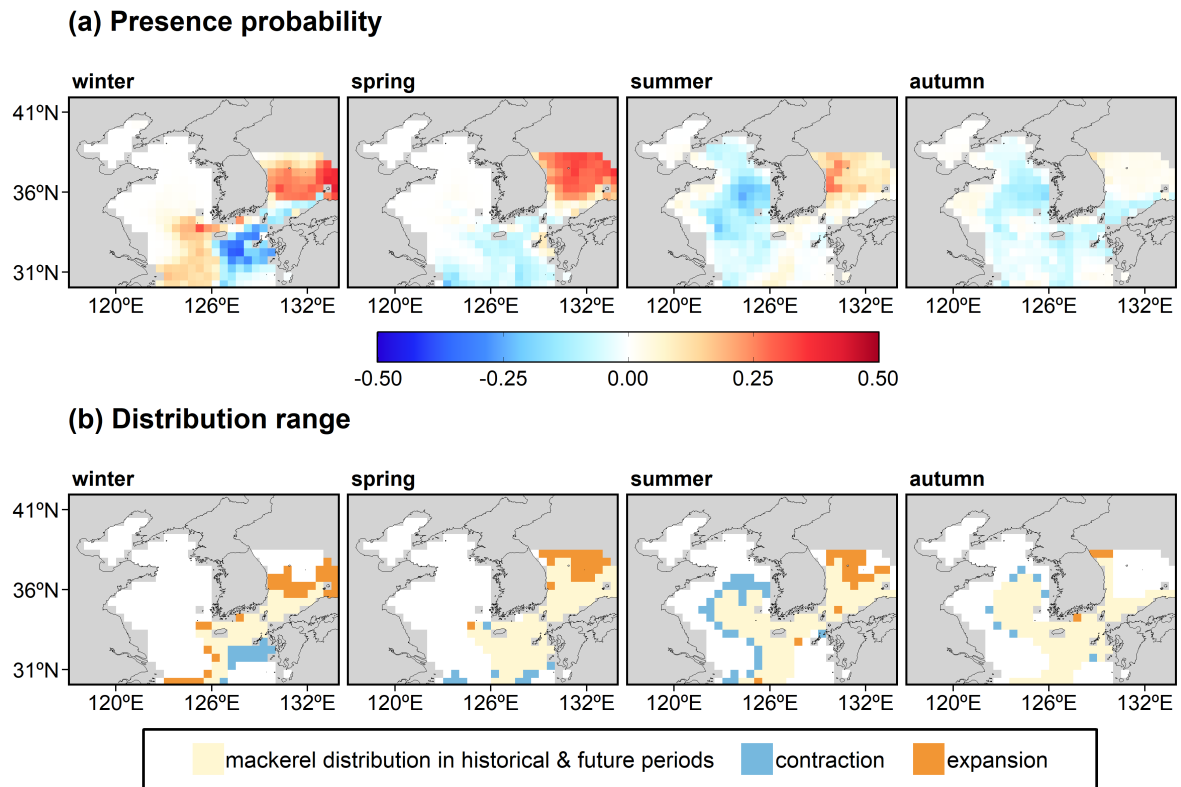


Fig. S3. Same as Supplementary Figure 1, but under the SSP2-4.5.

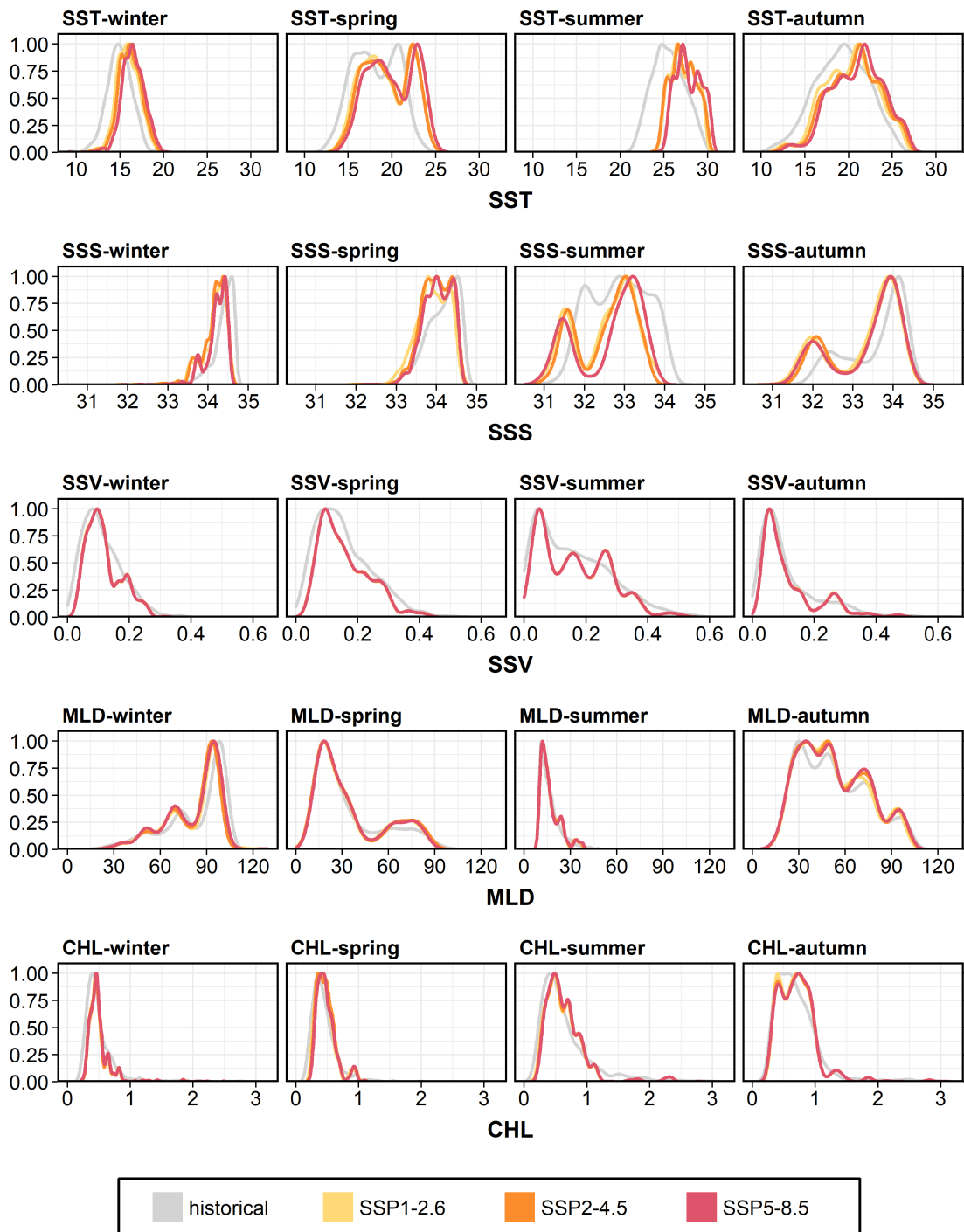


Fig. S4. Scaled kernel density distribution of the five environmental variables (SST, SSS, SSV, MLD, and CHL) in the chub mackerel (*Scomber japonicus*) presence in historical (1998–2015) and future (the 2050s) periods—the multi-model ensemble for the five environmental variables projected using five CMIP6 models. SSV shows minimal differences between the SSPs, resulting in overlapping lines in the figure.

SST, sea surface temperature; SSS, sea surface salinity; SSV, sea surface current speed; MLD, mixed layer depth; CHL, chlorophyll concentration