ENVIRONMENTAL IMPACTS OF BOTTOM COLD WATER MOVEMENT ON MARINE AQUACULTURE AREA AND ITS POSSIBLE CAUSE

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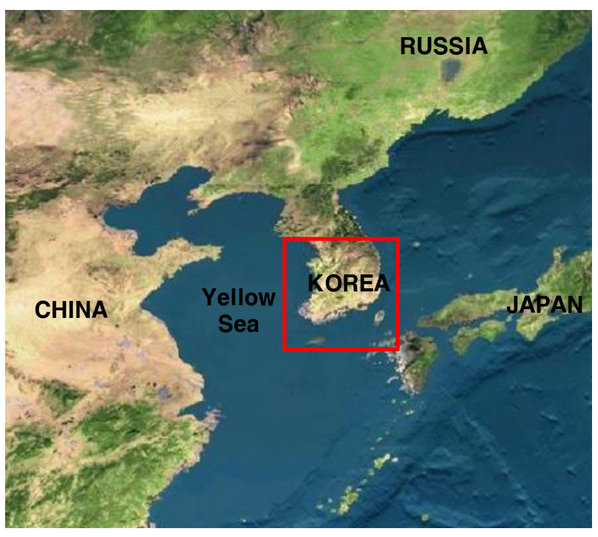
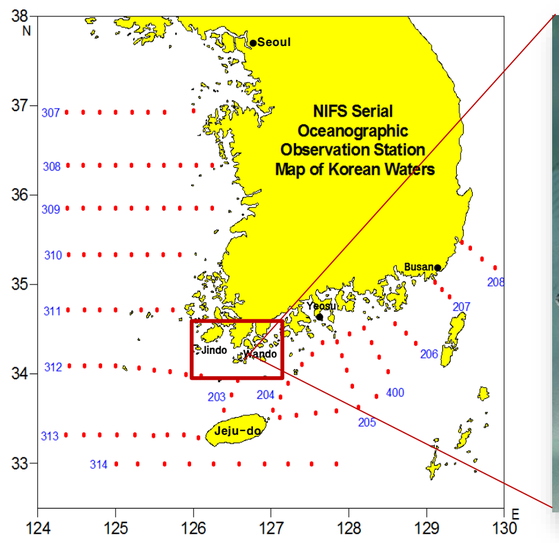
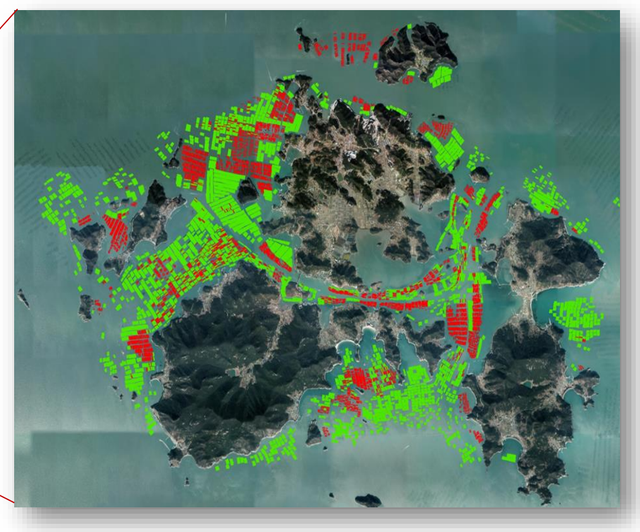
Abstract

To understand the environmental impacts of cold water on marine aquaculture area in the southwest coast of Korea, Daily and Bi-monthly observed long-time series data by National Institute of Fisheries Science(NIFS) during the 40 years, 1981~2020, were analyzed. The linear regression result shows that the increasing trend of sea surface temperature(SST) in summer is more significant than in winter with a rate of 0.01℃ year^{-1} over the whole period. This result suggests that the increased sea surface temperature in summer is associated with the weakened cold water in the southwestern coast(Jindo Cold Water, JCW). The JCW is known that the upwelled water mass by tidal mixing and pumping in the southwestern coast of Korea, and the temperature of this water mass is strongly correlated with the low temperature of bottom water affected by the Yellow Sea Bottom Cold Water(YSBCW). The YSBCW is well known that it is formed by sink into deeper layer during winter at the northern part of the Yellow Sea(YS) and occupies the central part and wide region below the YS thermocline in summer. From the preliminary results, two factors are expected to contribute to the decline in productivity of aquaculture farms: increased variability of SST and changes (distortions) of seawater movement. The increased variability of SST in summer is associated with the weakened cold water which is strongly influenced by the low temperature of bottom water associated with the YSBCW.

Study area

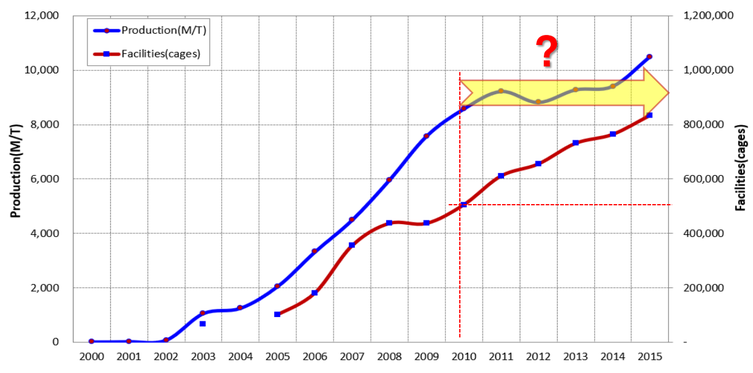




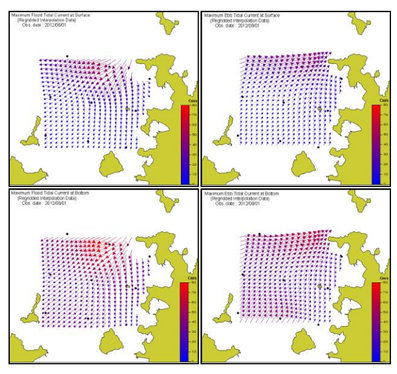


Study area and sampling stations. Bi-monthly hydrographic survey were carried out at 106 stations as part of the NIFS Serial Oceanographic Observation Program since 1965 in Korea. The seaweed and abalone marine aquaculture farms are well developed in the southwest coast(Jindo and Wando area) of Korea.

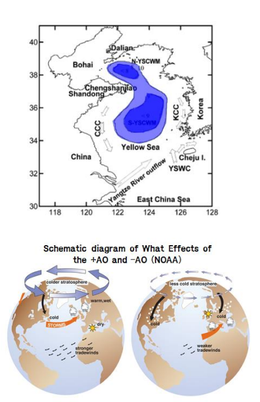
Results

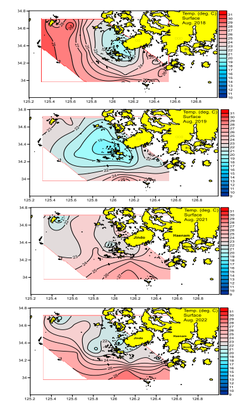


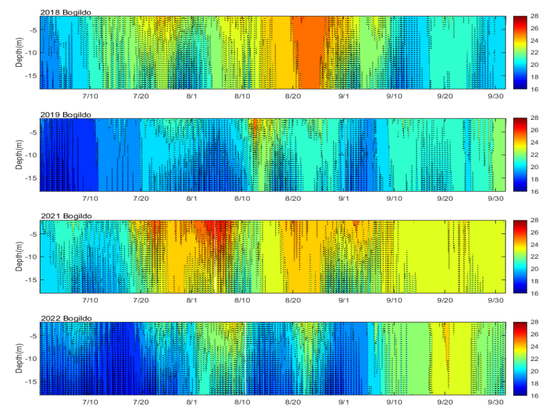
Temporal variation of the abalone production and number of marine aquaculture cages over the past 15 years in Korea.



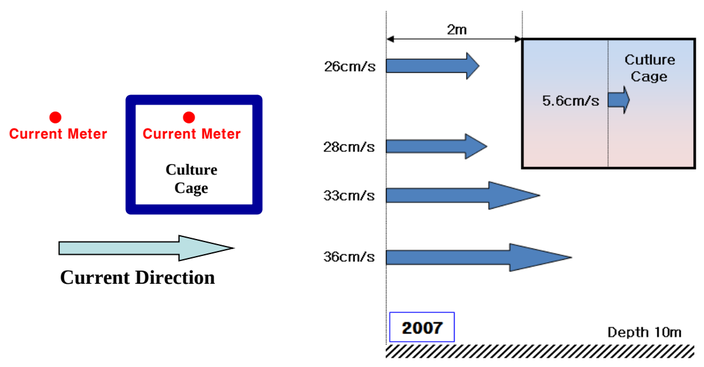
Maximum flood and ebb tidal current fields at surface and bottom layer in the study area.

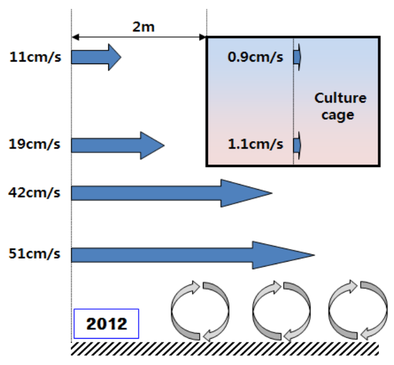




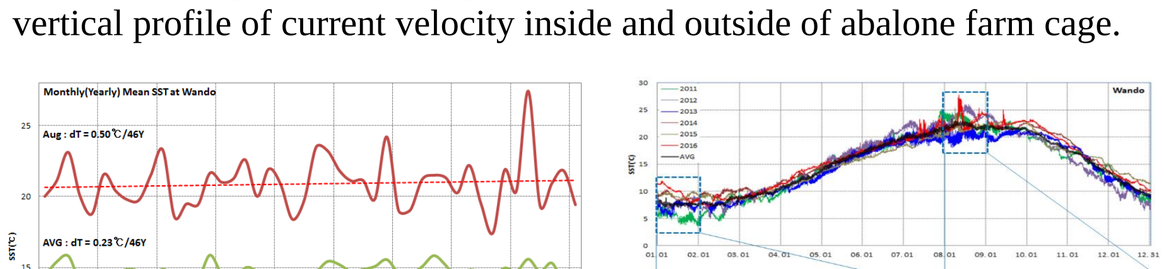


The interannual variation of seawater temperature in the southwest coast of Korea is greatly affected by the distribution of low temperature which is strongly correlated with the YSBCW.

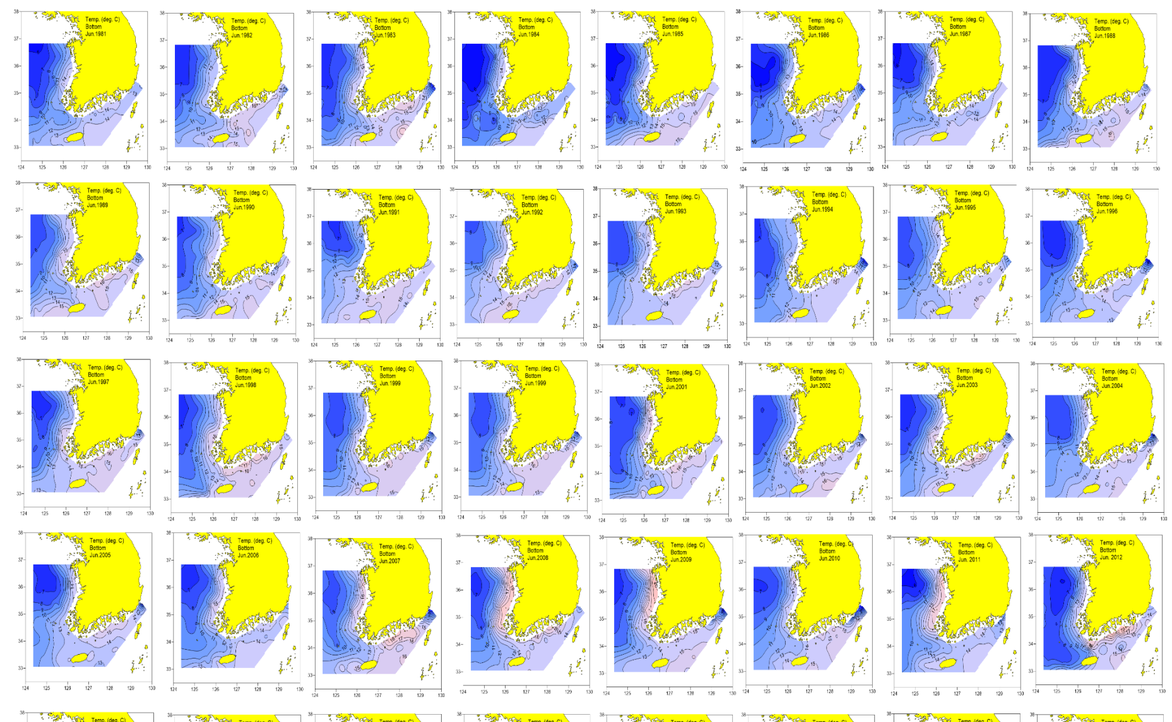




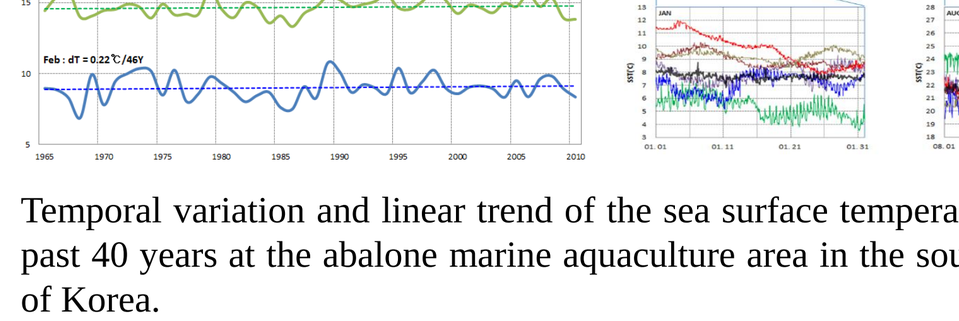
Schematic diagram showing plan view of hydrodynamic observation and vertical profile of current velocity inside and outside of abalone farm cage.



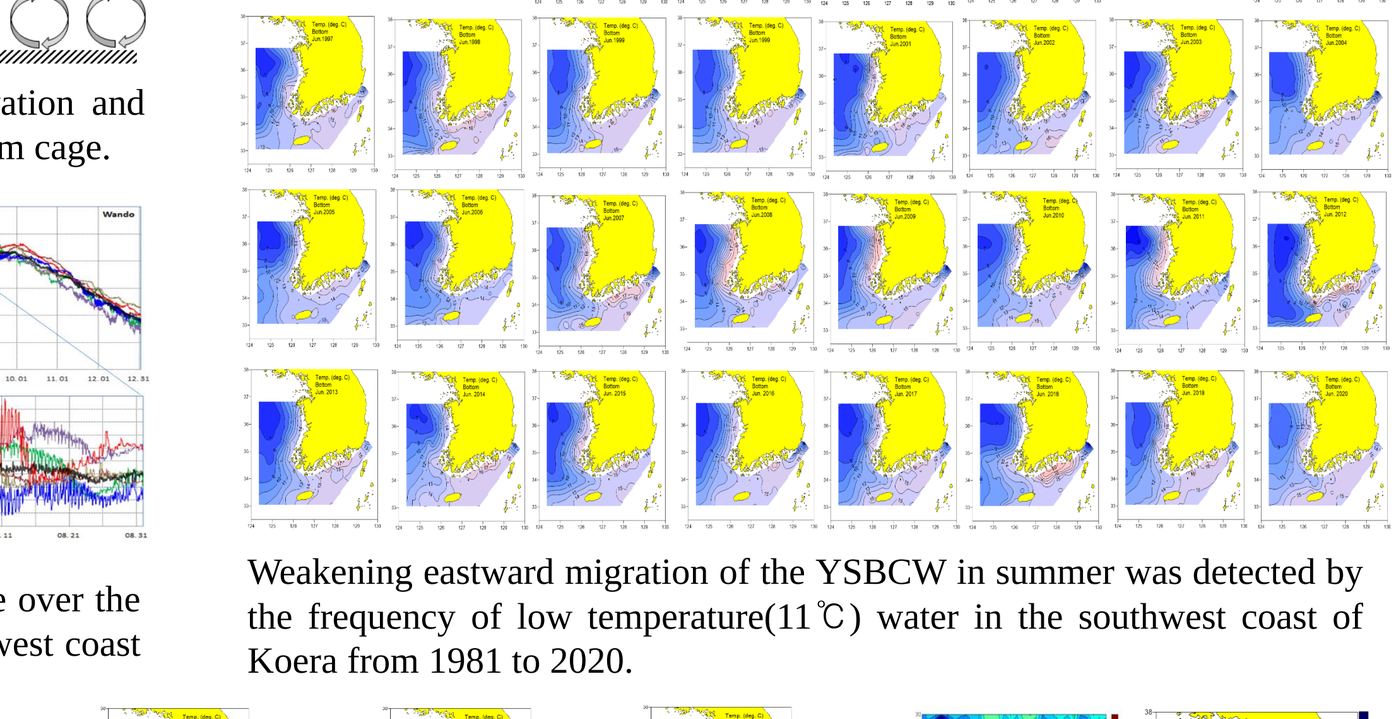
Temporal variation and linear trend of the sea surface temperature over the past 40 years at the abalone marine aquaculture area in the southwest coast of Korea.



Weakening eastward migration of the YSBCW in summer was detected by the frequency of low temperature(11℃) water in the southwest coast of Koera from 1981 to 2020.



Temporal variation of the sea surface temperature which is strongly correlated with the JCW near from the abalone marine aquaculture area in the southwest coast of Korea.



The area and southern limit of the YSBCW in summer is correlated with the Arctic Oscillation in the previous winter. The interannual variation and increasing linear trend of sea surface temperature is more significant in summer than winter.

References

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