Biological production in the water off Cape Inubo and its influence on the biological environment of the Kuroshio Extention region

*Kiyotaka Hidaka[1], Yasuhiro Kamimura[1], Sayaka Sougawa[1], Tsuneo Ono[1], Kosei Komatsu[2]

1. Japan Fisheries Research and Education Agency, 2. The University of Tokyo

The larvae of small pelagic fishes, e.g. Japanese sardine, Japanese anchovy, and Pacific saury, grows through the advection process in the Kuroshio and its surrounding waters. The environmental factors for fishes, which includes water temperature and food abundance, are expected to change geographically and thus process of biological production should be examined in each specific region. In this study, we examined the biological production and physico-chemical process around the Cape Inubo, where Kuroshio change its direction eastward, based on satellite data and oceanographic observation.
Satellite observation: Sea surface temperature (SST) and Sea surface chlorophyll concentration (SSChl) in the area bounded by 135˚30’ –142˚00’ E and 30˚00'–37˚00' N was examined. We used OISST (AVHRR only) for SST and MODIS-Aqua for SSChl and calculated climatological 8 day-mean for 2003–2013. In the study area, the Izu Ridge area was recognized to have depths of 500–3000 m in the area bounded by 138˚15'–141˚15' E and 30˚00'–34˚30' N. The grids in the study area with depths of > 500 m, except for those allocated to the Izu Ridge, were divided at 140˚ E into the Suruga-nada region to the west and the Boso (< 35˚42' N)and the Kashima-nada regions (> 35˚42' N) to the east. The areas assigned to these four sub-regions were further divided based on the location of the Kuroshio Current into the slope (near the coast), the Kuroshio Current (within the current), and offshore of the Kuroshio Current (the subtropical gyre) areas. The highest SSChl in the slope waters of the Suruga-nada and the Boso area was 0.75 and 0.84 $\mu g\ l^{-1}$, respectively, in late March to April in the former and 1 month later in the latter. In the Kashima-nada, the SSChl kept high (> 0.8 $\mu g\ l^{-1}$) from the mid April to the mid June, with the highest value (1.10 $\mu g\ l^{-1}$) among regions.
Field observation: Oceanographic observations were conducted in April 2009 and April–May 2015. At each station, a conductivity-temperature-depth profiler (CTD) cast was made along with water collection from the surface to 1000 m (2009) or 500 m (2015) depth. Water samples for nutrient and chlorophyll analyses were collected and concentrations of nitrate and chlorophyll were determined in the laboratory. Zooplankton were collected by a NORPAC net with a diameter of 450 mm and mesh size of 100 μm. Plankton collected in net pulls from a depth of 50 m to the surface, preserved in 5% buffered formalin-seawater solution, and examined in the laboratory for major taxa. The oceanographic condition in 2015 observation corresponded to the "O–pattern" in the analysis by Kubo (1985), which defined 3 oceanographic patterns for the area. In 2015, the surface water around the Cape Inubo was covered by a water mass, which extends from off Boso to Kashima–nada, with density of 0.25–0.50 kg m^{-3} higher than the surrounding waters. High concentrations of nutrients and chlorophyll were observed around the water mass. The chlorophyll concentrations in stations along the line south of the Cape Inubo were generally less than 2 $\mu g\ l^{-2}$, while higher chlorophyll concentrations (>5 $\mu g\ l^{-2}$) were observed in a station north of the cape. The water mass with the high chlorophyll concentrations had lower salinity than the surface waters of other stations. The neritic copepod species, *Acartia omorii*, was occurred with a high density (> 40,000 inds. m^{-2}) in the station. Thus the water mass was suggested to be advected from the coast of Honshu Island by the cyclonic surface current in the Kashima-nada (Yagi et al, 2001).
The satellite and field observations suggest that advection of and organisms by the surface current and subsurface upwelling of nutrients should both lead to the enhancement of the biological production in the surface, which would contribute to the food conditions of fish larvae/juveniles in the Kuroshio Extension area.

Keywords: Plankton, upstream of the Kuroshio Extension, Kuroshio

