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New environmental information (NCEP) applied for standardized swordfish CPUE of tuna longline fisheries (Japan and Taiwan) in the IOTC WPB6

Tom Nishida[1/,] Hiroshi Matsuura[2/] and Francis Marsac[3/]

1/ National Research Institute of Far Seas Fisheries , Shimizu, Shizuoka, Japan
2/ Cygnus Research International, Yokosuka, Kangawa, Japan
3/ IRD – CRHMT, Sète Cedex, France

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In the standardized (STD) SWO LL CPUE by Semba et al (2008) (Japan) and by Wang et al (Taiwan) for this meeting, we newly applied depth specific temperature, salinity and current data available from the NCEP Global Ocean Data Assimilation System monthly data (GODAS; http://cfs.ncep.noaa.gov/cfs/godas/monthly).

Original data include temperature, salinity and current (u, v) digital data for 28 depth layers , i.e., every 5 m starting from 5m depth to 225m with extra 4 deeper depth layers, i.e., 5m, 15m, 25m, 35m, 45m, 55m ,65m, 75m, 85m, 95m, 105m, 115m, 125m, 135m, 145m, 155m, 165m, 175m, 185m, 195m, 205m, 215m, 225m, 238m, 262m, 303m, 366m and 459m.

These depth specific data were estimated by the spatial models developed by the NCEP. For details refer to its web site. The worldwide NCEP data are available for 28 years from 1980 - 2007 with the resolution of (1/3) degrees in latitude and 1 degree in longitude.

Base on the original data we made following data 5x5 and month sets for the Indian Ocean for 27 years (1980-2006) for STD SWO LL CPUE i.e., (a) depth specific salinity and temperature corresponding to the LL hooks depth, (v) Thermocline depth (TD), (c) salinity and temperature gradients to represent the ocean fronts and (d) shear currents and its amplitudes. These ENV factors are considered to affect SWO habitats.

Following are descriptions how we made these ENV data sets.

(1) Depth specific salinity and temperature

Original data were aggregated then the average salinity and temperature data set were created by 5x5 and month.

(2)TD: Thermocline depths

Depths at 20 ^{o}C is the proxy of the depths of the TD (Mizuno et al and many others). We use this method to compute thermocline depths. We first made TD in the original data then made the average TD by 5x5 and month.

(3) Current shear and amplitude

The current shear, as defined by Bigelow et al (2006), is calculated throughout the water column, as an integration of the horizontal current ($\vec{u}$) from the near-surface to a given depth (Z), usually defined as the maximum depth reached by the hooks of the longline gear :

$$K = \log\left(\frac{\int_0^z \left\| \frac{\partial \vec{u}}{\partial z} \right\| dz}{Z} \right)$$

that can be approximated by :

$$\tilde{K} = \log\left\{ \frac{\sum_{n=1}^{N} \left[\left(\frac{u_{n+1} - u_n}{z_{n+1} - z_n} \right)^2 + \left(\frac{v_{n+1} - v_n}{z_{n+1} - z_n} \right)^2 \right]^{1/2} (z_{n+1} - z_n)}{\sum_{n=1}^{N} (z_{n+1} - z_n)} \right\}$$

where $\tilde{K}$ is the log-transformed vertical shear, u_n the zonal velocity component of layer n, v_n the meridional velocity component of layer n and z_n is the depth of layer n. vertical shear was estimated from the NCEP model by integrating from 5 to 205 m. Values found for this factor in the study area range between -4.65 and -0.09.

We also estimate the amplitude of the current in the water column where the shear is calculated. To do so, we calculate the difference between minimal and maximal current velocities found in the column sampled. This complements the shear current factor by providing a more direct value (in $cm.s^{-1}$) of the heterogeneity of current. Values found for this factor in the study area range between 0.31 and 168.9.

Following the original resolution of the NCEP model output selected, both shear current and amplitude are given by 1/3° latitude and 1° longitude box and month. Then 5x5 and month data set are created.

(4) Ocean fronts

Ocean fronts affect the SWO distributions and densities hence they affect the nominal CPUE (Bigelow, xxxx). To represent the ocean currents we compute the maximum gradients per 100km in eight directions around each pixel. After we select the maximum gradient per 100km we made average gradient by 5x5 and mobth.