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Stock assessment of the longtail tuna, *Thunnus tonggol* in the eastern Arabian sea off the north-west coast of India

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The stock assessment of the Longtail tuna, *Thunnus tonggol* off the North-West coast of India was attempted based on the observations along Gujarat coast, since the state contributes about 85 % of total long tail tuna landing in India. Length frequency and biology data were collected for a period of five years (2012-2016). *T. tonggol* was mostly exploited by gill netters followed by trawlers. The average catch for the decade ending 2016 was 6,908 t with a range from 2,808 t (2009) to 12,136 t (2012). The size of the fishes landed ranged from 25.8 cm to 82.0 cm with a mean length of 58.2 cm. The length-weight relationship was $W=0.122 L^{2.450}$, indicating isometric growth pattern. The growth parameters, estimated using Von Bertalanffy model were, $L_{\infty}=84$ cm, $K=0.270$ year⁻¹ and $t_0=0.073$ years. The total, natural and fishing mortalities were estimated as 1.77 year⁻¹, 0.56 year⁻¹ and 1.21 year⁻¹, with an exploitation ratio of 0.68, indicating moderate exploitation status of the *T. tonggol* stocks along the region. The length at first maturity ($L_{M50\%}$) was recorded as 60.98 cm. Recruitment pattern was observed with a single peak, observed during May-September which accounted for 79% of the total recruitment. Sizes of different probability of capture were estimated at 25% (58. 67 cm), 50% (62.10 cm) and 75% (65.52 cm).

Schaefer model was used to estimate biological reference points (BRP's) by using catch and catch per unit effort as input data. Model output parameters were $MSY = 7,703$ t, Carrying capacity (K) = 28967.41 t, intrinsic growth rate (r) = 1.063, catchability coefficient (q) = $7.27e^{-08}$, $B_{MSY} = 14483.7$ t and $F_{MSY} = 0.532$. The R^2 value between observed CPUE and model CPUE was 0.566 with a positive significant relationship ($p<0.05$). Current exploitation status of *T. tonggol* is moderate; in future, exploitation may be limited to the reference level suggested to sustain the fishery.

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Development of fish freshness assessment sensor

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Considering the increasing awareness and raising standards of food safety, finding out the freshness of the captured fishes available in the market or landing centres is much needed in view of increased use of chemicals used for preserving fishes. In this regard, a study has been conducted at ICAR-Central Institute of Fisheries technology, Kochi to find out the freshness indicators of fish for development of a sensor. Fresh Indian mackerel (*Rastrelliger kanagurta*) was procured from fish landing centre Kalamukku, Kochi, Kerala. The parameters considered to be depicting the extent of freshness of fish after it was caught were analyzed to get status of freshness. Color of fish eye, gill and skin were analysed by taking L^*, a^*, b^* color values using Hunter Color Lab. pH of mouth fluid and blood in belly bottom were tested. Trimethylamine

(TMA), Total Volatile Nitrogen (TVN) values of fish flesh was also analyzed to quantify the extent of spoilage. All the analyses were carried out for a period of 7 days with one day interval. In total, five experiments were conducted in which each experiment had 6 samples analyzed over 7 days storage period. The results revealed that the color values (L^* , a^* , b^*) of skin and gill were not following any particular trend with respect to storage days. However, in color values (L^* , a^* , b^*) of fish eye, reduction in the L value (24 to 20) and increase in a value (0.16 to 2.65) was observed with storage days. The cross examination of Hunter color values with the color of physical photograph also concurred with fish eye color, which turned dark and reddish at the end of storage. The spoilage indicators like TMA and TVN also indicated the extent of spoilage and those values were interpolated to get benchmark color values for fish eye to decide the level of fish freshness.

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Optimization of dietary fibre extraction from *Ulva lactuca* using response surface methodology

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This study was conducted to optimize extraction conditions of dietary fibre from *Ulva lactuca* and to evaluate its functional properties. Response surface methodology (RSM) was adopted following Box-Behnken design to determine the

optimal conditions of three independent variables namely concentration of the enzyme (% w/v, X_1), time of enzyme hydrolysis (minutes, X_2) and temperature of enzyme hydrolysis ($^{\circ}\text{C}$, X_3) for five response variables namely yield, total dietary fibre (TDF), water holding capacity (WHC), oil holding capacity (OHC) and swelling capacity (SWC). The models obtained by RSM produced a satisfactory fit to the data with respect to dietary fibre extraction (for yield: R^2 0.98, $p < 0.0004$; TDF: R^2 0.95, $P < 0.007$; WHC: R^2 0.97, $p < 0.0019$; OHC: R^2 0.93, $p < 0.02$ and SWC: R^2 0.91, $p < 0.03$). The results revealed that the optimum extraction conditions were 0.95%, 60 $^{\circ}\text{C}$ and 63.82 min for enzyme concentration, hydrolysis temperature and hydrolysis time, respectively. Under this optimal condition, the yield, TDF, WHC, OHC and SWC were 22%; 91.36%; 11.14 g/g; 1.24 g/g and 12.47ml/g, respectively. Structural pattern and surface morphology were conducted using Fourier-transformed infrared spectroscopy (FT-IR) analysis and scanning electron microscopy (SEM) analysis. The SEM image of dietary fibre showed irregular, uneven and intact surface morphology. The results showed that RSM can optimize the extraction of dietary fiber from *U. lactuca*. Results indicated that DF extracted from seaweed showed good functional properties, which could be considered as a promising functional food ingredient with wide application in the food industry.

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Dominance of *Noctiluca scintillans* in estuarine region of river Ganga in relation to hydrological parameters

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