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Relationship Between Tuna and Salinity in Tahitian Coastal Waters

During the austral summer (December-April), the current near Tahiti (17°30'S, 150°W) is an extension of the South Equatorial Countercurrent (SECC) which originates in the Solomon Sea, carries fresh water of salinity less than 35.5‰ in the upper 50 m, and flows eastward-southeastward against the prevailing tradewinds (Donguy and Hénin, 1978; Rougerie *et al.*, 1980). This SECC reaches speeds greater than 50 cm s^{-1} and its low salt content remains nearly constant because of the heavy rainfall associated with the South Pa- and sporadic catches during the austral winter (Figure 1). Comparison between variations of surface salinity and number or weight of tuna caught indicates that periods of low salinity correlate very well with large tuna catches (Figure 1); the correlation coefficient for the period 1976-1982 is −0.56. However, if only the periods when salinity is under 35.5‰ and above 36.0‰) (*i.e.*, when the current is primarily zonal and not reversing direction) are considered, the correlation coefficient is −0.82. Thus, there is a strong relationship between the salinity of the surface waters and the rate of tuna catches. Because the near-surface temperature field is nearly constant throughout the year (26°C in summer), the effect of the seasonal temperature variations upon the tuna catch rate is considered to be negligible.

Confirmation of the close relationship between salinity and abundance of tuna was evident during 1978, when the annual average salinity remained low all along the year and the annual tuna catch was the highest of the 1976-1982 period. Furthermore, for the same interval, the minimum monthly salinity (35.0‰) was recorded in the 1978 austral winter when the monthly tuna catch rate (75 tuna per day) was at its maximum.

Is the correlation between salinity and tuna catch rate dependent upon availability of fish and/or method of fishing? Although mature fish and pregnant fish were rarely caught, investigations on gonads have not associated mating period and catch rate. Aerial observations (Petit and Marsac, 1981) have shown that the number of tuna schools was minimal from July to November, indicating a substantial lowering of the number of tuna during the austral winter in Tahitian waters.

Two possible types of migration may explain the seasonal variability of surface tuna catch rate: vertical and geographical. In the case of vertical migration, the catch of asiatic longline vessels would be affected by a seasonal dive of the surface tuna; however, observations do not support this hypothesis. A geographical migration seems more logical because of the seasonal variations of the zonal currents and salinity. After marking tuna, particularly Bonitos, the South Pacific Commission (SPC) showed that trans-oceanic migrations occurred when fish tagged in the western Pacific were captured near Tahiti. Final analysis of the SPC data should reveal the principal migratory path. Donguy *et al.* (1978) found a relationship between surface salinity and quantity of tuna in the equatorial western Pacific. Dessier (1981) observed large zooplankton and copepod populations in the western Pacific and Solomon Sea, where the eastward flowing SECC originates, and small populations in the formation region of the westward moving South Subtropical Water. Thus, the low salinity SECC carries an abundant supply of food during the austral summer when the tuna catch rate is large. During austral winter, In December the SPCZ moves poleward, the southeast tradewinds decrease, and the near-surface current again flows eastward carrying low salinity water. Figure 1 show the mean annual cycle of surface salinity at Tahiti.

Within 100 km around Tahiti, fishing for Skipjack and Yellowfin tuna is done in the surface waters by about fifty pole fishing boats whose total annual catch is about 1500 tons. Studies of seasonal variations of this tuna fishery show large catches during the austral summer months, a rapid slump in June and July, when high salinity and low planktonic subtropical water arrives near Tahiti, the tuna catches are significantly decreasing.

In summary, salinity can be used to identify water masses and favorable fishing zones for tuna.

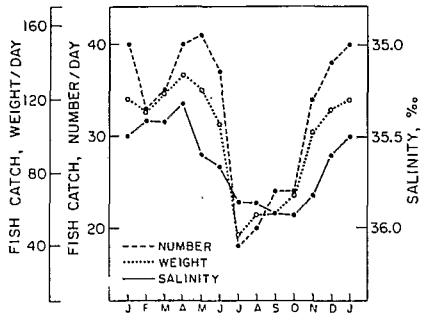

FIGURE 1 *(Rougerie and Chabanne) Mean monthly values of salinity and Skipjack and Yellowfin tuna catch rate for 1976-1982.*

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