EARTH ROTATION VELOCITY AND YELLOWFIN TUNA STOCK VARIATIONS

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The following hypothesis is suggested based on the results of researches by Larraneta M. G. and Vazquez A. (1985): long-term variations of fish production in large ocean ecosystems is determined by the general ocean circulation, and variability of the latter associates to the Earth rotation velocity. Based on this hypothesis variations of recruitment, biomass and age composition of yellowfin tuna, caught from the Pacific and Atlantic oceans, are analysed in relation to the Earth rotation velocity. Larranete M. G. and Vazqµez A. consider two elements of the Earth rotation: rotation velocity and oscillation of instantaneous pole of the Earth rotation. Velocity is measured by the Earth day duration (l. o. d.), and the oscillation of the instantaneous pole of the Earth rotation is measured by its orbit radius projection upon the Greenwitch meridian. Comparison of a fixed dispersion of the latter factor with El-Niño events revealed their coinsidence to the minimum dispersion values at a shift of 4 years. In its turn the dispersion change associates to a piece-broken-lined trend of summer maximum of the Earth rotation velocity (Fig. 1). Based on this association we may conclude that El-Niño event occurres 4 years later the Earth rotation slowing down.

According to the Report of Interamerican Commission on Tropical Tunas, the yellowfin tuna abundance is determined by three factors, such as recruitment, fishing mortality by ages and total fishery yieled. It seems that recruitment in its turn, is determined by natural factors and increased a year later El-Niño event. Comparison of a piece-broken-lined trend of the summer maximum of the Earth rotation velocity shows that recruitment pea s occurred 5 years later the maximum velocity of the Earth rotation (Fig. 2). In early 1980's decrease of small tuna demand resulted in catch lowering.

The nature of relation between El-Niño event and recruitment increase is not understood yet. However it is supposed that egg and larvae abundance varies in relation to the drift into the tropical East Pacific. El-Niño event is considered as one of anomalous variations of the global Ocean and atmospheric circulation when the thermocline deepens and water temperature and sea level rises. Besides the nutrients content in the upper-mixed layer decreases and it result in the fish forage base decrease and redistribution. In the years of moderate and strong El-Niño events tuna catches decrease below the average value over the decade. Tuna catch decrease during El-Niño events and small tuna abundance increase in tropical East Pacific may be caused by its transport at early stage of development from the major spawning areain the Central and West Pacific by the Equatorial countercurrent. This assumption is confirmed, firstly, by comparison between average catch per effort trends, average age in catches and average maturity (Fig. 3). The decreasing trends are observed in small and mostly juvenile tuna catches. Secondly, as can be seen from Figure 3, the decreasing trend associates to the Earth rotation slowing down. It must be noted that a more strong apparent association is observed at surpass shift of the Earth rotation velocity in 12 years. Such temporal shift seems to be caused by a high natural and fishery mortality at early stages of life cycle during the period of the Earth rotation slowing down. This assumption is confirmed by the tuna recruitment trends association to the Earth rotation velocity (Fig. 4). As it is evident from this figure, the recruitment level has been higher before and after the period of the Earth rotation slowing down. The comparison between trends of tuna abundance indices, estimated according to time spent for tuna aggregation searching and the curve of average annual velocity of the Earth rotation at 12-year shift, reveals satisfactory correlation and expected further trend of yellowfin tuna abundance in the Pacific Ocean from 1990 to 200 (Fig. 5).

The similar relation is observed for yellowfin tuna of the Atlantic Ocean. One-year-old fish abundance increases, similar to that in the Pacific Ocean, during the periods of the Earth rotation slowing down, and abundance of 2-year-old fish rises during the periods of velocity acceleration (fig. 6).

It may be interpreted as a result of tuna larvae transport from open ocean spawnign areas by the Equatorial countercurrent and associated increase of 1-year-old fish during the periods of the Earth rotation slowing down. The increase of 2-year-old fish abundance during the period of the Earth rotation acceleration seems to be related to immigration, since the Equatorial countercurrent weakens and thermocline depth decrease during such periods which creates favourable conditions to forage base development. Such interpretation is confirmed by long-term variations of tuna catches age composition. Figure 7 showes the curves of yellowfin tuna abundance by ages. As it can be seen, the abundance of the first four groups decreases during the periods of the Earth rotation slowing down. At the same time the average age of population increases (Fig. 8). Comparison between Fig. 7 and Fig. 8 reveals the recruitment decrease during the period of the Earth rotation slowing down. Thus it can be expected to increase during the period of rotation accelerates. The comparison between the curves of average population age, sea level at Takoradi and the Earth rotation velocity shows that the abundant year-classes occurred at sea level lowering and the Earth rotation acceleration, i. e. during the period of the Equatorial countercurrent weakened. In Fig. 2 the curves of sea level and the Earth rotation velocity are shifted to the right for 9 years. In the Pacific Ocean the similar shift equals to 12 years. Taking in account El-Nino event occurres in 4 years after the Earth rotation slows down, it may be concluded that an abundance variations delay as compared to water circulation is similar in the both Oceans.

Conclusion

The results obtained reveal a positive trend of yellowfin tuna stock state till 2000.

Legends

Fig. 1. Piece-broken-lined trend of the summer maximum of the Earth rotation velocity (a), fixed dispersion of projection of the Earth rotation instantaneous pole (b), El-Niño event (c).

Fig. 2. Deviation of yellowfin tuna recruitment abundance in the tropical East Pacific (1 a and b), piece-broken-lined trend of the summer maximum of the Earth rotation velocity (2a), average individual weight of the tuna caught (2b).

Fig. 3. Integral-differential curves of average catch per effort and average age of yellowfin tuna in the tropical East Pacific; duration of the Earth day at shift of 12 years (dotted line).

Fig. 4. Integral-differential curve of yellowfin tuna recruitment in the tropical East Pacific (1), duration of the Earth day at the shift of 12 years (2).

Fig. 5. Integral-differential curve of yellowfin tuna abundance in the tropical East Pacific (1), duration of the Earth day at the shift of 12 years (2).

Fig. 6. Abundance index of yellowfin tuna in the East Atlantic ocean from 1979 through 1989 (solid line), a piece-broken--lined trend of the summer maximum of the Earth rotation velocity (dotted line).
Abundance index of yellowfin tuna at the age of 2 years (solid line), a piece-broken-lined trend of the Earth rotation velocity summer maximum (dotted line).

Fig. 7. Integral-differential curves of abundance index for age-groups 1 - 1 year, 2 - 2 years, 3 - 3 years, 4 - 4 years, duration of the Earth day (dotted line).

Fig. 8. Integral-differential curves of yellowfin average age in the Earth Atlantic (solid line), sea level at Takoradi (dotted line), the Earth day duration (thin line).

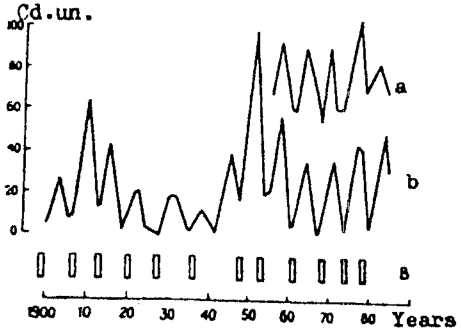

Fig. 1

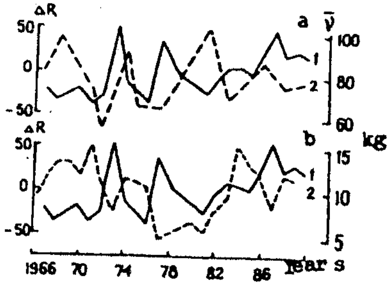

Fig. 2

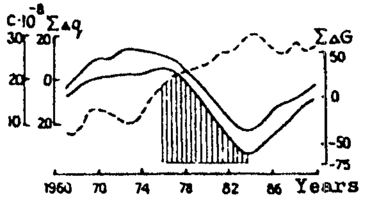

Fig. 3

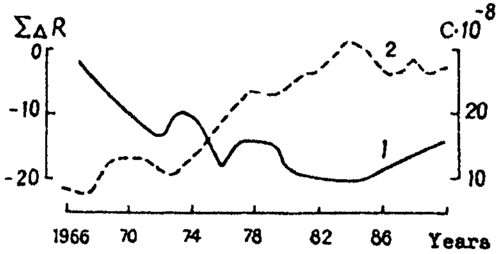

Fig. 4

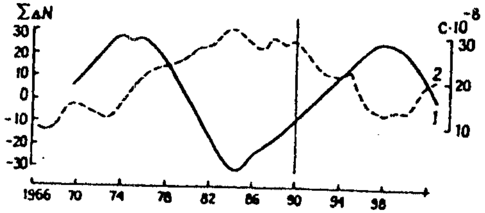

Fig. 5

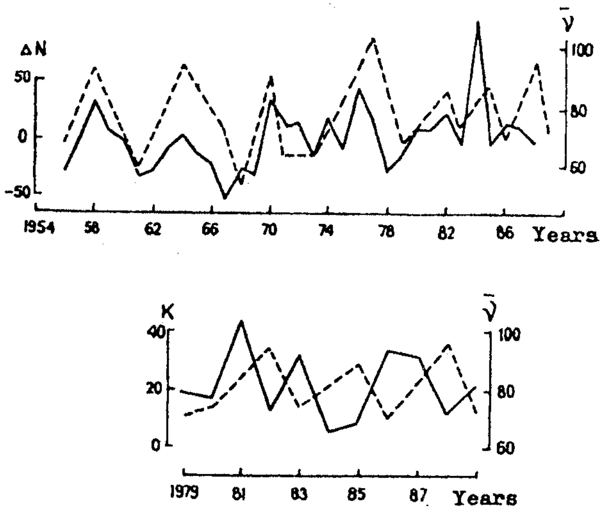

Fig. 6

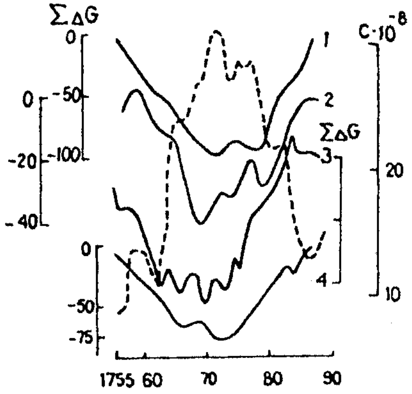

Fig. 7

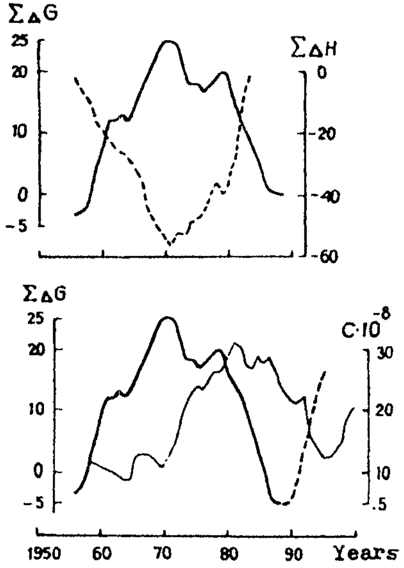

Fig. 8