GOLT as a clarification to Fishers' perceptions over recent trends in the pelagic fish catches in the Indian Ocean by Sri Lanka: a preliminary analysis

Nuwan D.P. Gunawardane

Department of Fisheries and Aquatic Resources, New Secretariat, Maligawatte, Colombo 10, Sri Lanka

ABSTRACT

In Sri Lanka, multi-day fishing operations are carried out by inboard multiday boats (IMUL). These boats usually target pelagic tuna and tuna-like species using drift gillnets, longlines and a small-scale surrounding net called ring nets. that although there was an increase in pelagic fish catches until around 2010, particularly yellowfin and skipjack tuna, catches of almost all pelagic fish species had a spectacular decrease over the years according to the IOTC data. . Fishermen also complaining on the same aspect claiming that there have been declining trends in the catch composition of target pelagic species. Results of a questionnaire survey indicated 64.7% of the skippers were of the view that the shifting of productive fishing locations of pelagic species was possibly due to changes in oceanic characteristics. An attempt was made to explain the trends of and fishers' attitudes about changes in pelagic catches in the Indian Ocean via GOLT theory. Results of GOLT analysis indicated that, pelagic fish species in the Indian Ocean off Sri Lanka can be considered to be susceptible to deoxygenation due to elevated sea temperature. It is therefore imperative that the regional fisheries management organizations such as IOTC consider, when defining data collection and analysis process and regional fisheries management plans, the possible shifting of pelagic fish stocks due to deoxygenation associated with increased sea surface and sub-surface temperature as an area of concern in addition to control of the amount of fishing

Keywords: climate change adaptations; GOLT; highly migratory fish; tropical tuna

1. current production trends

Annual production data and catch composition of pelagic fish species in the fleet of inboard multiday boats (IMULs) in the Indian Ocean off Sri Lanka from 1990 to 2000 (IOTC Historical Catch database of 2021/22) indicated that catches of almost all pelagic fish species had a spectacular decrease over the years. Fishermen also complaining on the same aspect claiming that there have been declining trends in the catch composition of target pelagic species.

Accordingly the present study was carriedout with an objective to find the catch decreses patters and the possible reasons for those changes. A questionnaire was adopt to gather information to extract the ideas of skippers of multiday boats and their ideas about the change of productive fishing grounds. Randomly selected skippers of IMULs operating from 14 fisheries harbours were selected for the quetionare servey.

Results of the questionare servey indicaed that 64.7% of the skippers were of the view that the shifting of productive fishing locations of pelagic species was possibly due to changes in water temperature, and water current patterns under the climate change scenarios. Skippers' perspectives about the change in productive fishing grounds.

2. The GOLT

In this preliminary analysis, it was hypothesized that the occurrence of pelagic fish species in a given location in the sea is dependent on the oxygen availability as postulated by the Gill Oxygen Limitation Theory (GOLT; Pauly 2021). The gill-oxygen limitation theory (GOLT) provides mechanisms for key aspects of the biology (food conversion efficiency, growth and its response to temperature, the timing of maturation, and others) of water-breathing ectotherms (WBEs). The GOLT's basic tenet is that the surface area of the gills or other respiratory surfaces of WBE cannot, as two-dimensional structures, supply them with sufficient oxygen to keep up with the growth of their three-dimensional bodies. Thus, a lower relative oxygen supply induces sexual maturation, and later a slowing and cessation of growth, along with an increase of physiological processes relying on glycolytic enzymes and a declining role of oxidative enzymes.

An attept was made to explain the trends of and fishers' attitudes about changes in pelagic catches in the Indian Ocean via GOLT theory. Here the fact of, that larger latitudinal shifts of fish communities resulting low catch species diversity and/or movement of communities to deeper waters were suggested to occur due to oxygen limitation (Young et al., 2019; Pauly 2019).

3. GOLT applicable for pelagic fish species of Indian Ocean

Asymptotic lengths (L_∞), minimum sizes of maturity of females (L_m), and exponents of length-weight relationships (b) of 18 pelagic fish species that are frequently caught in the Indian ocean obtained from various sources were used to investigate whether they conform to GOLT (Pauly 2021). L_∞^D vs L_m^D of each species put in to a graph to identiftythe relationship and the slo of that graph was calculated as 1.36 (with a 95% CI), substantiating GOLT because this slope was identical to the value that was hypothesized by Pauly (1984).

It is evident from the above analysis that 18 pelagic fish species in the Indian Ocean are confinged to the GOLT, which is shown to be consistent across marine and freshwater fish (Chen et al., 2022). As such, pelagic fish species in the Indian Ocean off Sri Lanka can be considered to be susceptible to deoxygenation due to elevated sea temperature. As mentioned above, when there is oxygen limitation, Pauly (2019), presenting the main features of GOLT, has mentioned that sensitivity to temperature extremes forces the poleward migration of fish, and/or increases in the depth in which they occur. The declined trends in the production of pelagic fish species in the Indian Ocean off Sri Lanka may possibly be due to such habitat shifting, resulting in reduced catches in IMULs because pelagic fish schools having unique temperature affinities such as tuna might move either to deeper, cooler waters or poleward.

It is therefore imperative that the regional fisheries management organizations such as IOTC consider, when defining data collection and analysis process and regional fisheries management plans, the possible shifting of pelagic fish stocks due to deoxygenation associated with increased sea surface and sub-surface temperature as an area of concern in addition to control of the amount of fishing.