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Consideration on high jump of Japanese longline CPUE for bigeye and yellowfin tuna in the late 1970s in the Indian Ocean

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Abstract

High jump of Japanese longline CPUE for bigeye and yellowfin tuna in the late 1970s has been a concern. One possibility was due to error in inputting or compiling logbook data, and so original logbook sheets were sampled and checked. As a result, there is almost no difference of catch and effort data between in the original logbook sheets and logbook database. Sharp increase in CPUE in the late 1970s was partly observed in other ocean as well including other longline fleets, although it was not universal. These implies that something happened for the stock or catchability, but the reason is still unclear.

1. Introduction

It has been a concern and mystery that bigeye and yellowfin tuna (especially bigeye) CPUE in the Indian Ocean by Japanese longline sharply increased in the late 1970s. In detail, as for bigeye tuna in the tropical area, CPUE sharply increased in 1977, kept high level in 1978 and decreased sharply in 1979 (Fig. 1). Similar phenomenon is observed for yellowfin tuna, although not so clear as for bigeye tuna (Fig. 2). It is unnatural that the amount of adult biomass suddenly increases.

Okamoto et al. (2001) investigated the cause of this phenomenon by examining two hypotheses: 1) concentration of fishing effort had occurred in the relatively narrow and high CPUE region in the Indian Ocean, and 2) in 1977 and 1978, enormous recruitment had occurred in the bigeye stock that was exploited by the longline fishery. Observing geographical distribution of effort and CPUE, and distribution of size specific CPUE, the first hypothesis was not supported. Sample length frequencies of the fish in tropical area in this Ocean did not indicate of strong year class, then second hypothesis was not also supported.

One possibility of the reason for this phenomenon is input and/or compile error for Japanese longline logbook data. To confirm this issue, we checked logbook data by randomly sampling and comparing with the data in the catch and effort database. We also reviewed and compared with CPUEs for yellowfin and bigeye tuna by Japanese longline in the other oceans.

2. Materials and methods

Comparison of logbook data:

Logbooks for ten cruises in each year during 1975-1980, which operated in the Indian Ocean, were randomly selected. During this period, one cruise (one logbook ID) corresponds to operations in one month. For the selected cruises, number of hooks and catch in number of bigeye and yellowfin tuna for each operation in the original logbook sheets were compared with those in the logbook database.

CPUE in the other oceans:

Bigeye and yellowfin tuna CPUEs in the other oceans were reviewed to see if high jump is observed in the late 1970s. As for western and central Pacific Ocean (WCPO: west of 150°W), nominal CPUE (number of fish per 1000 hooks) for bigeye and yellowfin tuna was calculated based on Japanese longline fishery logbook database (operational data). As for eastern Pacific Ocean (EPO), standardized CPUE of bigeye tuna by Japanese longline used for stock assessment in IATTC SAC8 (Aires-da-Silva et al., 2017) was used for comparison.

3. Results

Comparison of catch and efforts for the sampled cruises

Table 1 shows summary of comparison of catch and effort for the sampled cruises of Japanese longline between logbook database and original logbook sheets. There was no difference of fishing effort and catch of yellowfin tuna. There was very slight difference of the catch (two individuals) of bigeye tuna. This means that there seems to be no errors in compiling Japanese longline logbook database.

CPUE in the other oceans:

Fig. 3 shows the trend of nominal CPUE of bigeye and yellowfin tuna in the western and central Pacific (WCPO), and standardized CPUE of bigeye tuna in the eastern Pacific (EPO). Although nominal yellowfin tuna CPUE in the WCPO shows comparatively large jump in 1977, which coincides with that in the Indian Ocean, no large increase is observed for bigeye tuna CPUE in the WCPO.

4. Discussion

As a result of checking the original logbook sheets, we found that it is not likely that high jump of CPUE is due to error in the catch-effort data.

Comparison of CPUEs with those in the other oceans indicated that high jump in the late 1970s is partly observed but not universal. Okamoto et al. (2001) pointed out that high jump of CPUE in the late 1970s is observed for yellowfin tuna CPUE by Taiwanese longline in the Indian Ocean, bigeye tuna CPUE by Korean longline in the Indian Ocean, bigeye tuna CPUE by Japanese longline in the Atlantic Ocean, and yellowfin tuna CPUE by Japanese longline in the Pacific Ocean as well.

Taking these results in consideration, something may have occurred in several oceans, such as, change in oceanography, during this period. It may not be easy to elucidate this issue, but we will continue considering.

4. References

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Table 1. Summary of comparison of catch and effort for the sampled cruises of Japanese longline between logbook database and original logbook sheets.

		Logbook database			Original logbook sheet				
Year	Number of operations	Number of hooks	Bigeye in number	Yellowfin in number	Number of hooks	Bigeye in number	Yellowfin in number	Total hooks x1000	Coverage
1975	272	597,266	2,611	6,640	597,266	2,611	6,640	90,236	0.7%
1976	238	527,857	2,162	5,319	527,857	2,162	5,321	80,284	0.7%
1977	205	521,829	6,672	9,148	521,829	6,672	9,148	62,583	0.8%
1978	259	667,166	11,723	4,862	667,166	11,723	4,862	69,281	1.0%
1979	244	523,258	4,329	3,681	523,258	4,329	3,681	67,728	0.8%
1980	268	598,863	5,100	5,435	598,863	5,100	5,435	91,661	0.7%
Total	1,486	3,436,239	32,597	35,085	3,436,239	32,597	35,087	461,773	0.7%

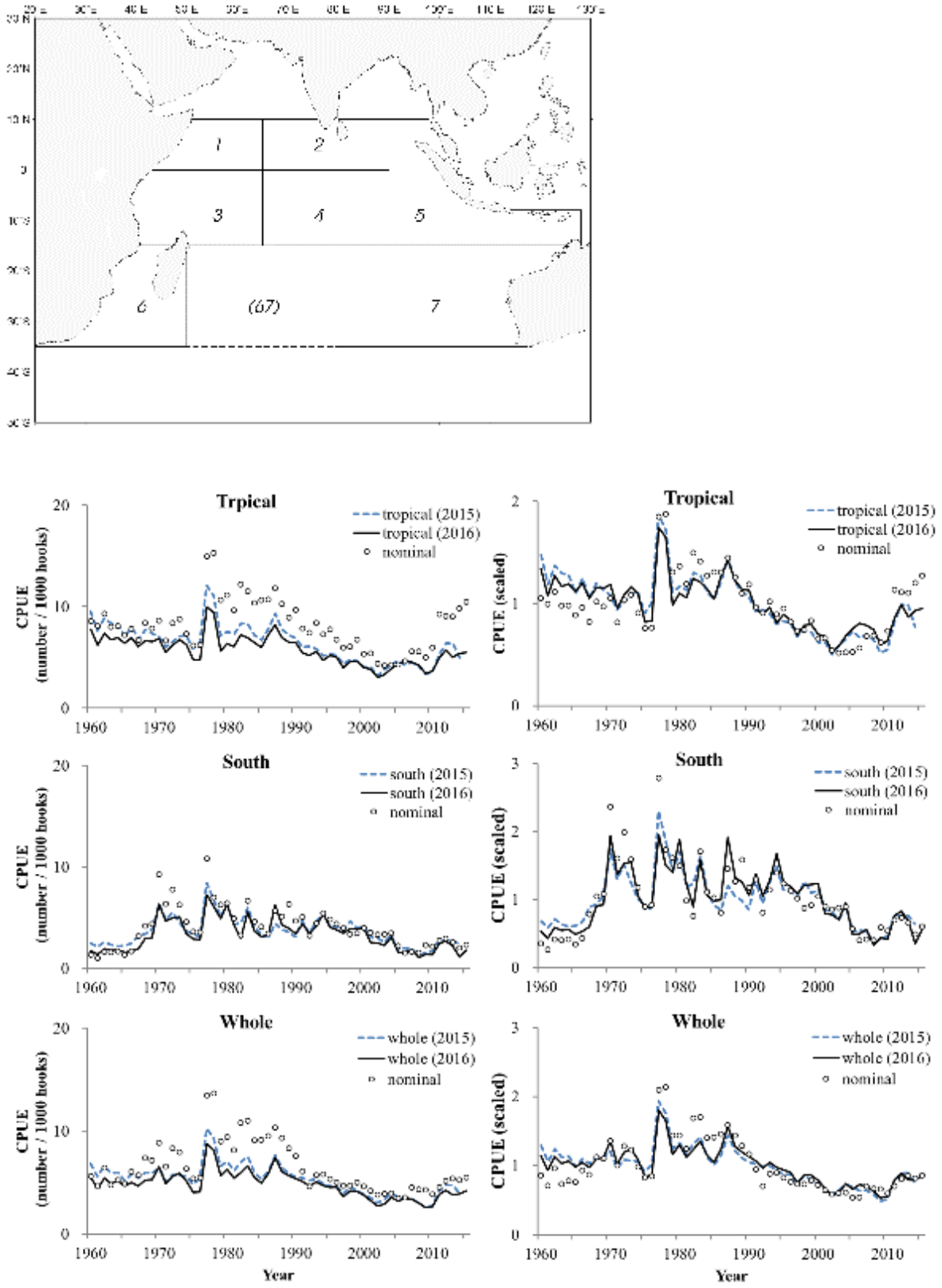

Fig. 1. Japanese longline CPUE (left: real scale, right: relative scale) of bigeye with definition of areas. The tropical, south and whole Indian Ocean regions consist of areas 1-5, areas 6-7 and areas1-7, respectively. Area 67 was not used in this study (Matsumoto et al., 2016a).

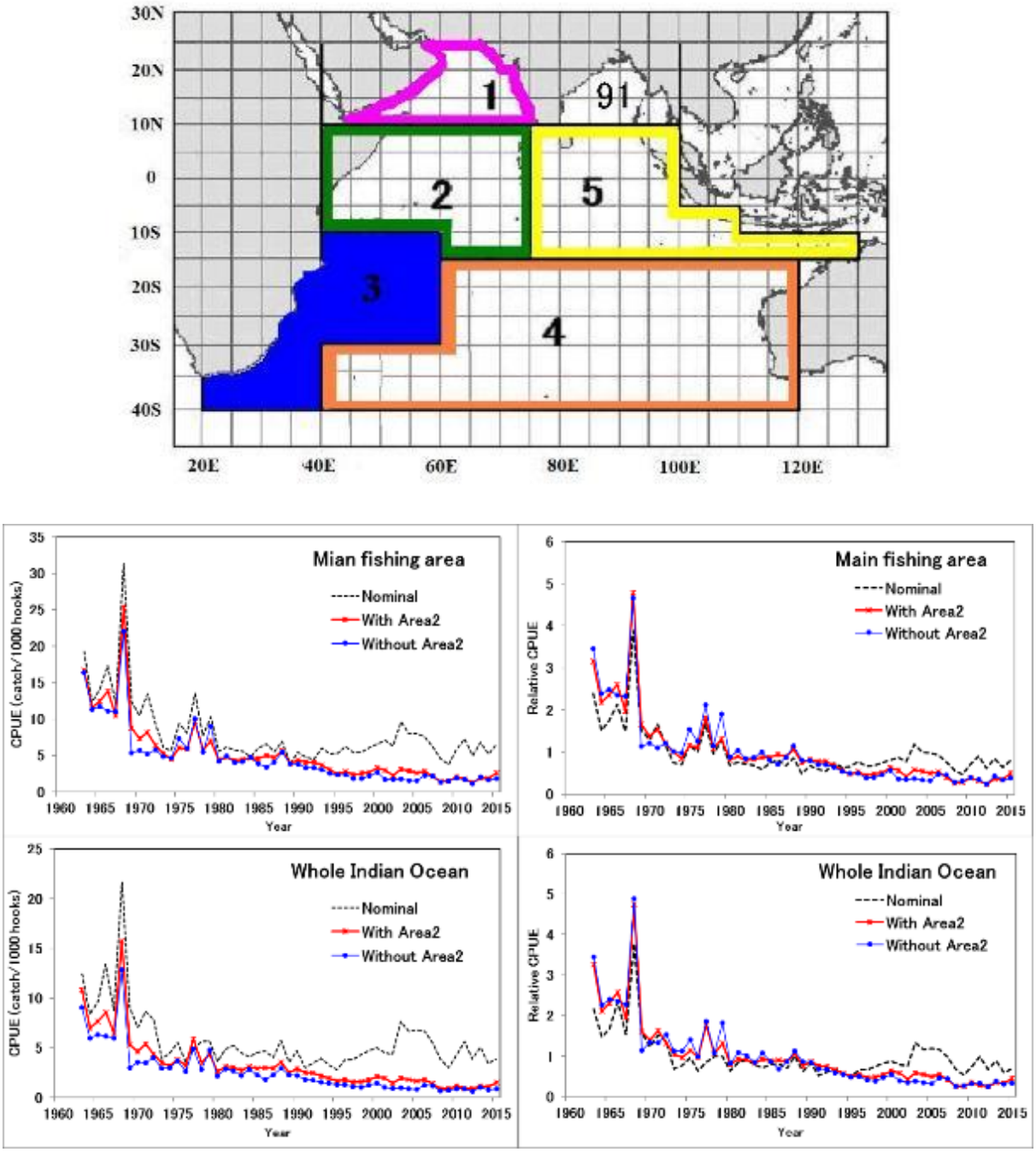

Fig. 2. Japanese longline CPUE (left: real scale, right: relative scale) of yellowfin tuna with definition of areas. Main (areas 2, 3 and 5) and whole (areas 2-5) fishing ground categories (Matsumoto et al., 2016b).

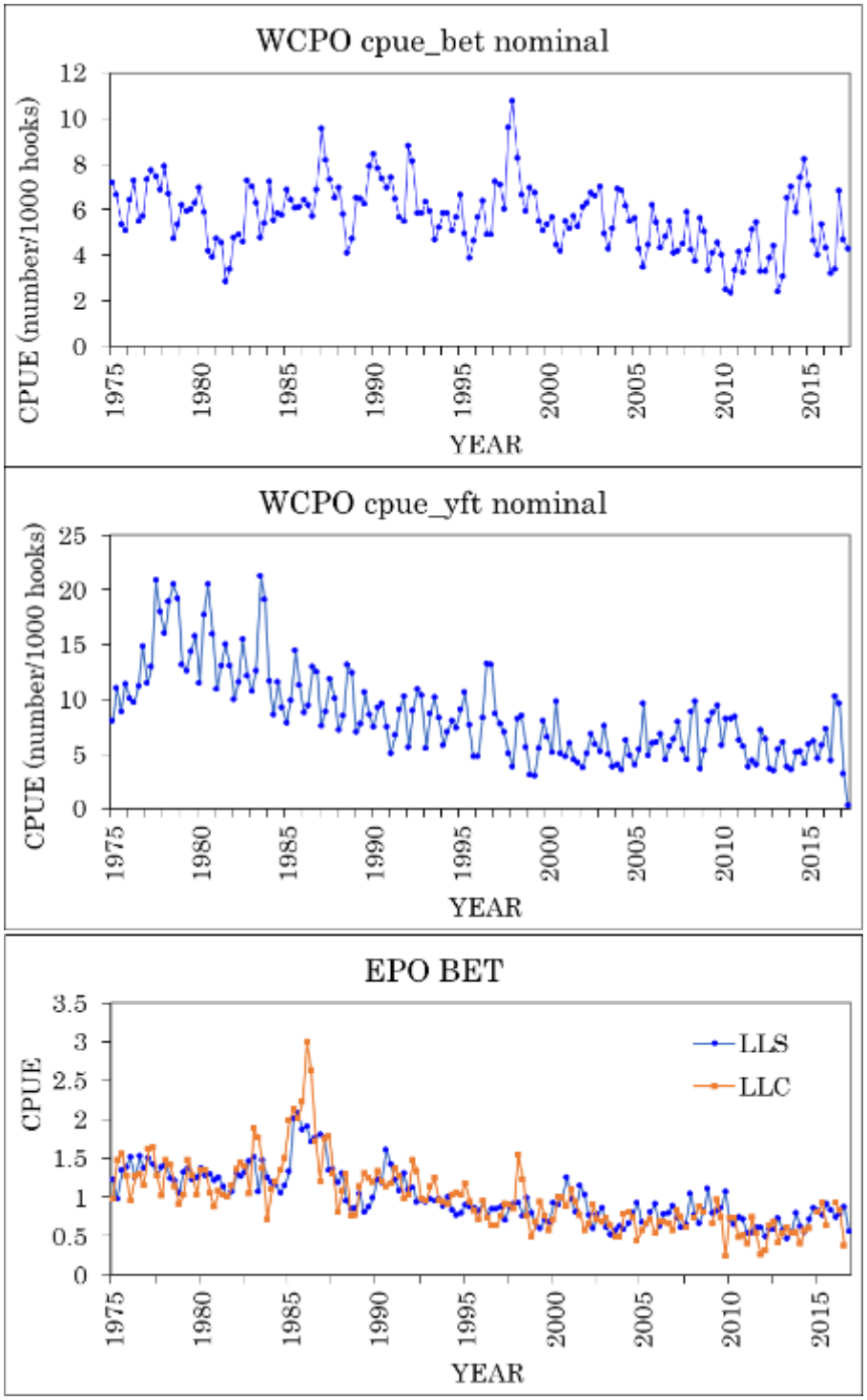

Fig. 3. Trend of nominal CPUE of bigeye and yellowfin tuna in the western and central Pacific (WCPO), and standardized CPUE of bigeye tuna in the eastern Pacific (EPO) by Japanese longline (data source: Aires-da-Silva et al., 2017). "LLS" and "LLC" indicate between equator and 10˚S, and south of equator and west of 100˚W, respectively.