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Short note on the Japanese longline gear configuration as targeting index

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Abstract

NHF (The number of hooks between float) has usually used as a targeting index in the standardization of longline CPUE for tunas and billfishes. Relationship between the NHF, gear depth and targeting was shortly discussed in this paper. NHF is not indicator of absolute depth of gear because larger NHF does not necessarily mean larger depth. Therefore, it is not appropriate to expect "hooks per basket (HPB) is a good proxy indicator of the maximum fishing depth in drifting longline fishery" Important and essential assumption for NHF as targeting index is that gear depth of the same NHF operations are relatively similar in the same strata (ex. year-area strata or quarter-area strata). In the early 1990s, NHF increased abruptly about 5 or 6, and 4 in the tropical and temperate areas, respectively. This rapid increase of NHF seems to be derived mainly from introduction of Nylon material to longline gear rather than any target shifting. Therefore, it would be needed to apply gear material information in the model for standardization.

Introduction

As a convenient method to grasp the abundance trend of tuna resource, longline CPUE has usually been used as abundance index. However, as CPUE is affected by factors other than change in abundance, it is necessary to remove those effects to extract real abundance trend. In order to standardize the difference in catchability by targeting, NHF (Number of Hooks between Floats) has often been applied into the model for standardization. This NHF is apt to be simply interpreted as absolute gear depth, misleadingly.

In this paper, relationships between longline gear configuration, gear depth and targeting would be discussed shortly.

Gear configuration and gear depth:

It is well known that the target species for Japanese longliners in the tropical ocean shifted in the middle of 1970s from yellowfin as mainly material for processed food to bigeye as material of "sashimi", accompanied with the shift of gear configuration from regular longline (NHF 5-6) to deep longline (NHF 10 or more, Suzuki 1977) . Historical change of NHF in the Indian Ocean, which was classified into 6 classes (Fig. 1), is showing well the shift of the gear configuration at tropical area, those days. Perhaps because this large and rapid increase in NHF was occurred to catch of bigeye which dwells deeper water than yellowfin effectively, sometimes it has been misunderstood that NHF itself is the indicator of absolute depth of longline gear.

Longline gear depth, that is, the depth of hook is determined by size of gear (length of float line, branch line length, and length of main line between branch lines), NHF (the number of hooks between floats) and sagging rate of main line. Using these data of gear configurations, theoretical gear depth can be calculated. In different words, exact theoretical gear depth can not be estimated without any one of these data.

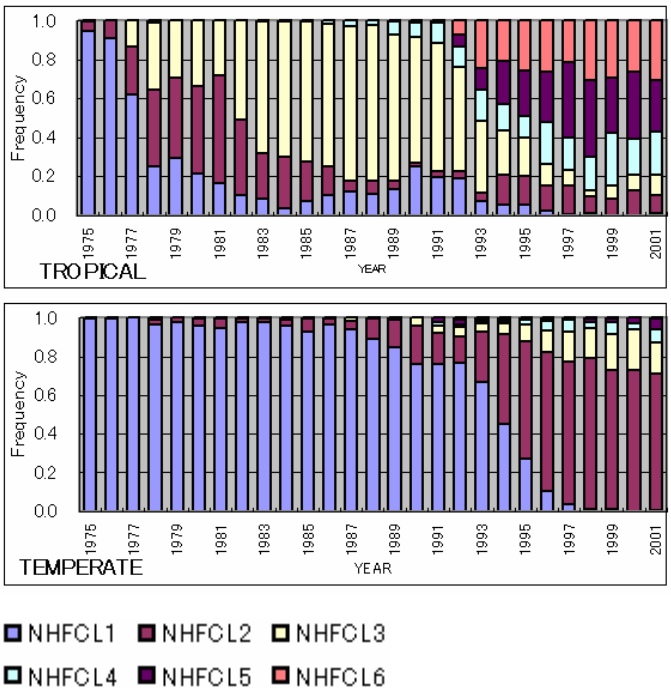

Fig. 1. Change in NHF divided into six classes (NHFCL 1: 5-7, NHFCL 2: 8-10, NHFCL 3: 11-13, NHFCL 4: 14-16, NHFCL 5: 17-19, NHFCL 6: 20-21) in the tropical and temperate Indian Ocean.

As described above, longline gear used in the tropical waters shifted in the middle 1970s from regular longline (NHF 5-6) to deep longline (NHF 10 or more). In the late 1970s, NHF 12 or 13 was popular at the equatorial waters targeting bigeye and its typical gear configurations were float line = 30 - 52 m, branch line = 36 – 42 m, length of mainline between branch line = 47 m (unpublished data). If sagging rate is assumed to be 80%, deepest hook of this gear is estimated to be 230 – 270 m. Longline gear of NHF 10 or more was reported to be used at least before middle of the 1960s (Shapiro 1950, or in "Katsuo-Maguro Soran" published in 1963) at temperate waters east off Japan to catch albacore. This gear which was called as "Tombo-nawa (albacore longline)", however, was not deep longline but was set **at shallower depth**. According to the example of Albacore longline gear shown in Shapiro (1950), its gear configuration was NHF = 13, float line = 27 m, branch line = 8m, length of mainline between branch lines = 19m. Assuming the sagging rate, 80%, deepest hook depth for this gear is estimated to be about 100 m, more than 100 m shallower than that of equatorial longline in the late 1970s. This example clearly shows that one can not know the absolute depth by NHF only. Therefore, it is not appropriate to expect "hooks per basket (HPB) is a good proxy indicator of the maximum fishing depth in drifting longline fishery".

NHF as targeting index:

NHF has been used as targeting index in the model to standardize longline CPUE for main tuna and tuna like species caught by longline. It should be minded that the targeting index is not equivalent to depth index because larger NHF does not necessarily mean larger depth. If the same NHF is used, gear depth is theoretically quite variable depending on other factors of gear configuration such as main line length between float or sagging rate as the example of albacore and equatorial longline gears. It would be possible that NHF 20 is shallower than NHF 16. It is also possible that in a period, NHF 20 is targeting YFT at shallow depth in one area while the same

NHF is targeting BET at deep water in another area. In these cases, adequate area partition is needed and including interaction between NHF and area in to a model would be necessary to standardize CPUE, appropriately. **Important and essential assumption for NHF as targeting index is that gear depth of the same NHF operations are relatively similar in the same strata (ex. year-area strata or quarter-area strata).** In different words, as far as in the same strata and same NHF, gear configurations other than NHF (float line length, branch line length, length of main line between branch line, and sagging rate) should be relatively similar. Therefore, if quite different configurations, ex. 50% and 90% sagging rates, are used with one NHF to target different species in the same strata, validity of NHF as targeting index would be reduced. Then, how can we confirm the validity of NHF as targeting index? One method available would be ANOVA (Analysis of Variance). If NHF is not representative as target index in the strata, effect of NHF in the model of standardization must become not significant.

There is one concern on the NHF as targeting index in the Indian Ocean. In the early 1990s, NHF increased abruptly about 5 or 6, and 4 in the tropical and temperate areas, respectively (Figs. 1 and 2, Okamoto et al. 2004). This rapid increase of NHF seems to be derived mainly from introduction of Nylon material to longline gear rather than any target shifting (Okamoto 2005). Although it might be reasonable to suppose that the different gear material would cause the difference in catchability for species caught, the same NHF of different material can not be distinguished in the model by only NHF information. Therefore, it is needed to include gear material information as explanatory variable in the model with interaction between NHF and gear material. In Japanese logbook, the gear material (Nylon or Other) has been recorded since 1994 about five years after the introduction the new materials. In the latest standardization of Japanese longline CPUE for bigeye, this information has been applied in the model of GLM (Okamoto and Shono 2006).

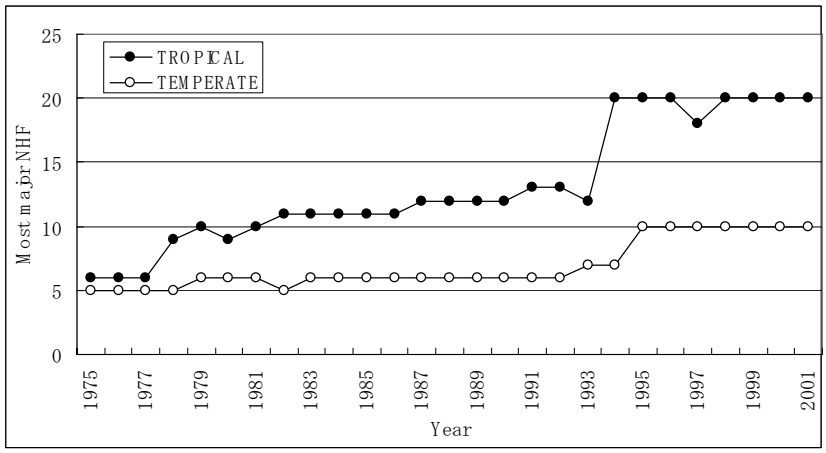

Fig. 2. Change in the most major NHF in Tropical and Temperate Areas.

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