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# SOME COMMENTS ON THE Y/R STUDY

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## Some comments on the Y/R study

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In the so-called Y/R-model, the process to materialize the amount of catch is extremely simplified considering the incomplete nature of available information. Principally, the amount of catch, Y, comes out through the process below;

$$Y = R \times Y/R$$

So, Y/R is only a fraction of elements to decide Y. The conditions for Y/R to be a practical representation of the amount of yield are;
1. constant amount of recruitment
2. constant factors, F, M, K etc. throughout lifespan
3. immediate completion of recruitment

To supplement the insufficient efficiency of simplified Y/R as representation of yield, varieties of modification have been made in relation to the above mentioned conditions. Studies on yield model on the basis of age dependent change in F, M etc. or those on the problem in reproduction, for instance, are intended to overcome such deficiency.

Some further trials to find out measures to improve the validity of Y/R are presented below as a material for discussion.

Trial-1. Modification of Y/R model to response to real conditions of the existing fishery:

Let's consider the cases in which more than two fisheries with different character are in operation. One of such fisheries is observed in albacore fishery in the Indian Ocean, in which mature group (older than 6 years old) and immature (younger than 6 years old) are fished in completely separated areas. And the fishing intensity (fishing effort) changes rather independently in each fishery. However, amount of recruitment to the fishery on mature fish is onesidedly influenced by the other which exploit the immature group in advance. The result of calculation of Y/R is demonstrated in Fig. 1.

Another case is albacore fishery in the North Pacific, where more than two different fisheries in nature concurrently exploit the same stock. In this case, a Y/R model with age dependent change in F is practical.

Trial-2. Y/R model with variable recruitment:

If information on reproduction is, more or less, available, it appears that trial calculation of Y/R with changable recruitment would provide with useful key for the future development of study. In this model, character of "Critical line", beyond which sustainable reproduction can not be expected, is influenced by
1) character of reproduction curve

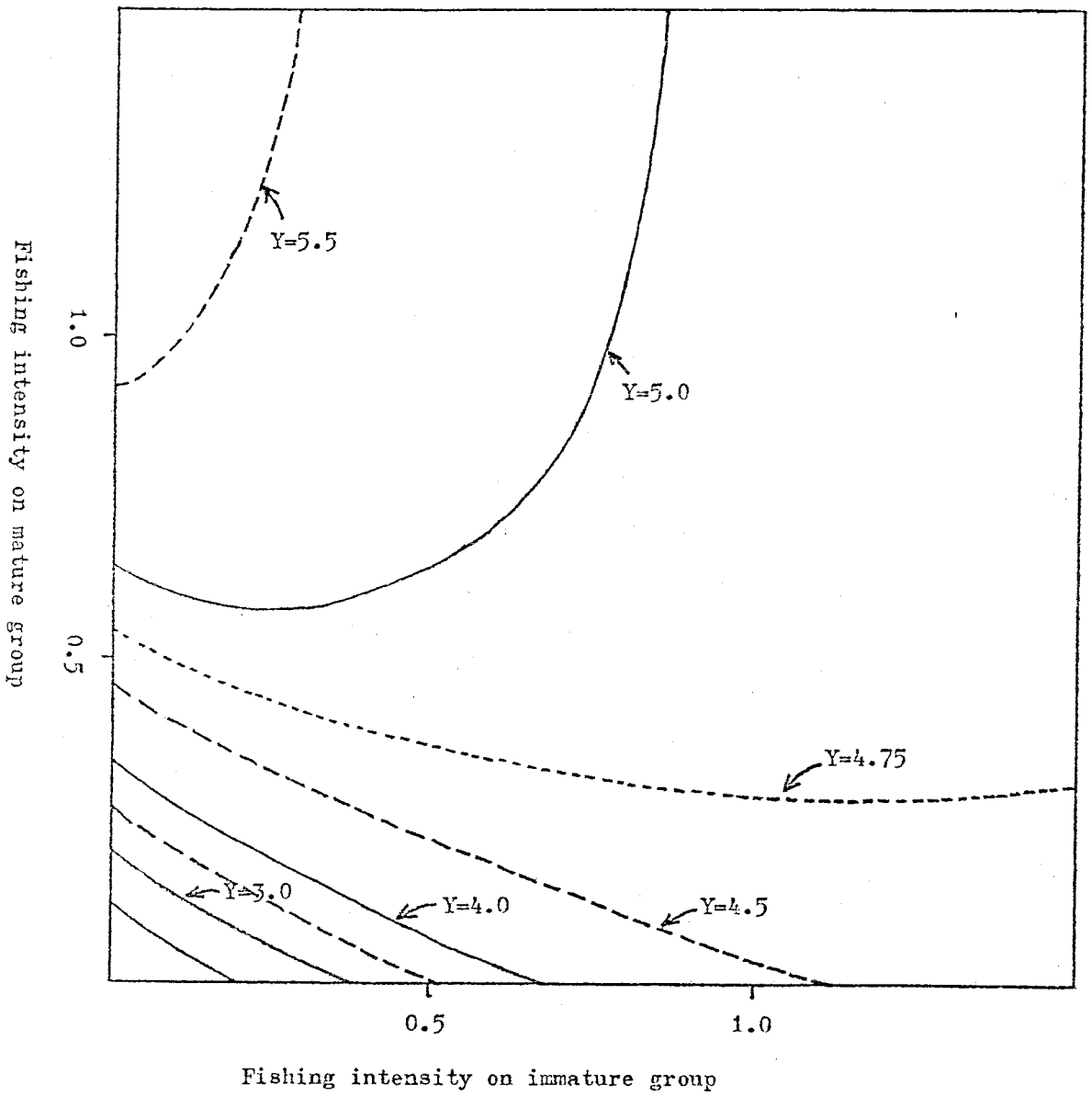
2) age dependent change in group maturity
3) nature of size (or age) selectivity of gear (or fishing ground)
The relationship between "Critical line" (0-contour line) and "Eumetric line" especially attracts attention. In the case of North Pacific albacore fishery in which fishing efforts are concentrated on immature group (Fig. 2-1), the two lines are positioned closely each other and yield-contour lines are concentrated between the two lines. It seems that, if fishing intensity increases beyond the eumetric line, amount of catch and CPUE may decrease rapidly to attain to the critical level. Bigeye tuna get matured younger than albacore and proportion of immature fish in commercial catch is less for bigeye than for albacore. And decrease in amount of yield for bigeye occurs less markedly on the righthand side of eumetric line (Fig. 2-2).

Trial-3. Observation on sequential recruitment and its influence on calculated amount of Y/R value:

It is experienced that the recruitment to the fishable stock needs some time period to be completed. The Pacific bigeye takes four years from 2 to 5 age to be fully recruited. 8%, 21%, 39% and 32% of a breeding enter fishery at 2, 3, 4 and 5 age respectively. In the case of longline caught yellowfin in the central and western tropical Pacific, 0.6% of a breeding enter fishery at 1 or 5 age, 19% at 2 or 4 age and 60% at 3 age. As to the effect of calculation of Y/R under the supposition of immediate recruitment for a fishable stock that is recruited sequentially, taking the Pacific bigeye as an example, Suda(1970) suggested it is rather insignificant (Fig. 3).

It is, however, likely that varieties in features of reproduction curve, group maturity and/or size selectivity of gear may generate different consequence.

Not only the nature of recruitment but also that of dispersion from fishery, the latter of which will perhaps takes long duration again, must be observed. It appears that inconveniences be generated through the rather independent treatment of $t_c$ and $t_d$ so that both parameters may be better understood by considering together as an indicator of size selectivity of the gear.




Fig/ 1. Y/R value for the albacore in the Indian Ocean exploited by two types of fishery, the fishery depending on immature group south of 30S and fishing on mature group between 10S and 30S

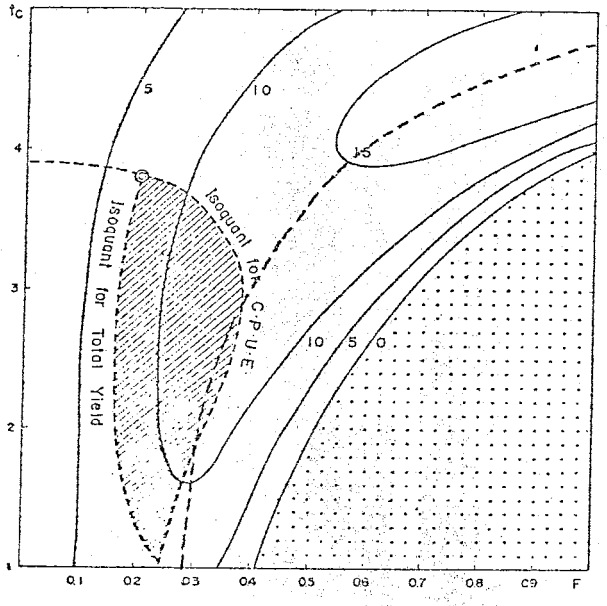



Fig. 2-1. Y/R value for the North Pacific albacore with changable recruitment

Full line: Contour line for amount of yield
Broken line: Eumetric yield line

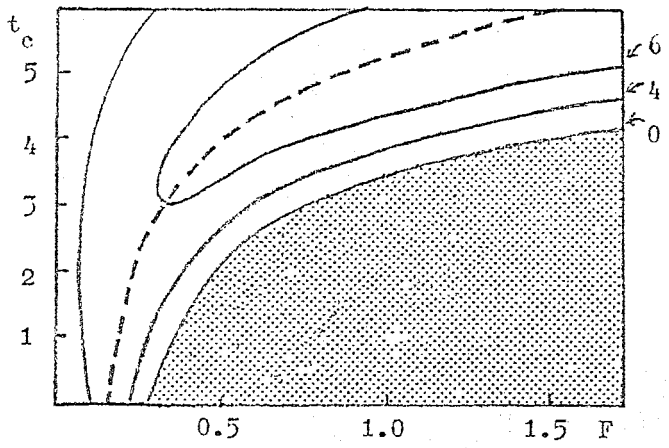



Fig. 2-2. Y/R value for the Pacific bigeye with changable recruitment

Full line: Contour line for amount of yield in ten thousand tons
Broken line: Eumetric yield line

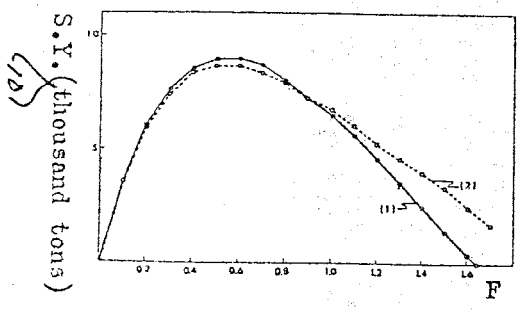



Fig. 3. Comparison of two calculated sustainable yield curves of the Pacific bigeye tuna

Curve (1): calculated on the basis of immediate recruitment
Curve (2): calculated on the basis of sequential recruitment