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ON THE GROWTH OF YELLOWFIN AND BIGEYE TUNA ESTIMATED FROM THE TAGGING RESULTS

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SUMMARY

Using mark-recapture data, an attempt was made to estimate von Bertalanffy growth equation of yellowfin and bigeye tunas by Farbens method (1965). However, the estimation resulted in no reasonable outcome. This appears to be due to the tendency of mark-recapture data to exhibit slower growth rates in the size range of 40-60 cm.

RESUME

A partir des données de récupération de marques, on a tenté d'estimer l'équation de croissance de Von Bertalanffy, pour l'albacore et le thon obèse, par la méthode de Farbens (1965). Néanmoins, cette estimation n'a pas donné de résultats positifs. Ceci semble être dû à ce que les données de récupération de marques montrent un taux de croissance plus faible pour la gamme de taille de 40 à 60 cm.

RESUMEN

El base a los datos de marcado y recaptura, se intentó evaluar la ecuación de crecimiento de Von Bertalanffy, respecto al rabil y al patudo, por el método Farbens (1965). Sin embargo, la estimación no dió resultados fiables, lo que se supone es debido a que los datos de marcado y recaptura tienden a señalar una tasa de crecimiento más lenta en las tallas entre 40-60 cm.

1. Introduction

On the growth of Atlantic yellowfin and bigeye tuna, several studies have been reported on the analyses based upon 1) markings or spacing of the "annuli" on the hard parts and 2) length increment of modal points in the size composition (Le Guen and Sakagawa, 1973: Fonteneau, 1980: Champagnat et Pianet, 1974: Gaikov et al., 1980: Draganik and Pelczarski, MS). As to the former analysis, the difficulty and problem involved are objectiveness of "annuli" reading and "Lee" phenomenon, and in the case of the latter, the results are affected by the long duration of spawning period and uncertainty in following the size composition of the same cohort (Suzuki, 1973). On the other hand, information obtained from mark release-recapture does not contain the above problems and enables to pursue process of individual growth. The present study estimates growth parameters in Bertalanffy growth equation on Atlantic yellowfin and bigeye tuna based on tag recapture data to facilitate better understanding of their growth.

2. Materials and method

During the years 1978-1982, about 500 recaptured data for each yellowfin and bigeye tuna were reported from the eastern Atlantic centered in the Gulf of Guinea. The data were summarized from two data base from Japanese ISYP (International Skipjack Year Program, ICCAT) and from tag recapture file of CRO, Dakar and Abidjan, both of which were cross-checked in the use. Among data examined, excluded were incomplete data which did not have size measurement and accurate recapture date. Another factor considered in this analysis was to minimize the effect of tag installation, for which the recapture data less than 50 days at liberty and indicating negative growth were excluded. The data utilized are summarized as follows:

	Length range at release	Length range at recapture	Days at liberty	Number of data
Yellowfin	350-790 mm	410-1506 mm	50-672	198
Bigeye	385-800 mm	440-1260 mm	50-822	127

Growth parameters in the Bertalanffy equation was estimated using Fabens' method (1965). This method is advantageous to such tuna species that are difficult to determine the age, since it does not necessarily require information on absolute age and the input data are lengths at release-recapture and days at liberty.

3. Results and discussion

In Fig. 1, illustrated is a chart showing length increment of individual tag recovery record between release and recapture against days at liberty by length groups of 10 cm interval at release. Both species exhibited large variation in length increment among individuals. The length increment of yellowfin tuna larger than 60 cm at release (Fig. 1-3) indicated better growth (5 cm/month) shortly after release, being slowed down its growth rate after more than 400 days at liberty, while the increment for the fish less than 60 cm at release was smaller than the former until 200-300 days at liberty and then turned to be increased. In the case of bigeye, although there appears to be no distinctive difference in the length increment by size at release, rate of increment was rather slow as was the case of yellowfin less than 60 cm, and as the days at liberty increases, the rate of increment improves.

In general, growth of animal is well described by Sigmoid curve, namely it follows gradual increasing rate of growth at initial stage of life until it approaches to an inflection point, and then the growth rate turns adversely. It is noted that Bertalanffy equation mimics the animal growth only by the gradual decreasing rate and hence it can be applied to the growth after an inflection point. Therefore, it is suggested that when the data to be analysed indicate as the case of the present study, fitness of the data to the Bertalanffy equation would not fully be appropriate.

Taking into account of the above consideration, estimation of the growth of both species was carried out by fitting to Fabens' method for the following 3 tag release-recapture data sets: 1) all available data, 2) the data from long-term recovery (more than 200 days at liberty) and 3) the data for the fish larger than 60 cm at release. The computation resulted in only one solution in all the data sets, which was for yellowfin larger than 60 cm at release, and derived equation was:

$$L_t = 183.9(1 - e^{-.56}) \quad \text{------- (1)}$$

where length (L) is expressed in terms of fork length in cm, and unit of time interval is year and t_o is assumed to be 0. Other data sets produced negative value of growth rate (k) in the course of fitting process, and accordingly no growth parameters were obtained.

The only estimated growth equation in this analysis was compared graphically to past growth equations as shown in Fig. 3. Maximum length (L) and growth rate (k) are greatly influenced by quality and quantity of the data used. In this analysis, only one data set was fitted to the model for the data of yellowfin larger than 60 cm and not for the fish less than 60 cm, so that an absolute age could not be drawn. It is pointed out that the growth rate obtained, as derived in equation (1), is similar to those of past studies. However, this would only be applied to the fish of larger than 60 cm, and direct comparison is difficult to both calculated ages directly owing to uncertainty in absolute age.

A consideration was given to the reasons why the other sets of data did not afford any growth parameters. Firstly, it is assumed that the growth of both species should follow the Bertalanffy's type of growth, but that the growth would be affected by the installation and retention of tag, which led slower growth. Although this possibility has not been evidenced positively, there seems to be more influence of this source for the smaller fish . Second aspect is that the growth of yellowfin would not follow the Bertalanffy equation because of its slower growth for the fish in the size range of 40-60 cm as reported by Fonteneau (1980). An examination was made to calculate the age at release from length at recapture using such growth equations as obtained by Le Guen and Sakagawa (1973) for yellowfin and Dragansk and Pelczarski (MS) for bigeye, and then back calculated the age at release. The results were shown in Figs. 4 and 5. If these growth equations represent adequate growth, then the dots in the Figs. 4 and 5 should scattered above and below the growth curves evenly, and if the equations under-estimate the growth, the dots calculated from tag records would be distributed below the curves, and if the equations over-estimate, then the dots would be distributed adversely. Figs. 4 and 5 exhibit that for the length of less than 50 cm, estimated individual dots were clustered above the curves for both species, but for the length larger than 50 cm the dots scatter above and below the curves. Such trend is more obvious for the yellowfin case. As far as the present study is concerned, Bertalanffy type growth equation estimates more growth increment in younger stage of life, and an inflection point of growth would probably exist at 50-60 cm.

As pointed out that the present estimation technique is more favorable in pursuing the process of the individual growth, it is recommended that further tagging program for yellowfin and bigeye tuna should emphasize the release of juveniles less than 40 cm as well as large-sized fish such as larger than 100 cm, which would facilitate better understanding of the growths of both species.

Literature

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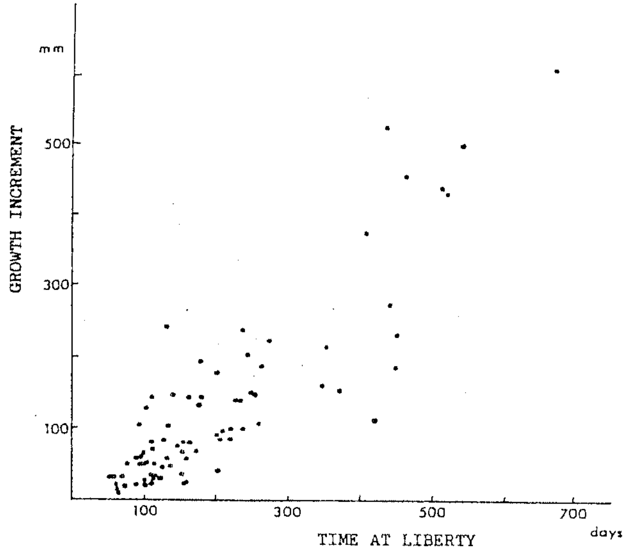

Fig. 1-1 Growth increment of tagged yellowfin tuna by size at release, smaller than 50 cm.

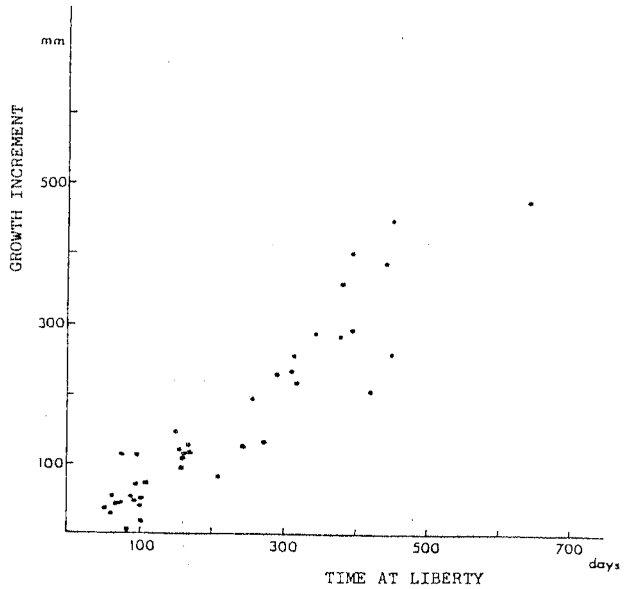

Fig. 1-2 Growth increment of tagged yellowfin tuna by size at release, between 50 and 60 cm.

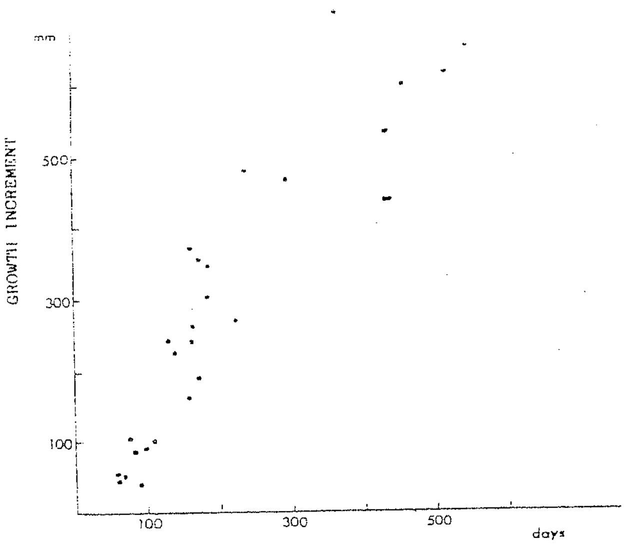

Fig. 1-3 Growth increment of tagged yellowfin tuna by size at release, larger than 60 cm.

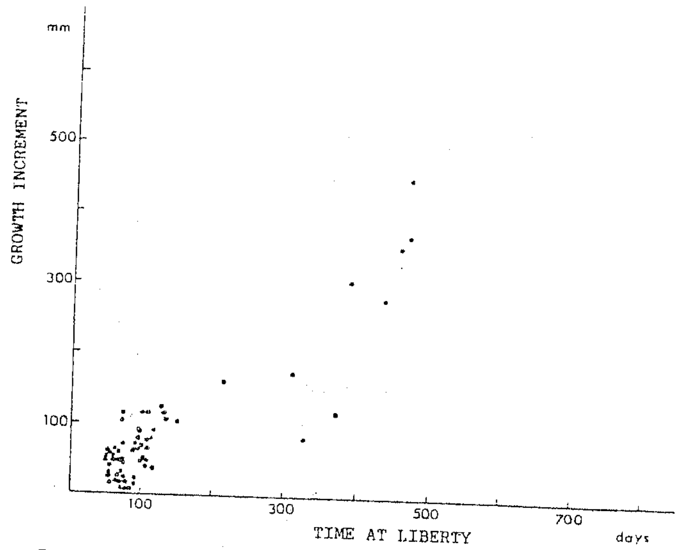

Fig. 2-2 Growth increment of tagged bigeye tuna by size at release, between 50 and 60 cm.

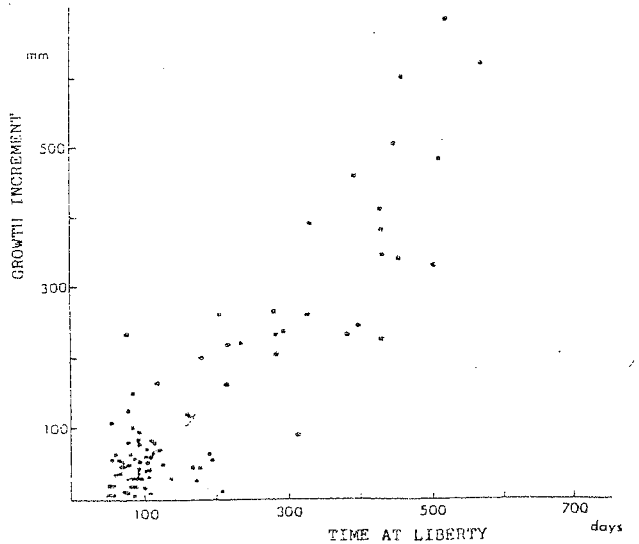

Fig. 2-1 Growth increment of tagged bigeye tuna by size at release, smaller than 50 cm.

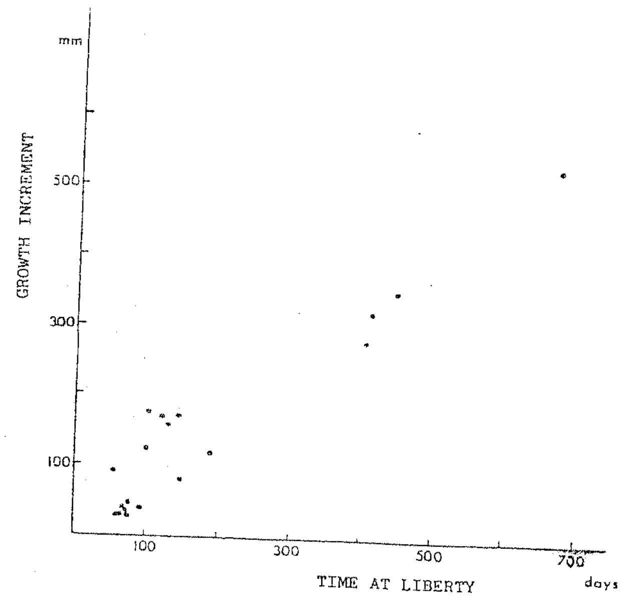

Fig. 2-3 Growth increment of tagged bigeye tuna by size at release, larger than 60 cm.

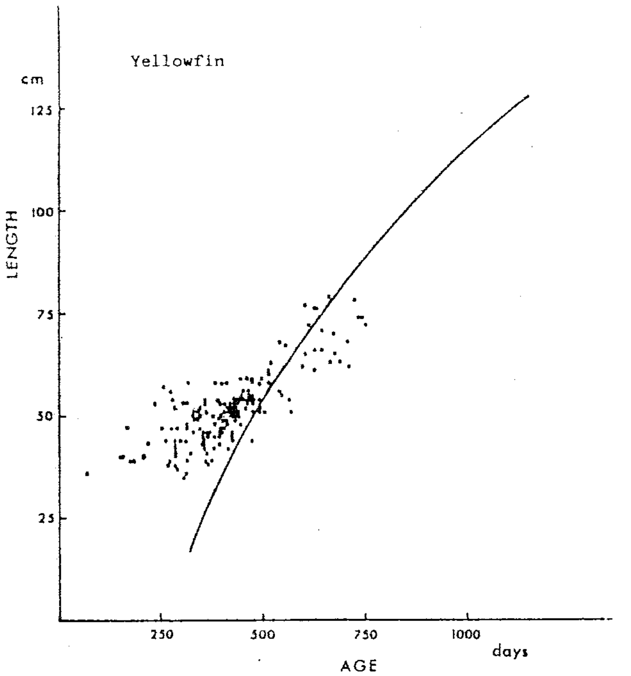

Fig. 4 Schematic indication of recalculated length at release of yellowfin tuna from Bertalanffy's equation of Le Guen and Sakagawa(1973).

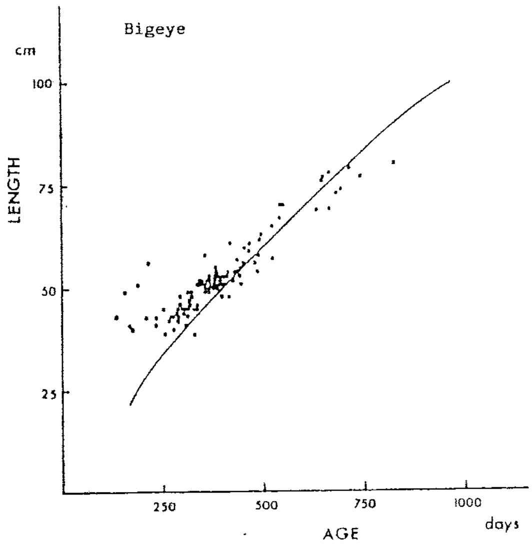

Fig. 5 Schematic indication of recalculated length at release of bigeye tuna from Bertalanffy's equation of Draganik and Pelczarski(1983).

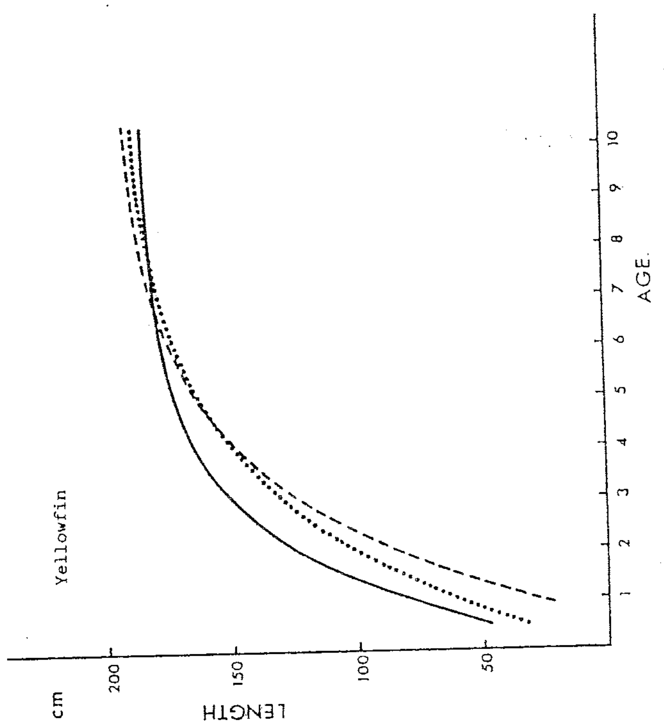

Fig. 3 Comparison of growth curves of yellowfin from Atlantic ocean. Solid line indicates present study(larger than 60 cm at release), dotted line Draganik and Pelczarski(1983), broken line Le Guen and Sakagawa(1973).