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Abstract

This preliminary result is concerning biological features of tuna catches from the first sampling onboard M.V. SEAFDEC. The data analysis of this part would certainly support for the study on by-catch composition of tuna purse seine fisheries within three years study. The length frequency distribution of skipjack and yellowfin tuna are evident as mode more than one cohorts. The relative length-weight was determined using allometric equation for skipjack tuna ($W = 8.23185E\text{-}06\ L^{3.2319}$), yellowfin tuna ($W = 2.36464E\text{-}05\ L^{2.9539}$), and bigeye tuna ($W = 1.8E\text{-}05\ L^{3.0431}$), The skipjack tuna's mean weight was significant heavier than other species at the same length. The size at first maturation was occur at length 64.5 cm. for yellowfin tuna and 63.0 cm. for bigeye tuna and found mature all in skipjack tuna. The number of skipjack and yellowfin males is slightly higher than females but the number of bigeye females was out numbers the males. The female ratio was explain by equation; $Rf(L) = 0.7407 - 0.006*L$ for skipjack tuna and $Rf(L) = 1.3764 - 0.0105*L$ for yellowfin tuna. The largest gonad index was found about 67 in yellowfin tuna but low in number of samples same as bigeye tuna. The small number of samples was effected in some process of reproductive study. However, there was a significant correlation between the variables by the t-test statistic ($t_{0.05}$).

Key words : Indian ocean, Skipjack tuna, Yellowfin tuna, Bigeye tuna, Biological features, Reproductive study, Gonad Index

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1. Introduction

The tuna purse seine fishery of M.V. SEAFDEC was conducted under the responsible fishing promotion program in order to support the sustainable fishing technology and proper management of marine resources to the Southeast Asian Region. The project duration was three years; starting January 2001 and first sampling was conducted during January to April 2001 aim to investigated on composition of catch, age class and maturation stage in the Eastern Indian Ocean. This report is the preliminary result concerning biological features of tuna catches from the first sampling onboard M.V. SEAFDEC. The data analysis of this part would certainly support for the study on by-catch composition of tuna purse seine fisheries within three years study.

2. Materials and Methods

The Training and Research vessel, M.V. SEAFDEC has carried out fishing operations of tuna purse seine in the Eastern Indian Ocean between latitude 00° – 04° S and longitude 086° – 096° E. Every operations the tuna samples were collected from the first and second scoop. The biological parameters were recorded as follow; fork length (cm) was measured from the most anterior part of the fish to the tip of the median caudal fin rays by measuring board with a rigid head piece. Dorsal girth (cm) was measured the distance round the body at the pre-dorsal fin by measuring tape and weight (kg) was measured by spring balance. The samples were sexed and identified the maturity stages using a maturity scale of five stage (King, 1995).

Length frequency distribution during the survey period was observed for cohort pattern. The relationship between length and weight of each species was analyses and represented by power curve equation;

$$W = qL^{b} \quad \text{.........(1.1)}$$

Where; W = weight (kg)
L = Length (cm)
q and b = constant determined empirically

Testing the significance of regression by t-test statistic.

The maturity indices calculated as follows;

- Percentage of maturation in each station.
- First size maturity using equation;

$$P(L) = 1/(1+e^{a+b*L}) \quad \text{.........(1.2)}$$

Where; P(L) = probability of maturity at any length
L = mid-length at any length class
a and b = constant determined empirically

Testing coefficient of determination (r^2) by t-testing (Aryuthaka, 1993)

$$T = \sqrt{(n-2)r^2/1-r^2}$$

Where; r = coefficient of determination
N = no. of sample

- Sex ratio using linear relationship between female ratio (Rf) and length (L)

$$Rf(L) = a + b * L \qquad (1.3)$$

Where; Rf = Nf/(Nf+Nm)
L = mid-length at any class interval
Rf = female ratio
Nf = no. of female
Nm = no. of male
a and b = constant determined empirically

- Gonadosomatic Index calculate using the relative ovary weight as equation below;

$$G.I. = \text{ovary weight (g)} \times 10^{3} / \text{fish weight (g)} \qquad (1.4)$$

3. Result

Length frequency distribution

The length frequency distribution of each species were showed in Fig.1. The length distribution of skipjack and yellowfin tuna are evident as mode more than one cohorts. The maximum size length of skipjack and bigeye tuna are occur in class rang 43.5-44.5 cm. and 55.5-56.5 cm. which has mid-length of 44.0 cm. and 56.0 cm., respectively. There are two maximum size length of yellowfin tuna occur in class rang 49.5-50.5 and 50.5-51.5 cm. .For bigeye tuna number was too small to show any obvious mode.

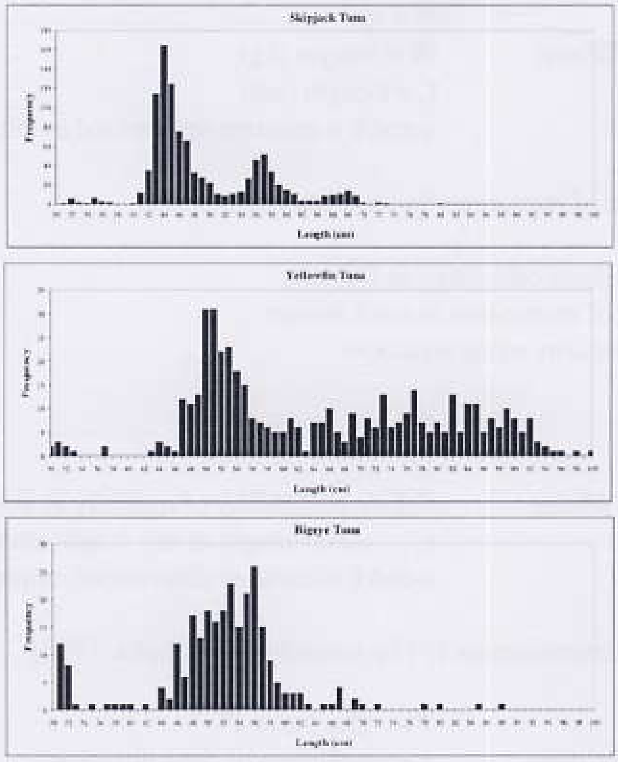

Fig. 1. Length frequency distribution of tuna catch during February to April 2001.

Length-Weight relationship

Length-weight relationship were determinded using linear regression analysis and described by the equation below and the relationship were showed in Fig. 2.

The length-weight relationship;

Skipjack tuna; $W = 8.23185E\text{-}06\ L^{3.2319}$, $r^2 = 0.9233$

Yellowfin tuna; $W = 2.36464E\text{-}05\ L^{2.9539}$, $r^2 = 0.9831$

Bigeye tuna; $W = 1.8E\text{-}05\ L^{3.0431}$, $r^2 = 0.9561$

The regression was showed sinigficant by t-test statistic ($t_{0.05}$). The coefficient determination of yellowfin tuna was the highest followed by bigeye tuna and skipjack tuna. The slope of skipjack tuna (3.23) was higher than bigeye (3.04) and yellowfin tuna (2.95). This reflected in the mean weight where significant heavier than other species at the same length, these indicated from the slope of skipjack tuna was the highest followed by bigeye tuna and yellowfin tuna.

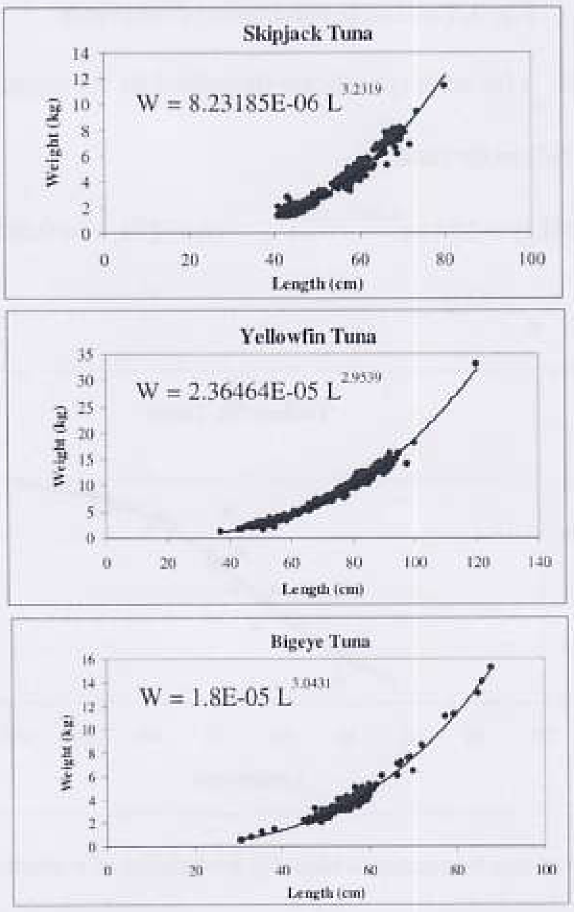

Fig. 2. Length-weight relationship of tuna catch during February to April 2001

Maturation

Fig.3 was showed the maturation percentage of each species. All skipjack tuna samples rang 41-80 cm. are mature. The yellowfin tuna samples were rang from 37-120 cm., the maturation are occur at length 50 cm. and frequently found from length 66 cm. and mature all from length 89 cm. . Bigeye tuna samples were rang from 30-88 cm., the maturation are occur at length 44 cm. and frequently found from length 54 cm. and found mature all from length 66 cm. . Fig.4-5 was shown the sigmoid curve of size frequency to identify probability of maturity (L_{50}) for yellowfin and bigeye tuna.

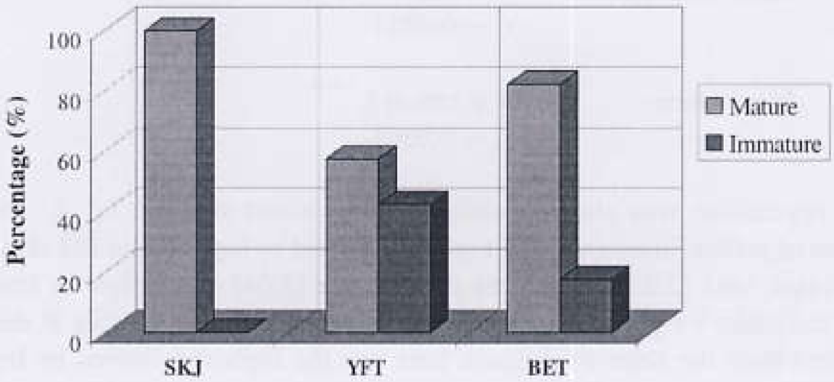

Fig. 3. Percentage maturation of tuna catch.

The first size maturity (L_{50}) for each species are described by the equation;

Yellowfin tuna ;

$$P(Li) = 1/(1+e^{6.514-0.101Li}) , \quad (n = 274, r^2 = 0.8014)$$

$$L_{50} = 64.5$$

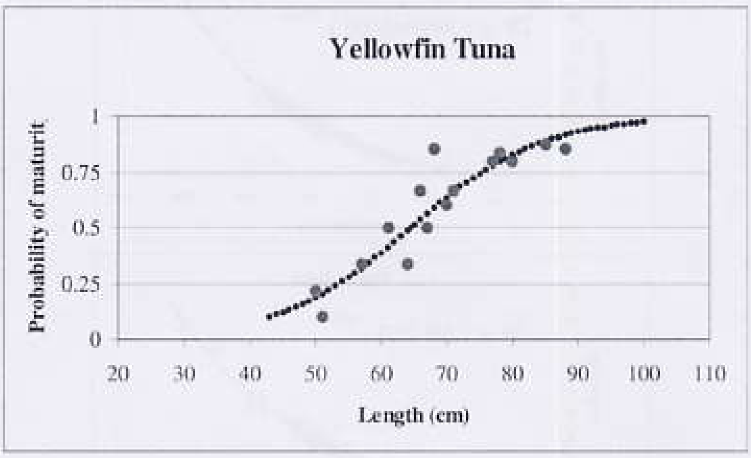

Fig. 4. A sigmoid curve of size frequency to identifiy probability of maturity (L_{50}) for yellowfin tuna.

There was a significant correlation between maturity stage and fork length by the t-test statistic ($t_{0.05}$).

t-testing (Aryuthaka, 1993)

$t = \sqrt{(n-2)\,r^2/1-r^2}$

$t = 6.3529$

$t_{0.05} = 1.812$

$t > t_{0.05}\,(n-2)$

Bigeye tuna ;

$P(Li) = 1/(1+e^{12.133-0.193Li})$, $(n = 173, r^2 = 0.4493)$

$L_{50} = 63.0$

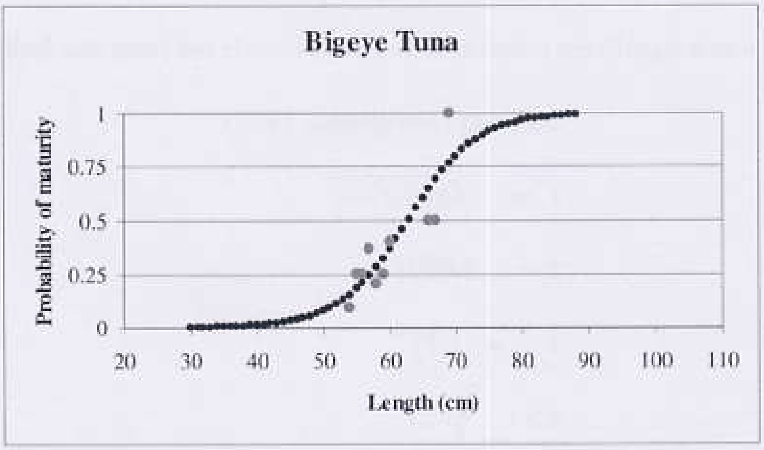

Fig. 5. A sigmoid curve of size frequency to identifiy probability of maturity (L_{50}) for bigeye tuna.

There was a significant correlation between maturity stage and fork length by the t-test statistic ($t_{0.05}$).

t-testing (Aryuthaka, 1993)

$t = \sqrt{(n-2)\,r^2/1-r^2}$

$t = 2.0223$

$t_{0.05} = 2.015$

$t > t_{0.05}\,(n-2)$

Sex ratio

The length distribution of males and females were rang between 42-88 cm.. The relationship between female ratio and length were shown in Fig.6-7 and described by the equations below.

Skipjack tuna ; $Rf(L) = 0.7407 - 0.006*L$
$(n = 307, r^2 = 0.1628)$

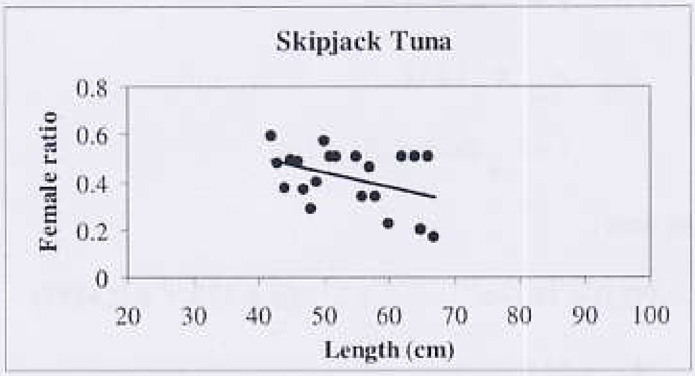

Fig. 6. The relationship between female ratio and length of skipjack tuna.

There was a significant correlation between female sex ratio and fork length by the t-test statistic ($t_{0.05}$).

t-testing (Aryuthaka, 1993)

$$t = \sqrt{(n-2)\, r^2 / 1-r^2}$$

$$t = 1.9721$$

$$t_{0.05} = 1.717$$

$$t > t_{0.05}\ (n-2)$$

Yellowfin tuna ; $Rf(L) = 1.3764 - 0.0105*L$
$(n = 107, r^2 = 0.1718)$

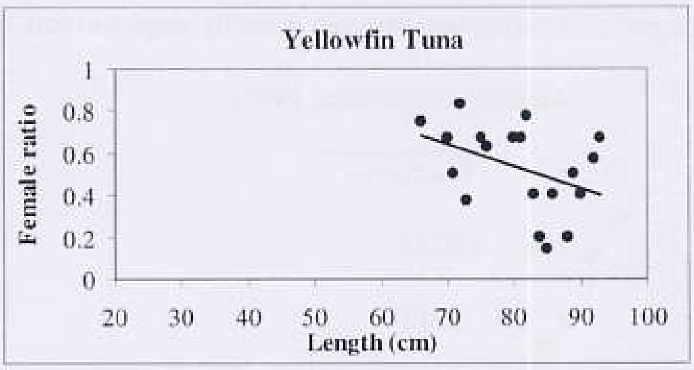

Fig. 7. The relationship between female ratio and length of yellowfin tuna.

There was a significant correlation between female sex ratio and fork length by the t-test statistic ($t_{0.05}$).

t-testing (Aryuthaka, 1993)

$$t = \sqrt{(n-2)\,r^2/1-r^2}$$

$$t = 1.8779$$

$$t_{0.05} = 1.734$$

$$t > t_{0.05}\ (n-2)$$

However, the tendency of correlation was difficult to observe. Especially, the statistical signification of bigeye tuna data can not be verified because of the low number in the samples.

Fig. 8. was showed sex composition of each species. The number of skipjack and yellowfin males was slightly higher than females but the number of bigeye females was out number the males.

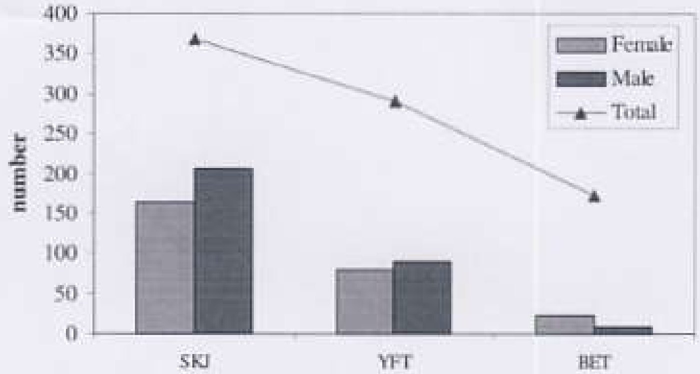

Fig. 8. Sex composition of tuna catch.

Gonad index

The gonadosomatic index (GI) was calculated and showing in table 1. The largest gonad index was found about 67 in yellowfin tuna but low in number of samples same as bigeye tuna. The average gonad index of skipjack tuna was come from 89 samples with not much difference in value of samples.

Table. 1 Gonad index of tuna catch and parameters concerning.

	No. sample	Mean	Mode	Min	Max
SKJ	89	26.08	25	13.08	52.50
YFT	8	16.34	-	3.33	66.67
BET	10	23.56	-	2.50	56.25

4. Discussion

The small number of samples was effected in some process of reproductive study on yellowfin and bigeye tuna. However, there was a significant correlation by statistical testing and the result was explain and precise determination. The result of maturation study presence that skipjack tuna catch was in peak spawning period but not exist clearly in yellowfin and bigeye tuna. Stequert (1996) studies and show that yellowfin tuna in the western Indian ocean spawning successfully throughout the year, but principally between November and March. Anyway, sex composition of catch was slightly higher in male and gonad index of this study was not high compare to the study result of Bernard (1996) and Howard (1964). The frequency distribution of length was produce different size classes and evident population more than one cohort with different spawning period in this area. On the contrary, time series sampling study will assist in precise determination.

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