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REPRODUCTIVE BIOLOGY OF LONGTAIL TUNA IN THAI WATERS

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ABSTRACT

Reproductive Biology of long tail tuna (*Thunnus tonggol*) in Thai waters was studied during January to December 2012. Fish samples were collected from purse seiners who had landed at the fishing ports along the Gulf of Thailand and the Andaman Sea. In the Gulf of Thailand, length-weight relationship equations of male and female were $W = 0.016FL^{3.039}$ and $W = 0.023FL^{2.936}$ respectively, sex ration was 1:0.97. Average sizes at the first maturity of male and female were 40.77 and 42.16 cm. Female longtail tuna had fecundity in range 99,773.00 – 3165849.00 oocytes. Relation between fecundity and fork length was in equation, $F = 6.7*10^{-9}FL^{7.38756157}$. Spawning season of longtail tuna in the Gulf of Thailand was found all year round, which the peak showed during February to May and July to August. Andaman Sea, length-weight relationship equations of male and female were $W = 0.0239FL^{2.9327}$ and $W = 0.0251FL^{2.9187}$ respectively. While sex ratio between male and female was 1:0.76. Average sizes at the first maturity of male and female were 41.42 and 40.25 cm respectively. Fecundity of longtail tuna in the Andaman sea was 44,628.56 - 240,477 oocytes. Fecundity and fork length Relationship of long tail tuna in the Andaman sea can be showed in equation, $F = 259.3139FL^{1.5906}$. Spawning season was found in January to March and July to November with high peak in September.

Key words: reproductive biology, Longtail tuna, Gulf of Thailand, Andaman sea, Thai waters

INTRODUCTION

Longtail tuna (*Thunnus tonggol*) is one of tuna species in family Scombridae. Longtail tuna is a neritic tuna which found in Thai waters both in the Gulf of Thailand and Andaman sea in at 15-30 nautical miles from coastal zone 20-45 meters in depth (Chuenpan,1985). Not only open sea but Longtail tuna also found in island area as well (Klinmaung, 1978). Longtail tuna were caught by variety of fishing gears, the main fishing gears were the purse seines. At present fishing gears and techniques have been developed by using light luring techniques, fish aggregating devices and advance technology such as fish finder equipment were introduce to increase efficiency of catching. According to the fisheries statistics, the total catches of neritic tunas in Thai waters in the period from 2006 to 2011 have been decreased in range 123.8, 112.7, 63.3, 38.3, 35.1 and 38.3 billion metric tons respectively (Department of Fisheries, 2013). At present, Thailand is the main supplier of canned fish and other fish products to foreign markets throughout the world. However, the rapid fisheries development may lead into the deterioration of neritic tunas stocks in Thailand. Therefore studies on reproductive biology of small neritic tunas such as longtail tuna would be one of important data for neritic tuna management resources.

OBJECTIVE

To study reproductive biology of longtail tuna in Thai waters i.e. length-weigh relationship, sex ratio, size at first mature, fecundity and spawning ground

MATERIAL AND METHOD

Study area

Biological data and samples were collected from purse seiners along the fishing ports both in Gulf of Thailand (from Trat to Pattani provices) and Andaman. Sea (from Ranong to Satun provinces) during January to December 2011.

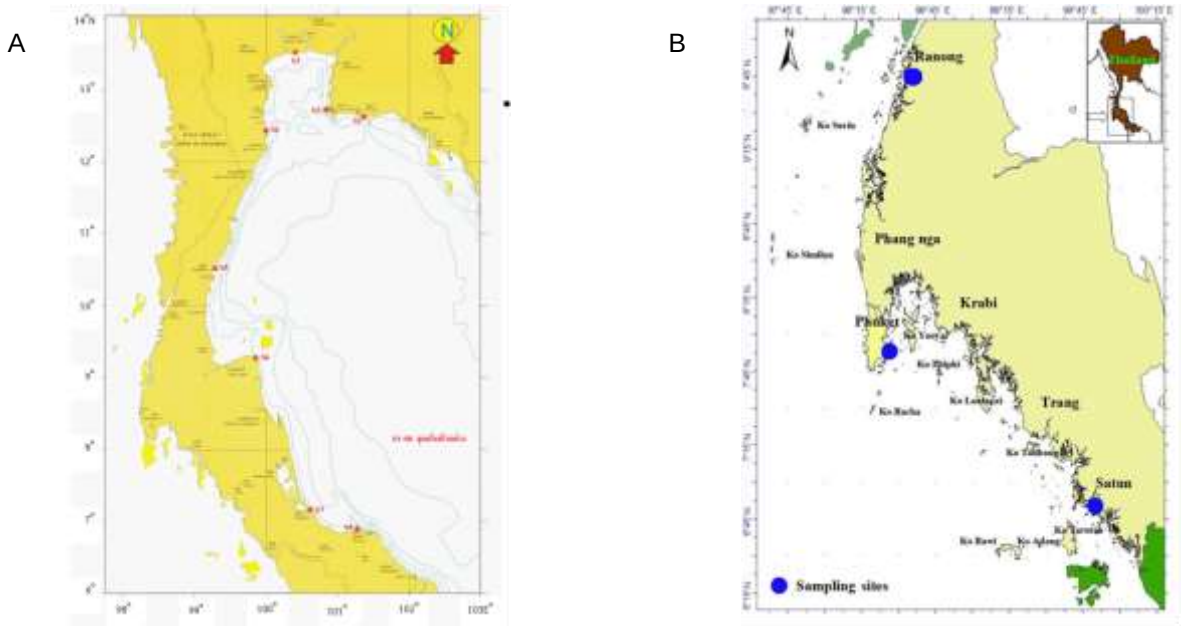

Figure 1 Sampling sites of longtail tuna in Thai waters (A) Gulf of Thailand (B) Andaman Sea coast of Thailand year 2012

Sampling and laboratory procedure

Sampling longtail tuna all size found at least 30 samples per fishing gears per fishing port monthly. Measurement total length (TL), fork length (FL, in centimeter) and weight (WT, in gram). Then sex and maturity stage determination were done by dissecting specimen in laboratory followed by Kesteven (1960). (Fig.2.) Mature ovaries (stage 4) were preserved in 10% formalin to estimate number of oocytes of longtail tuna. (Fig.3)

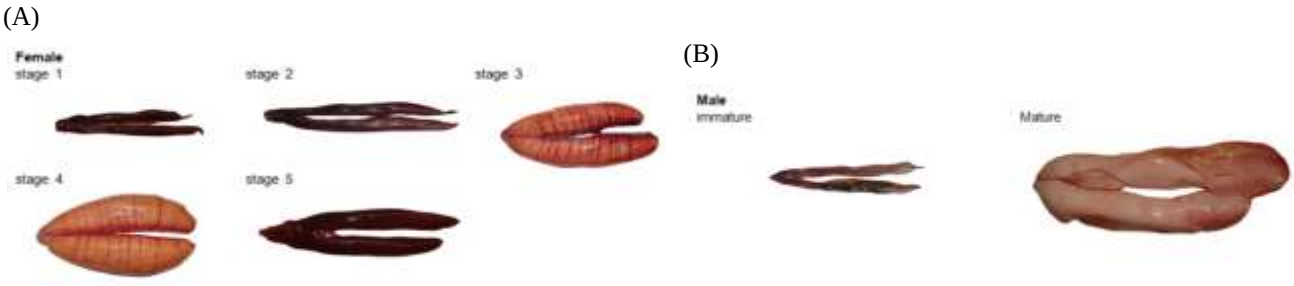

Figure 2 maturity stages of male (A) and female (B) longtail tuna

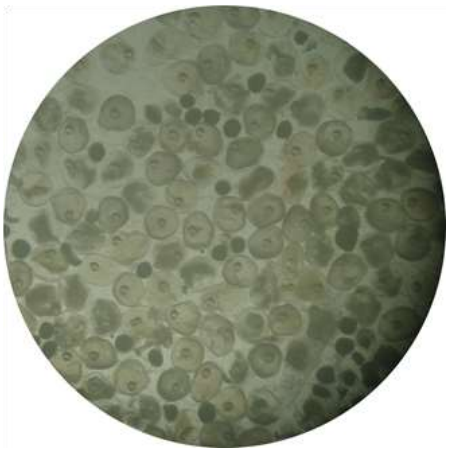

Figure 3 Oocytes of longtail tuna caught in Thai waters year 2010

Data analysis

Length-weight relationship

Relationship between fork length and weight were done by regression method followed by Ricker (1975) as equation;

$$W = aFL^b$$

Where W = body weight (grams)
FL = fork length (centimeters)
a and b = constant from regression

sex ratio

sex ratio was analyzed by chi-square test (χ^2, Zar (1996) with null hypothesis (Ho) : sex ratio between male and female longtail tuna were 1:1 at confidence level 95% ($\chi^2_{0.05,1}$ = 3.8415), then test by equation as follow;

$$\chi^2 = (f_1 - f_2)^2 / n$$

Where χ^2 = calculated chi-square compared to χ^2 table
f_1 = number of male longtail tuna
f_2 = number of female longtail tuna
n = total number of longtail tuna

Size at first maturity

Sizes at first maturity calculated by using proportion between numbers of immature and mature from all sampling longtail tuna at each length-class as Somerton (1980) equation as;

$$Y = 1 / (1 + EXP (A+BX))$$

Where Y = proportion between number of immature and mature at length X
X = mid length in each length class of longtail tuna fork length
a and b = constant from regression

In Andaman sea, size at first maturity was calculated by moving average method

Fecundity
Fecundity were calculated by Holden and Raitt (1974) method as follow;

$$F = nG / g$$

Where F = Fecundity
n = number of sampling counted oocytes
G = weight of ovary
g = weight of sampling oocytes from ovary

Spawning season
Spawning season of longtail tuna were done by determined of changing in gonad development and mean gonadosomatic index (MGSI) in each moth of the year. In which period that had high percentage of maturity stage and MGS, these were presumed that the peak of longtail tuna spawning season.

Gonadosomatic index (GSI) is the proportion between weight of testis or ovary and weight of fish by individual (Krajangdara *et.al* quote to Yuen and June, 1957) as following equation;

$$GSI = (GW/TW)*10^3$$

Where GSI = Gonadosomatic index
GW = testis or ovary weight (gram)
TW = Fish weight (gram)

When we got GSI from individual fish then calculated for mean GSI in each month then which month showed high value in GSI that mean fish ready for breeding.

RESULT AND DISCUSSION

THE GULF OF THAILAND

Length-weight relationship
Total samples were 1,493 individuals, the result showed ranged of FL from 10.00 - 56.40 cm. (average 34.51 ± 8.55) cm. and weight in rage 12.00 - 3,460.00 g (average 899.63 ± 540.16 g) which have Length-weight relationship as follow (Fig. 4)

All	$W = 0.012FL^{3.104}$	$r^2 = 0.992$	n =1,493
Male	$W = 0.016FL^{3.039}$	$r^2 = 0.979$	n = 585
Female	$W = 0.023FL^{2.936}$	$r^2 = 0.985$	n = 568

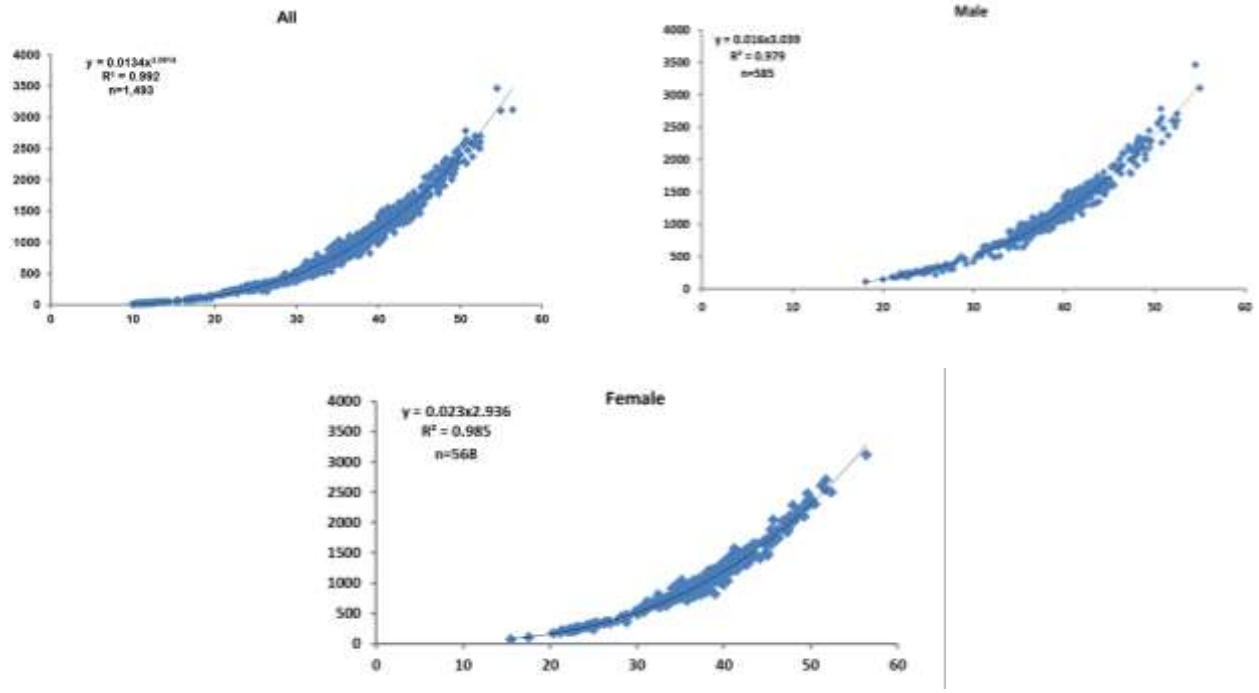

Figure 4 Relationships between fork length (x) and body weight (y) of longtail tuna in the Gulf of Thailand year 2012

Sex ratio

Sex ratio of longtail tuna in the Gulf of Thailand was 1 to 1.097. There was no significant different between male and female. Griffiths et al. (2010) had said that longtail tuna is a gonochoristic species and there is no evidence of sexual dimorphism in external morphology. In the few studies that have examined sex ratio (Klinmuang, 1978; Wilson, 1981; Yesaki, 1982; Griffiths et al., 2010), there has been no evidence of departure from the expected male to female ratio of 1:1.

Size at first maturity

In this study, the smallest size of male and female longtail tuna in the Gulf of Thailand found maturity stage 3 from observation were 27.40 cm and 28.8 cm. respectively. The size at first maturation from calculation of male and female longtail tuna were 40.77 and 42.16 cm respectively. (Fig.5) However, Chuenpan (1985) had studied longtail tuna caught from the Gulf of Thailand during year 1976-1980. Result found the first maturity by observation at 342 mm. and maturity by calculating at 396 mm. In the waters off Thailand, Yesaki (1982) used macroscopic staging of gonads of nearly 800 fish to determine that the length at first maturity was 43 cm FL.

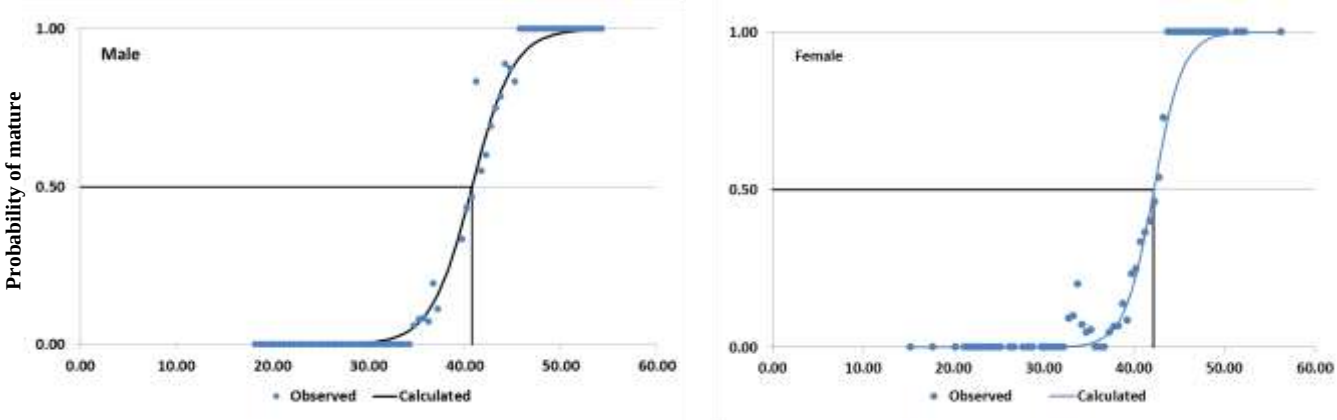

Figure 5 Size at first maturity of longtail tuna in the Gulf of Thailand year 2012

Fecundity

Maturity stage 4 of longtail tuna 14 individuals with fork length in rage 38.40-49.20 cm (average 45.16±3.44 cm) and weight in range 880.00 - 2,280.00 g (average 1,775.71 ± 402.62 g) have ovaries weight in range 12.20 - 175.00 g (average 105.10 ± 47.57 g) which fecundity in range 99,773.00 – 3165849.00 oocytes (averages 1438583.11 ± 920,715.20 oocytes) Relation between fecundity and fork length of long tail tuna in the Gulf of Thailand was in equation, $F = 6.7*10^{-9}FL^{7.38756157}$ ($r^2 = 0.440$). In the western Gulf of Thailand and off the east coast of Malaysia, Klinmuang (1978) examined the ovaries of fish between 44 – 49 cm FL and estimated fecundity to be between 1.2–1.9 million oocytes. (Quoted from Griffith *et.al*, 2010)

Spawning season

From maturity stage determination in all year round found male and female longtail tuna had developed testis and ovary every month in one year. These mean longtail tuna can mating and spawning all year round. However when considered MGSI, result showed the highest peak of male and female longtail tuna GSI were 35.54 and 22.30 in April and gradually dropdown until increase again to another peak in August with MGSI 13.51 in male and 12.30 in female. (Fig.6)

Several studies have investigated the timing of spawning of longtail tuna in a number of countries, primarily using a GSI or macroscopic staging of gonads. The common trend in these studies is that spawning occurs over a period of several months during the warmest period of the year in a particular region. However, there is an apparent difference in the frequency of spawning period between the northern and southern hemisphere. Yesaki (1982) used macroscopic staging of gonads to determine that mature fish were most abundant in the outer neritic region in the waters off the west coast of Thailand during the beginning and end of the monsoonal period between January–April and August–September. Similarly, Cheunpan (1984) suggested the presence of two spawning peaks occurring slightly later in the year between March–May and July-December in the Gulf of Thailand. (Quoted from Griffiths, et.al, 2010)

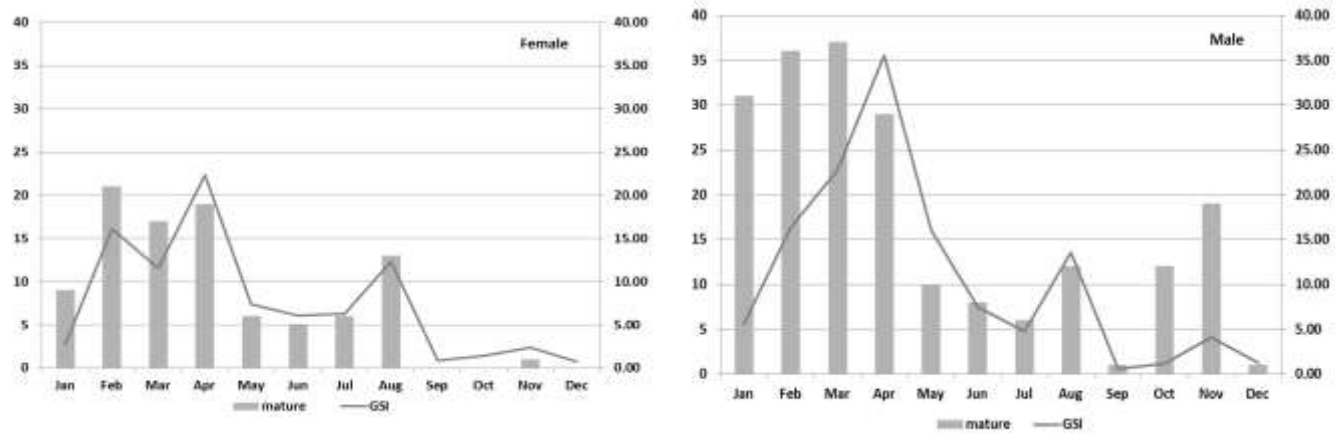

Figure 6 Percentage of mature and mean gonadosomatic index (MGSI) of longtail tuna in the Gulf of Thailand years 2012

ANDAMAN SEA

Length-weight relationship

Total samples were 1,715 individuals, the result showed ranged of FL from 7.00-64.00 cm. (average 35.32 ± 7.98 cm) weight in range 64.00 - 4,720.00 g (average 941.74 ± 546.31 g) (Fig. 7)

All	$W = 0.0125FL^{3.1105}$	$r^2 = 0.9882$	n =1,715
Male	$W = 0.0239FL^{2.9327}$	$r^2 = 0.9657$	n = 551
Female	$W = 0.0239FL^{2.9327}$	$r^2 = 0.9724$	n = 421

Saranakomkul (1985) studied on length-weight relationship of Tuna on the Indian Ocean coast of Thailand. Length-weight relationship for total, male and female longtail tuna were in the following equations i.e. $W = 0.0002493L^{2.9471}$ (n = 1,539), $W = 0.0001884L^{2.9946}$ (n = 779), $W = 0.0003509L^{2.8896}$ (n = 760)

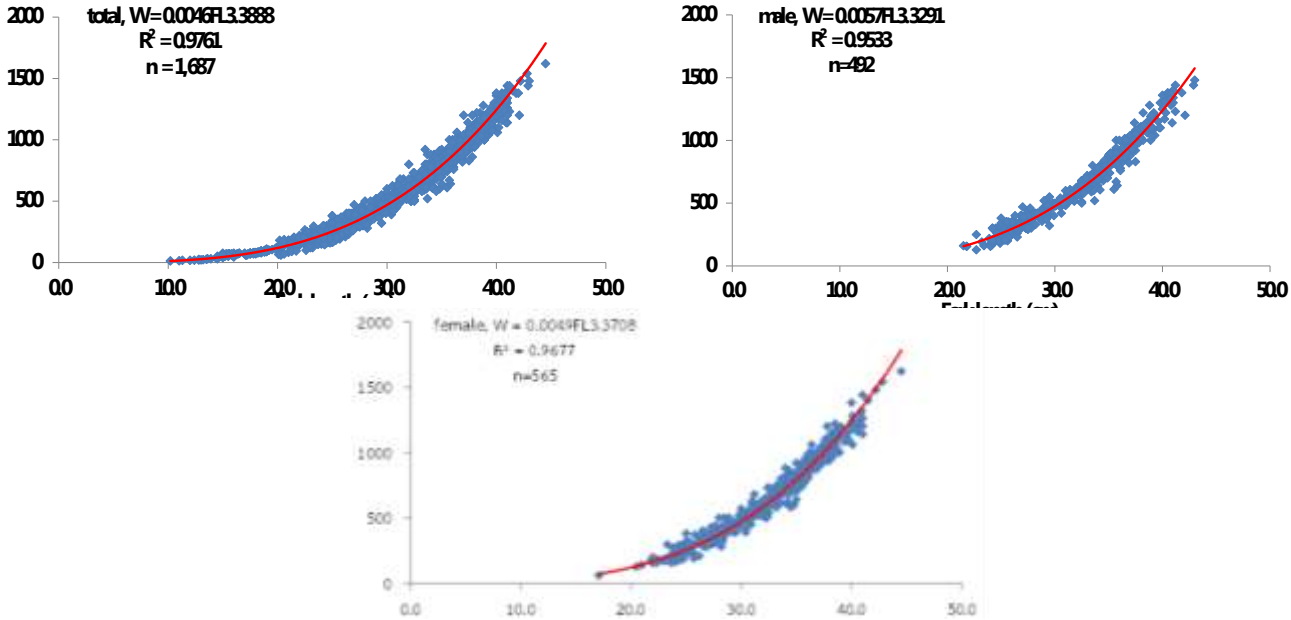

Figure 7 Relationships between fork length (x) and body weight (y) of longtail tuna in the Andaman Sea year 2012

Sex ratio

Sex ratio of longtail tuna in the Andaman sea was 1 to 0.76. There was significant different between male and female. This mean sex ratio between male and female of longtail tuna in Andaman sea is not equal to 1 to 1

Size at first maturity

Male longtail tuna with fork length 22.70-64.00 cm number 551 individuals and female in range 18.50-58.80 cm. number 421 individual from the Andaman sea which found maturity stage 3 from observation were 38.5 cm and 41.0 cm. respectively. The size at first maturation from calculation of male and female longtail tuna were 41.42 and 40.25 cm respectively (Fig.8)

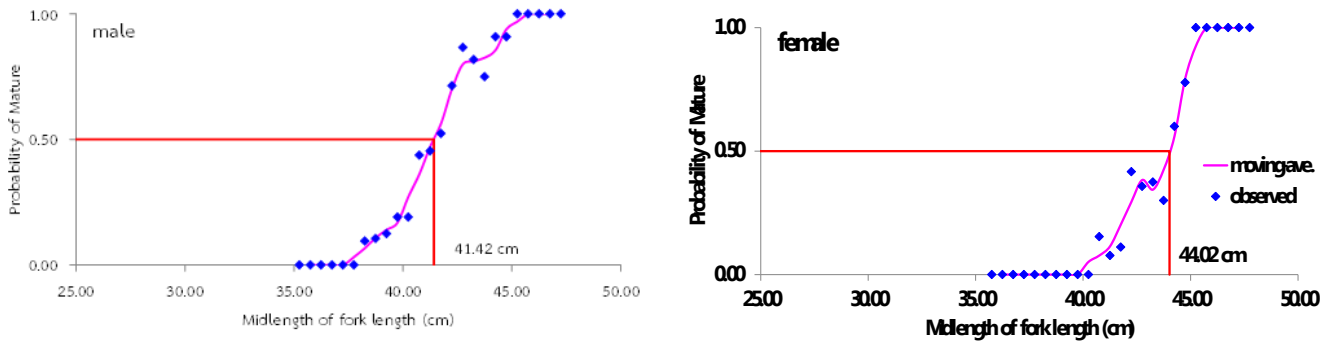

Figure 8 Size at first maturity of longtail tuna in the Andaman Sea coast of Thailand year 2012

Fecundity

Longtail tuna 12 individuals with fork length from 43.00 - 49.50 cm (average 45.70 ± 2.09 cm) weight from 1,630.00 - 2,460.00 g (average 1,853.33 ± 242.69 g) had ovaries weight 18.05 - 101.86 g (average 48.56 ± 28.24 g). Fecundity of longtail tuna in the Andaman sea was 44,628.56 - 240,477 oocytes (average 123,966.63 ± 55,470.64 oocytes). Fecundity and fork length Relationship of long tail tuna in the Andaman sea can be expressed in equation, $F = 259.3139FL^{1.5906}$ ($R^2 = 0.0249$).

Spawning season

MGSI of Longtail tuna in Andaman sea, for male showed the highest peak in March to April with percentage of maturity 66.67-86.36 and November 69.57 while female found development of gonad in every month of the year. The highest MGSI found in April with percentage of maturity was 74.07 and MGSI was also found the highest in April as well with 15.53. Therefore, this could be presumed that the spawning period of longtail tuna in Andaman sea were found during April. (Fig. 9)

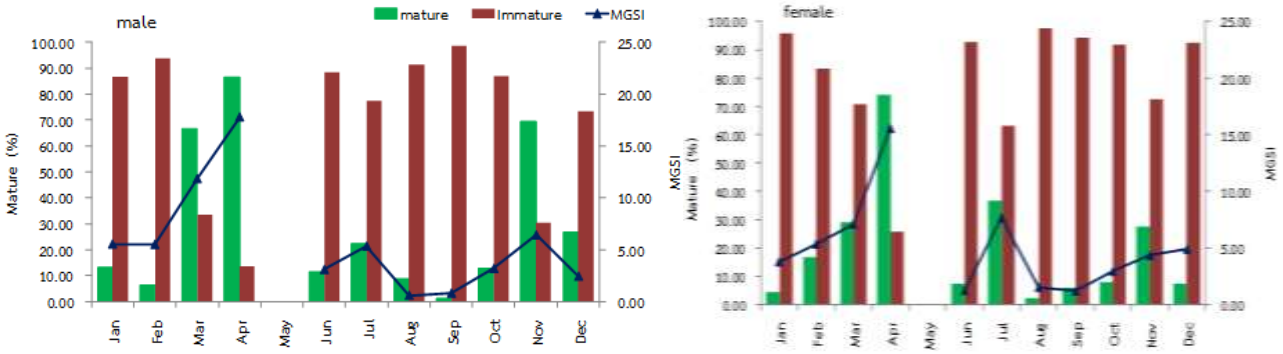

Figure 9 Percentage of mature and mean gonadosomatic index of longtail tuna in the Andaman Sea year 2012

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