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Some Biological Aspects of Frigate Tuna (*Auxis thazard*), Bullet Tuna (*Auxis rochei*), and Kawakawa (*Euthynnus affinis*) in West Coasts Sumatera IFMA 572, Eastern Indian Ocean

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Abstract

Frigate tuna (*Auxis thazard* Lacepede 1800), bullet tuna (*Auxis rochei* Risso 1810), and Kawakawa (*Euthynnus affinis* Cantor 1849) is are belonga to neritic tuna species that exist in the West Coast of Sumatra, eastern Indian Ocean. These species are commercially exploited by several fishing gears such as purse seine, troll line, liftnet, gillnet, seine and pelagic danish seine. Observations on the some biological aspects of three species of neritic tuna were carried out based on fish landing caught by purse seiner. A short period of Sampling from January-April 2013, shows the size of *Auxis thazard* ranged from 21-40 cm (FL), *Auxis rochei* 15-32 cm, and *Euthynnus affinis* 18-54 cm. The result of t test of length-weight measurements primarily indicated that growth of three species are categorized as isometric. Sex ratio of male to female of *Auxis thazard* is 1:1, *Auxis rochei* 1.3:1, and *Euthynnus affinis*1.2:1. The result of chi-square test shows that male and female ratio for three species are significant difference (p> 0:05). Laboratory exercise on stomach content showed that food habits of *Auxis thazard* are consisted of sardines (*Sardinella* sp,) Crustaceans, Anchovy (*Stolephorus* sp), and some squids like Lolingidae.Some materials of the stomach was found as fish that have been ruined and difficult to identify. Empty stomach is also found in some specimens. One of the food item of *Auxis rochei* is anchovies (*Stolephorus* sp.), while empty stomach predominantly up to 61%, whereas one of the food item *Euthynnus affinis* is scads (*Decapterus* sp), and empty stomach condition predominantly found (80%) and the condition of ruined fish is too much

Key words: biological aspects, *Auxis thazard*, *Auxis rochei*, *Euthynnus affinis*, West Coasts Sumatera, Eastern Indian Ocean.

1. Introduction

Neritic tuna is an important comodities West Coast of Sumatra in the eastern Indian Ocean. This area belong to Indonesian Fisheries Management Area (IFMA) 572. National capture fisheries data in 2011 estimated transaction value of neritic tuna reached 802,184,398.00 IDR or around 85,000 US$. Neritic tuna landed in West Sumatra in several locations, among others: Aceh, Padang, Sibolga, those species from fisherman catches are mainly sold at the local market, and at small quantities it also supplied to industry as exported fish. Serial trend landing data on Neritic tuna production during the year of 2002-2011 indicated that still continues to

increase. Highest production occurred in 2008, reaching 79.874 tonnes, and the lowest in 26.270 in 2002, tons (Anon, 2011).

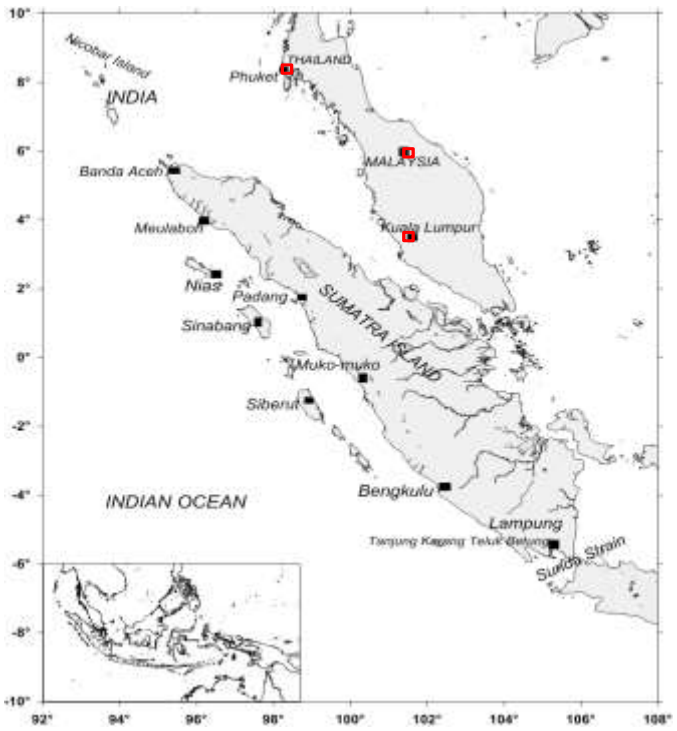
Neritic tuna species in West Coast of North Sumatra landing were caught by purse seine, troll line, liftnet, pelagic danish seine, gillnet and seine. Field observation shows Catch compositions of purse seine shows that mainly consisted of tuna, small pelagic and neritic tuna. Large pelagic species are mainly skipjack (26%), yellowfin tuna (11%), then from the group finfishes such as scad (18%), indian mackerel (16%), Sardinella sp (3%), trevallies (2%), and neritic tuna groups were consisted of frigate tuna (13%), bullet tuna (5%), Kawakawa (2%), and others (4%).

Some neritic tuna species listed under the IOTC management are include: longtail tuna (*Thunnus tonggol*), frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*), Kawakawa (*Euthynnus affinis*), narrow-barred spanish mackerel (*Scomberomorus commerson*), and indo - Pacific king mackerel (*Scomberomorus guttatus*) (IOTC, 2009). Almost all neritic tuna species can be found in the West Coast of Sumatra.The capture of neritic tuna with purse seine in West Coast of Sumatera are also commonly found in traditional scale fisheries. The Capture Fisheries Statistics of Indonesia 2011, reported that there were 652 purse seine vessels in the West Coast of Sumatra. Most of Purse seine use FADs and lights as an auxiliary gears to catch this type of schooling fish. The types of FADs are fixed FADs and portable FADs. The size of purse seine vessels is 15-20 GT (small purse seine), with a length over all of 17-21 m, and wide 3-4.2 m, within 2-3 m. The net lengths is 400-650 meter, and depth of 60-75 meters, the mesh size used varies from 1-3 inches.

Observations on biological aspects of neritic tuna in Indonesia is still need to carried out as a base line of population study. This paper describes some biological aspects include size distributions, sex ratio, and food habits of Auxis thazard, Auxis rochei, and Euthynnus affinis caught by purse seine landed in West Coast of Sumatra, Indian Ocean.

2. Material and Methods

2.1. Study Site and Sampling



(Fig. 1) Biological Sample Collection Area in West Coast of Sumatera

This paper specifically studied of neritic tuna from the West Coast of Sumatra, Indian ocean. Samples of three species of neritic tuna *Auxis thazard*, *Auxis rochei*, and *Euthynnus affinis* were collected between January to April 2013 from several neighboring landing sites. Sample were measured from purse seiner that landed in Banda Aceh, Meulaboh, Sibolga, and Padang (Fig. 1).

Fork length were measured in centimetre and weight in gram, were randomly measured for all three fish species. The length frequency of data were pooled into groups with 1 cm length intervals for *Auxis thazard*, *Auxis rochei*, and 3 cm length intervals for *Euthynnus affinis*. Length weight relationships were analyzed using the formula Bal and Rao (1984):

$$W = aL^b$$

where the: W = weight (kg), L = fork length (cm), a and b = regression constanta

From these equations it can be seen growth patterns of observed neritic tuna. b values obtained are used to determine the growth pattern of the criteria (Bal and Rao, 1984). Furthermore, to determine whether the value of b which is greater, equal to or smaller than 3

were tested by using the t test at 95% confidence interval (Steel & Torrie, 1989). According to Effendi (2002) length weinght relationship could be used to predict the weight from the length of the fish vise versa, to describe of fish growth pattern, condition factors, which is assuming influenced by the environment. Effendie (1997), adding a length-weight relationship of fish is useful to organize the management of fisheries in the region. This criterion is analyzed by looking at variance of value of b.

Sex ratio was analyzed by comparing the number of male and female fish, that is:

$$X = M/F$$

Where the: X = Sex Ratio, M = number of male fish, F = number of female fish

Sex ratio of each species from several months combined to see the percentage of male and female and then carried of Chi - Square test by Sugiyono (2004) with the formula:

$$X^2 = \sum_{i=l}^{k} \frac{(f0-fn)^2}{fn}$$

Where the: X2 = Chi – Square, fo = observed frequency, fn = expected frequency

Test table in the 95% significance level (n-1) with the following hypothesis:

h0: there is no real difference between the number of male and female.

h1: there are significant differences between the number of male and female.

If, χ 2 count <χ 2 tables, h0, h1 was rejected.

If, χ 2 test> χ 2 tables, h1 is accepted, h0 is rejected (Effendie, 2002).

A total of 65 specimens of *Auxis thazard* and 175 of A. rochei and 54 of *Euthynnus affinis* were collected during sampling periods to study the food and feeding habit of three species. Stomachs were isolated and preserved in 4% formalin for food content analysis and identification.

3. Result

3.1. Length Frequency Distributions

In January obtained samples of Kawakawa (*Euthyynus affinis*), with size intervals 3 cm obtained the size range 19-45 cm, mode in 19-21 cm, and an average 23.6 cm (Fig. 2).

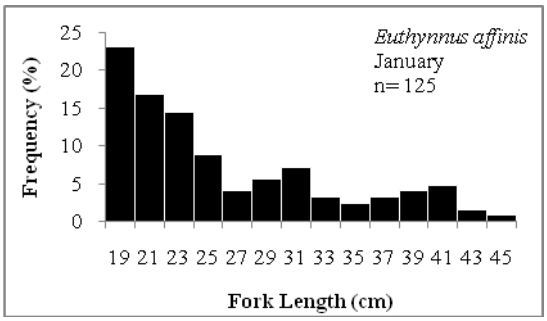
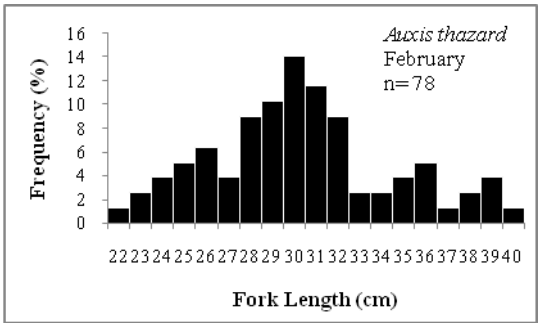
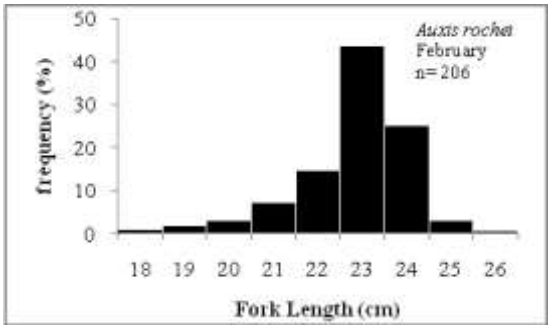


Fig. 2. Size Frequency Distributions of *Euthynnus affinis*, Catch by Purse Seine in January.

In February we get samples of frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*), Kawakawa (*Euthynnus affinis*), with size intervals 3 cm obtained size range of *Auxis thazard* is 22-40 cm, with an average of 32.5 cm and a mode in the size range 30 -32 cm, *Auxis rochei* in the size range is 18-26 cm, mode in 23-24 cm, and an average of 23.4 cm. Kawakawa (*Euthynnus affinis*) with intervals 3 cm obtained size range 18-54 cm, with a mode in the size range 22-26 cm, and the average is 24.2 cm (Fig. 3).





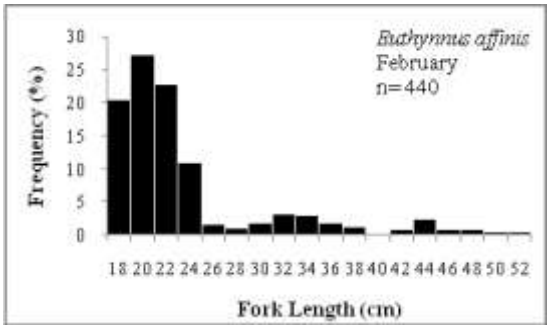


Fig. 3. Size Frequency Distributions of *Auxis thazard*, *Auxis rochei*, *Euthynnus affinis*, Catch by Purse Seine in February.

In March obtained *Auxis rochei* size range is 15-32 cm, mode on the size 19-20 cm, and the average 22.2 cm, while the Kawakawa (*Euthynnus affinis*), size range of 21-37 cm, the mode in of 23-25 cm, and an average of 27.3 cm (Fig. 4).

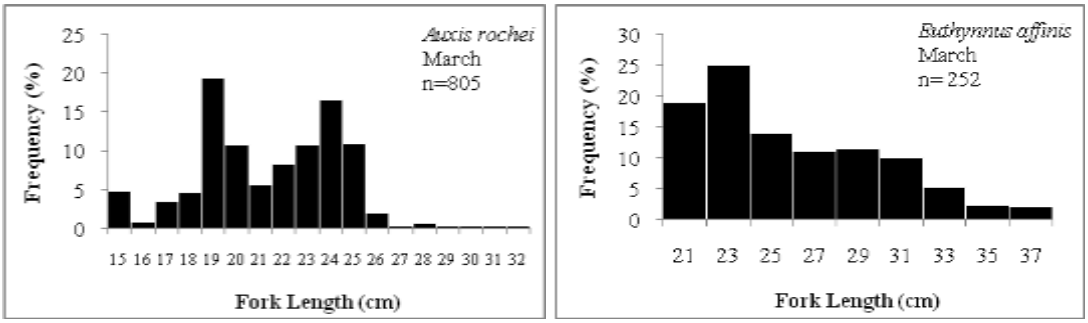


Fig. 4. Size Frequency Distributions of *Auxis rochei*, and *Euthynnus affinis*, Catch by Purse Seine in March.

In April are obtained frigate tuna and bullet tuna samples, frigate tuna (*Auxis thazard*) size range is 21-39 cm, mode on the size range 22-23 cm, and the average 25.4 cm, while the bullet tuna (*Auxis rochei*) is at size range 16-30 cm, mode on the size 23-24 cm, and the average of 23.8 cm (Fig. 5).

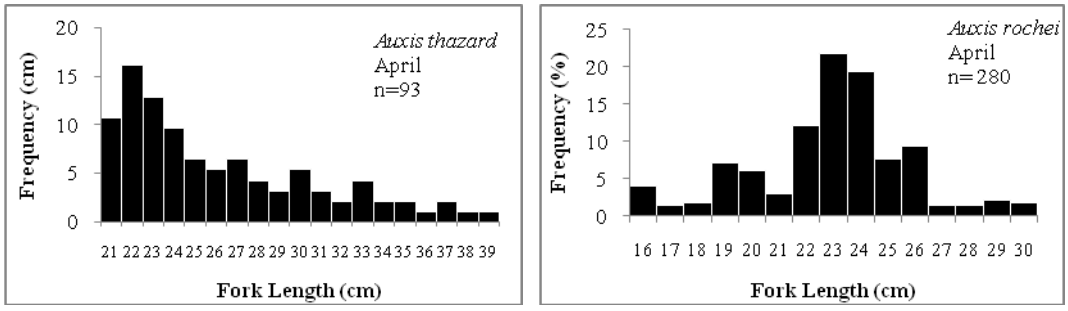


Fig. 5. Size Frequency Distributions of *Auxis thazard* and *Auxis rochei*, Catch by Purse Seine in April.

3.2. Length Weight Relationship

In January length-weight relationship of *Euthynnus affinis* obtained b value 3,012, and the $r^2 = 0.961$, in February for *Auxis thazard* obtained b value 2,805, and $r^2 = 0.955$, *Auxis rochei* has b value 3,089, $r^2 = 0.740$, and *Euthynnus affinis* has a value of b = 3.130, $r^2 = 0931$. Values of a and b in the other months can be seen in Table. 1. The value of 'a' combination of several months to *Auxis thazard* are 0.025, *Auxis rochei* 0.018, and *Euthynnus affinis* 0.015.

Tabel 1. Length-Weight Relationship of *Auxis thazard*, *Auxis rochei*, and *Euthynnus affinis* in West Coast of Sumatra.

Month	Species	n	Length-Weight Relationship	r^2
January	*Euthynnus affinis*	125	$W=0.017FL^{3.012}$	0.961
February	*Auxis thazard*	78	$W=0.028FL^{2.805}$	0.955
	Auxis rochei	206	$W=0.009FL^{3.089}$	0.740
	Euthynnus affinis	440	$W=0.011FL^{3.130}$	0.931
March	*Auxis rochei*	805	$W=0.014FL^{2.984}$	0.891
	Euthynnus affinis	252	$W=0.016FL^{3.042}$	0.914
April	*Auxis thazard*	93	$W=0.022FL^{2.827}$	0.879
	Auxis rochei	280	$W=0.030FL^{2.727}$	0.896

Length weight relationship frigate tuna (*Auxis thazard*) in some areas can be seen in Table 2.

Tabel. 2. Length-Weight Relationship Frigate tuna (*Auxis thazard*), from International Commission for the Conservation of Atlantic Tuna, (ICCAT), 2006

Equation	Area	Country	Reference
$W=0.00166FL^{3.642}$	Gilbraltar Strait	Spain	Ramos, et. al, 1985
$W=0.0547FL^{3.7}$		South Africa	Van Der elst, 1981
$W=0.01FL^{3.13}$	Soutwestern Brazil	Brazil	Madureira and Rossi-Wongtschowski, 2005
$W=0.0061FL^{3.3}$	Mikomoto	Japan	Ishida, 1971
$W=0.077FL^{3.509}$	Shionomisaki	Japan	Ishida, 1971
$W=0.0018FL^{3.334}$		Sri Lanka	Sivasubramaniam, 1966

3.3. Sex Ratio

Sex ratio of male and female obtained by dissecting fish samples. The sum of all sex then compared by dividing the number of male and female. Auxis thazard obtained for a ratio of 1:1, Auxis rochei 1.3:1, 1.2:1 and Euthynnus affinis (Table 3).

Tabel 3. Sex Ratio of Auxis thazard, Auxis rochei, and Euthynnus affinis.

Area	Species	Sex Ratio		n
		Male	Female	
West Coast Sumatera	*Auxis thazard*	1	1	65
	Auxis rochei	1.3	1	175

Euthynnus affinis	1.2	1	54

3.4. Food Habits

Frigate tuna (*Auxis thazard*) by the number of samples 65 obtained stomach contents are dominant species unidentified fish (fish ruined) 41%, empty stomach 32%, and some material were can be identified are as sardines (*Sardinella* sp) 14%, crustaceans (*Acetes* spp) 10%, Anchovies (*Stolephorus* sp.) 2% and Squids (Lolingidae) 1% (Fig. 6).

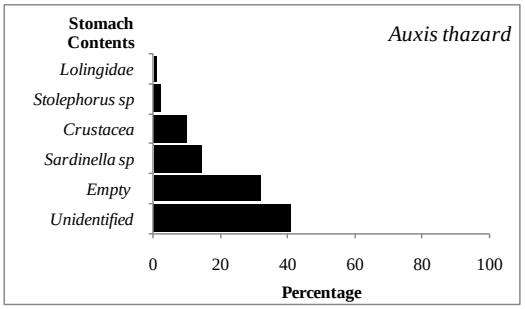


Fig. 6. Stomach Contents of *Auxis thazard*.

Bullet tuna (*Auxis rochei*) with a sample of 175 predominantly found an empty stomach (61%), contains anchovy (*Stolephorus* sp) 28%, and unidentified fish (fish ruined) 12% (Fig. 7).

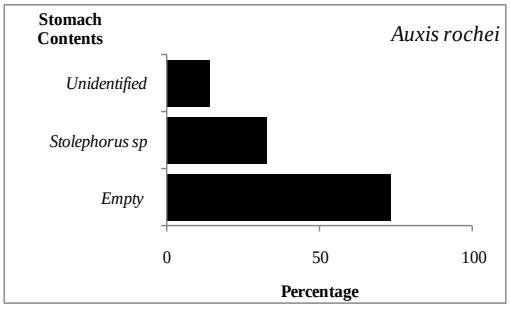


Fig. 7. Stomach Contents of *Auxis rochei*.

Kawakawa (*Euthynnus affinis*) with a sample size of 54 was found to be empty stomach dominant (83%), unidentified fish (fish ruined) 12%, and scads (*Decapterus* sp) 5% (Fig. 8).

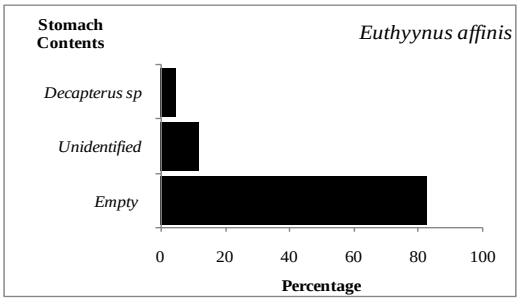


Fig. 8. Stomach Contents of *Euthynnus affinis*.

4. Discussion

Size frequency distribution of Kawakawa (*Euthynnus affinis*) in the January to March seen some movement shifting modes, each in the range of 19-21 cm, 20-22 cm, and 23-25 cm. Length average length on in January is 23.6 cm, February 24.2 cm and March at 27.3 cm. Kawakawa is caught by purse seine in January-March is still largely juvenile. Another study carried out in other waters by Iswarya and Sujatha, (2012) at North Andhra Pradesh, India get shows the size range of 32-66 cm. Bachok, et. Alal., (2004) in Waters Terengganu, East Coast of Peninsular Malaysia get the size range in 33-45 cm.

Size frequency distribution of frigate tuna (*Auxis thazard*) in February gained a larger range than in April, with a mode in 30-32 cm compared to 22-23 cm, an average in February is greater (32.5 cm) than in April (25.4). February is suspected probably related to that many fish are with ripe gonads stage were caught by purse seine. Robert, et. al, 1997 in the New Zealand Water with purse seine obtain the size range 26-41 cm. Iswarya and Sujatha, 2012 at North Andhra Pradesh, India to get the size range of 30-46 cm. Yu Tao et al., (2012) in the Taiwan Strait from the purse seine obtain the size range of 25-40 cm.

Bullet tuna (*Auxis rochei*) in March to April obtained size range 15-32 cm, the mode and the average size does not show any significant shift. Macias, et. al, 2006 to obtain the range of bullet tuna in the South Western Spanish Mediterranean 25-47 cm, the mode is 36 cm from several fishing gear like traps, purse seine, and handline. Kahraman, et. . al., (2010) with purse seine gear and troll line in Turkish Mediterranean Coasts obtain the size range of 34-48 cm, an average of 40.78 cm.

The result off the t test on b value can be inferredindicated that length weight relationship *Auxis thazard*, *Auxis rochei* and *Euthynnus affinis* in West Coast of Sumatra have are isometric growth, *Auxis rochei* isometric growth, and *Euthynnus affinis* have isometric growth. Ghosh, et. al, 2010 in Veraval India gain obtained value b for *Auxis thazard* is 3,.171, and in in Indian Water 2012 the b values are the same as in Veraval. Macias, et. al., 2006, in West Spanish Mediterranean for *Auxis rochei* has a value of b = 3.292 (alometric). While Plandri et. Alal., 2009 in the Ligurian Sea obtained the value of b = 3,674 (alometric). Comparison of eEstimated values of a and b as a comparison of the value of this researchfrom several findings in the tropical waters can be seen in Table 4.

Tabel 4. Estimated a and b Value of *Euthynnus affinis* in the Length-Weight Relationship (Rohit, et. al., 2012).

Area	Value		Reference
	a	b	
Indian Ocean	0.0166	2.963	Morrow, 1954
Philippine Water	0.0108	3.154	Tester and Nakamura, 1957
Indian Ocean	0.0138	3.0287	Silas, 1967
Mangalore, India	0.000031	2.886	Muthiah,1985
Indian Waters	0.019	2.95	James, et. al, 2003
Indian Waters	0.0254	2.889	Rohit, et al.,2012
West Coast Sumatera	0.015	3.061	This study

The result of chi-square test shows that male and female ratio for three species are significant difference (p> 0:05). Muthiah, (1986) in Mangalore waters get obtained sex ratio of *Auxis thazard* is 1:1.16, *Auxis rochei* is 1:1.02 and *Euthyynus affinis* is 1:1.05; result of chi square test shows a comparison of male and female *Euthynnus affinis* and *Auxis rochei* is not a significant difference, and Auxis thazard were significantly difference differentratio of male and female. Macias, et. Alal., (2005), in South Western Spanish Mediterranean found the sex ratio of males to females *Auxis rochei* is 1.7:1. Kahraman, (2010) at the Turkish Mediterranean Coasts obtained results that are not significantly difference different between the number of male and female of *Auxis rochei*. Bachok, (2004) in the East Coast of Peninsular Malaysia obtained the male and female ratio of *Auxis thazard* is 1.14:1 and 1.62:1 for *Euthynnus affinis*.

From stomach contents can be concluded Observation on food habits of *Auxis thazard* are mainly consisted of *Sardinella* sp, Crustaceans, *Stolephorus* sp, and Lolingidae. Most of the

stomach containing destroyed fish so difficult to identify. Empty stomach is also found. One of the food item of *Auxis rochei* is *Stolephorus* sp. Empty stomach dominant up to 61%. *Euthynnus affinis* food item are scads (*Decapterus* sp), empty stomach condition predominantly found (80%) and food conditions have been destroyed too much, so the kinds of foods commonly eaten feed by Kawakawa can not identified. In the January to April for the three species have not shown the varies of food types. In the purse seine sometimes three species are often caught together, this indicates that the similarity of foods causing the fish is one location in order to find food.

The food items in the diet of *Auxis thazard* were classified into three major groups: crustaceans, cephalopods and finfishes. Crustaceans comprised mainly of non-like *Acetes* spp. The Loligo sp dominated among cephalopods and sardines, anchovies, mackerels, scads were dominated among finfishes.

Ghosh, et. al., (2012) also found an empty stomach conditions dominate the *Auxis thazard* (74%) in the Indian Water. Bachok, (2004) in the East Coast of Peninsular Malaysia found the *Auxis thazard* stomach are contents anchovies, and indian mackerel, whereas for *Euthynnus affinis* is anchovy, and squid. Kumaran, (1964) in the Indian Ocean found that the most important food *Auxis rochei* divided into three groups, namely finfishes, crustaceans, and cephalopods. Finfishes like *Sardinella* spp, *Anchoviella* spp, *Leiognathus* sp, and Carangidae. From crustaceans like *Rhopolophthalmus* sp, *Hyperia bengalensis*, *Oxycephalus Clausi*, *Pseudophausia latifrons*, *Acetes erythreus*, and Squilla larvae.

5. Conclusion

This study specifically examined the major species of the purse seine catches. Of samples obtained starting January-April 2013, *Auxis thazard* found that size range is 21-40 cm, *Auxis rochei* 15-32 cm, and *Euthynnus affinis* 18-54 cm. The result of t test on the value of b from three species known is isometric growth. *Auxis thazard* have sex ratio 1:1, *Auxis rochei* 1.3:1, and *Euthynnus affinis* 1.2:1. The result of chi-square test shows that male and female ratio for three species are significant difference (p> 0:05). Food habits of *Auxis thazard* are *Sardinella* sp, Crustaceans, *Stolephorus* sp, and Lolingidae. Most of the stomach was found containing destroyed fish. Food item of *Auxis rochei* is *Stolephorus* sp., an empty stomach dominant up to

61%, Food item of *Euthynnus affinis* is scads (*Decapterus* sp), an empty stomach condition predominantly found (80%) Most of the stomach of kawakawa was found containing destroyed fish and so difficult to identify. Study of biology aspects for neritic tuna has been conducting.unidentified species. A further study of these species were proposed to understand their dynamics and fisheries status.

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