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Catch and Size Distribution of Bullet and Frigate Tuna Caught by Drifting Gillnet in Indian Ocean Based at Cilacap Fishing Port, Indonesia

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ABSTRACT

In Indonesia, bullet and frigate tuna in the Indian Ocean were caught by various of fishing gears including, drifting gillnet" and landed in various fishing port in along coastal of west Sumatera (Banda Aceh, Pariaman, Bungus/Padang and Painan) as well as south Java, Bali and Nusatenggara (Muarabaru/Jakarta, Pelabuhanratu, Cilacap, Kedonganan, Benoa). In Cilacap, especially tuna drifting gillnet fishery produces bullet and frigate tuna as by product. This paper presents the information on catch and size distribution of bullet tuna (*Auxis rochei* Risso, 1810) and frigate tuna (*Auxis thazard* Lacepède, 1800) caught by drifting gillnet based at Cilacap Fishing Port. Data and information obtained through catch monitoring, port sampling and landing report of Cilacap Fishing Port 2011 as well as from Capture Fisheries Statistics of Indonesia 2010. The catch estimation of bullet and frigate tuna on drift gillnet fishery based at Cilacap fishing port in 2011 about 3.220 and 47.346 tons respectively. Size (FL) of bullet tuna ranged between 16-39cm and frigate tuna ranged between 25-46cm. Neither bullet nor frigate mostly caught by drifting gillnet on adult size.

Key Word: catch and size distribution, bullet and frigate tuna, drifting gillnet, Indian ocean, cilacap fishing port.

INTRODUCTION

Drifting gillnet was developed in Cilacap since tens year ago, Cilacap was located in the Southern coastal of the Central Java. The fishing area of the drifting gillnet based at Cilacap was Indian Ocean. The main target of the drifting gillnet is tuna and tuna like including neritic tuna and sheerfish. Based on the Cilacap Fishing Port Annual Report in 2011, the number of drifting gillnetter base at Cilacap Fishing Port was 205 fleets. The number has significantly increase compared to 2010 which was 165 gillnetters (Widodo, 2011). The drifting gillnet was nylon multifilament with mesh size 5 inch and operated by wooden boat 20-30 GT. Each gillnetter operates about 50-60 piece of net.

There are 6 species of neritic tuna and sheerfish under IOTC management i.e. 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*) (Herrera, at al., 2009). National Fisheries Statistic of Indonesia (DGCF, 2011) noted that the 6 species were caught in Western Sumatera and Southern Java Indian Ocean. Generally neritic tuna and sheerfish are part of the catch of purse seine, drifting gillnet, hand lining and trolling gear. This paper presents the information on catch and size distribution of bullet

tuna (*Auxis rochei* Risso, 1810) and frigate tuna (*Auxis thazard* Lacepède, 1800) caught by drifting gillnet in the Indian Ocean based at Cilacap Fishing Port.

MATERIAL AND METHODS

Two types of data (primer and secondary) data were analyzed in this paper.

1. The primer data come from catch monitoring and landing report based at Cilacap Fishing Port which was conducted in 2011. The data cover fishery aspect and fish biology aspect. Fishery data consist fishing operational and catch. The biological data consist of species and size (fork length-FL) obtained through sampling which was conducted on April, August and December. The sampling activity was part of catch monitoring program, number of samples was 5-7% of total catch.
2. The secondary data came from National Fisheries Statistics 2005-2010 published by DGCF and Annual Report of Cilacap Fishing Port 2005-2011.

RESULT

a. Fishery (Fleet, Gear and Operational Aspect)

The number of registered fishing fleet are fishing in Indian Ocean FMA 573 based at Cilacap Fishing Port as per 2011 was 892 with breakdown for 299 tuna longliners, 138 set gillnetters, 205 drifting gillnetters, 181 trammel netters, 98 monofilament gillnetters, 42 bottom Danish seiners, 7 pelagic Danish seiners, 7 portable trappers and 3 lift netters (Table 1). The 205 drifting gillnetter were 23% of total fleet and only 127 active gillnetters noted in 2011. In general the number of gillnetter increased about 5.7% in average year by year.

Table 1. Fishing fleet structure based at Cilacap Fishing Port.

Fishing Fleet	2005	2006	2007	2008	2009	2010	2011
Tuna Long Liner	161	128	156	170	188	245	299
Drifting Gillnetter	63	196	184	183	213	165	205
Set Gillnetter	84	103	105	132	140	134	138
Trammel Netter	327	199	115	178	192	179	181
Pelagic Danish Seine	6	8	10	4	4	6	7
Botton Danish Seine	39	40	50	38	38	38	42
Portablel Trapper	0	0	64	13	12	13	7
Lift Netter	0	0	0	0	0	11	3

In general gillnetters are medium-size, ranging from around 10 m to more than 20 m long vessels. Their wheelhouse may be aft but, more often forward to leave enough space for storing nets. Generally the shooting is from the stern and the hauling by the side. Modern gillnetters, setting and hauling operation are performed by hydraulic, and in Indonesia mostly of gillnetter hauling by hand. Most of gillnet fleets based at Cilacap were wooden boat size 10-30 GT with the main engine 120-160 HP and generator engine 24-30 HP. Fish hold of the gillnet fleets were not equipped with refrigeration machine, the freshness of catch is preserved with the ice. Gillnet fleets generally equipped by compass and GPS for the navigation purpose and SSB radio for communication. Number of crew each boat about 12-14. Fishing trip duration is 18-22 days per trip with the effective days 16-20. Figure 1 presents size (GT) structure of active gillnetters based at Cilacap Fishing Port in 2011.

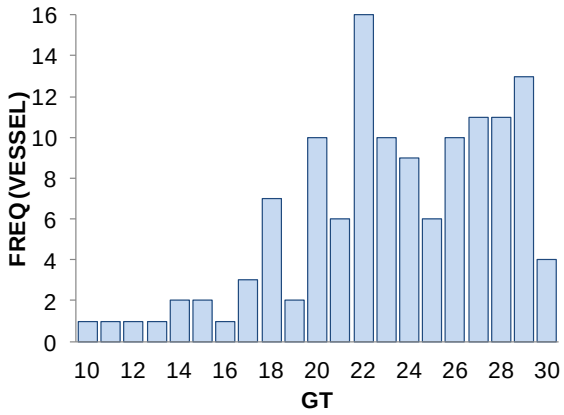


Figure 1 Size (GT) structure of 127 active gillnetters based at Cilacap Fishing Port 2011.

The drifting gillnet is a wall of fine, large-meshed synthetic netting with a line of float (corks) at the top and a series of weight (leads or concrete) at the bottom to maintain it vertical in mid-water, in general, not far below the surface. It is normally set at dusk and hauled at dawn or in the morning. The length of drifting gillnets deployed by fishermen targeting tuna or other large pelagic fish such as swordfish, is commonly several kilometers whereas the height ranges from 18 to 30 m. Widodo (2011) noted that one piece of drifting gillnet in Cilacap has length 38-40 m and height 18-20 m. Webbing material is nylon multifilament type d-21 and mesh size 5 inch. Floats are synthetic rubber type Y-15 as much as 6 floats and 4 weights from concrete 0.5 kg each weight. Each piece of gillnet is equipped 2 plastic buoy Ø 30 cm and buoy line 6 m in length for keeping the position of gillnet about 5-6 m below the sea surface. One gillnetter is generally operating 50-60 piece gillnets or about 1.5-2.5 kilo meter in total length.

Widodo (2011) noted that based on onboard observation conducted in 2008, 2009 and 2010 the gillnet fleet based at Cilacap have similar fishing ground pattern in those year. In April they operate in the offshore waters, whereas in July and October they operate in the inshore waters. In 2011, the situation was relatively similar with the previous year. The fishing position of drifting gillnetter in 2011 ranged 7.0^{o}-11.0^{o}S and 107.0^{o}-111.0^{o}E (Figure 2). Since 2010 gillnet fishery experienced fishing pressure by the operation of purse seiners those are fishing in gillnet fishing ground. The purse seiners deployed FADs in the conventional drifting gillnet fishing area and since that time most drifting gillnet fleets move to the inshore waters. Frigate tuna is probably cosmopolitan in warm waters; it is an epipelagic, neritic as well as oceanic species (Anon., 2006).

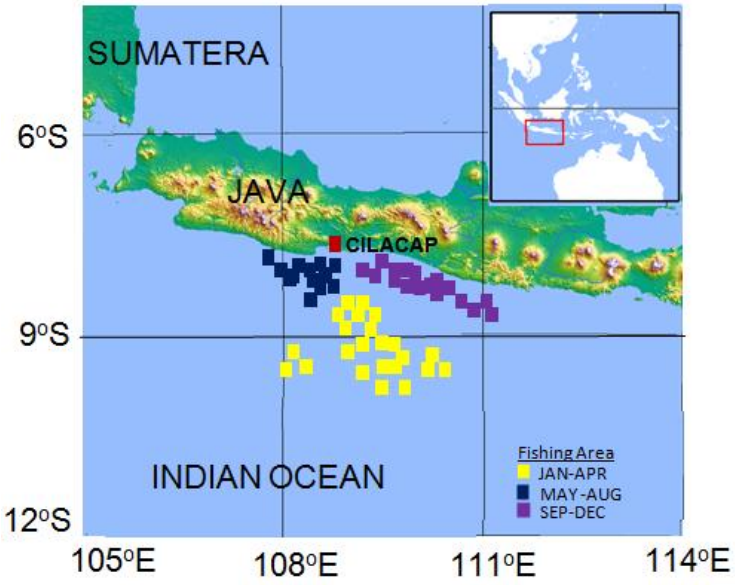


Figure 2 Drifting gillnet fishing area based at Cilacap Fishing Port in 2011.

The fishing season represented by number of landing, the number of bullet and frigate landing in 2011 fluctuated between months, with the highest landings of was experienced in December (Figure 3). In December drifting gillnet was mostly fished in offshore waters where sea condition was very calm.

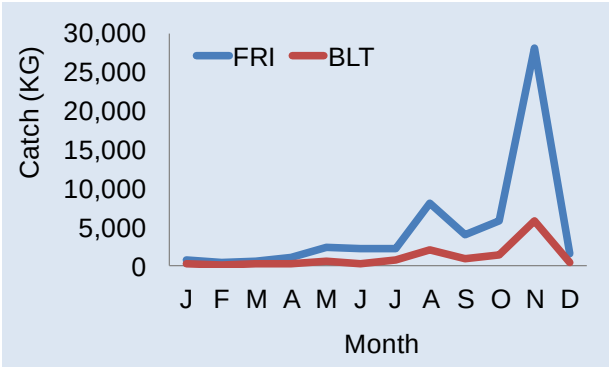


Figure 3 The fluctuation of bullet and frigate tuna catch on drifting gillnet fishery based at Cilacap Fishing Port during 2011.

b. Catch

Indonesian fisheries national statistic reported that annual catch of the 2 (two) main species of neritic tuna such as bullet and frigate tuna from Indian Ocean which

composed of Western Sumatera, Southern Java and Southern Bali-NTT in 2010 estimated 2,445 and 47,113 mt respectively as described in the Table 2. Compared to the annual catch previous year, annual catch of bullet has experienced significant increasing. Since the past six years, the average annual catch of frigate tuna annual catch increased about 76% per year. While the average of bullet tuna annual catches was experienced steady decreasing reach 34% per year. The catch of frigate tuna from Indonesian Indian Ocean shared about 35% to the national level of frigate tuna total catch estimation (132,772 mt). Whilst the catch of bullet tuna contributed about 66% to the national level of bullet tuna total catch estimation (3,696 mt) as described in the Table 3.

Table 2 The estimate of catch of neritic tuna and sheerfish landing in Western Sumatera, Southern Java and Southern Bali-Nusatenggara 2005-2010.

Year	Landing Places	Production by Species (TON)					
		FRI	BLT	LOT	KAW	COM	GUT
2010	West Sumatera	19,516	2,296	14,435	13,840	7,923	7,444
	South Java	149	121	516	15,217	2,466	1
	Bali-Nusatenggara	27,448	28	3,995	10,818	4,646	268
	Sub Total	**47,113**	**2,445**	**18,946**	**39,875**	**15,035**	**7,713**
2009	West Sumatera	16,691	2,869	12,925	7,507	2,358	7,916
	South Java	2,891	897	361	19,514	2,358	5
	Sub Total	**19,582**	**3,766**	**13,286**	**27,021**	**4,716**	**7,921**
2008	West Sumatera	19,251	936	8,183	29,380	8,010	7,351
	South Java	4,202	982	476	18,417	30	2,571
	Sub Total	**23,453**	**1,918**	**8,659**	**47,707**	**8,040**	**9,922**
2007	West Sumatera	20,733	10	11,622	8,599	7,676	9,220
	South Java	5,439	3,304	374	15,124	11,175	64
	Sub Total	**26,172**	**3,314**	**11,996**	**23,723**	**18,851**	**9,284**
2006	West Sumatera	4,460	3	6,251	16,771	6,737	4,488
	South Java	13,257	530	3,626	228	2,885	45
	Sub Total	**17,717**	**533**	**9,877**	**16,999**	**9,622**	**4,533**
2005	West Sumatera	3,929	3	3,057	15,038	4,456	2,992
	South Java	6,912	0	1,682	2,108	2,358	36
	Sub Total	**10,841**	**3**	**4,739**	**17,146**	**6,814**	**3,028**
2004	West Sumatera	3,237	6	11,216	9,963	4,555	3,480
	South Java	31	0	8,127	6,068	2,737	1
	Sub Total	**3,268**	**6**	**19,343**	**16,031**	**7,292**	**3,481**
		Little Tuna				**COM**	**GUT**
2003	West Sumatera	26,312				6,147	6,034
	South Java	10,009				2,775	29
	Sub Total	**36,321**				**8,922**	**6,057**
2002	West Sumatera	18,210				4,315	3,745
	South Java	26,609				3,855	24
	Sub Total	**44,819**				**8,170**	**3,769**
2001	West Sumatera	22,409				6,522	4,471
	South Java	6,875				3,160	105
	Sub Total	**29,284**				**9,682**	**4,576**

Source: Capture Fisheries Statistics of Indonesia 2010 (DGCF, 2011).

Table 3 The national catch of frigate and bullet tuna in Indonesian Indian Ocean waters 2010.

Landing Places	Production by Species (TON)					
	FRI	BLT	LOT	KAW	COM	GUT
NATIONAL	**132,733**	**3,696**	**89,281**	**141,190**	**140,277**	**23,297**
INDIAN OCEAN	**47,113**	**2,445**	**18,946**	**39,875**	**15,035**	**7,713**
Sub Total						
West Sumatera	**19,516**	**2,296**	**14,435**	**13,840**	**7,923**	**7,444**
Aceh (**Aceh**)	4,169	1,835	3,672	3,707	1,623	31
Sumatera Utara (**North Sumat**	1,528	-	730	6,464	2,119	1,435
Sumatera Barat (**West Sumat**	12,102	399	7,578	471	2,642	5,380
Bengkulu (**Bengkulu**)	1,645	36	2,369	2,087	742	598
Lampung (**Lampung**)	72	26	86	1,111	797	0
Sub Total						
South of Java	**149**	**121**	**516**	**15,217**	**2,466**	**1**
Banten (**Banten**)	0	0	0	2,360	1,840	0
Jawa Barat (**West Java**)	5	120	375	1,392	244	0
Jawa Tengah (**Central Java**)	25	1	0	168	26	0
DI Yogyakarta (**Yogyakarta**)	119	0	141	18	22	0
Jawa Timur (**East Java**)	0	0	0	11,279	334	1
Sub Total						
South of Bali-Nusatenggara	**27,448**	**28**	**3,995**	**10,818**	**4,646**	**268**
Bali (**Bali**)	15,475	0	1,713	3,384	282	1
NTB (**West Nusatenggara**)	922	27	2,161	6,747	2,001	267
NTT (**East Nusatenggara**)	11,051	1	121	687	2,363	0

Source: Capture Fisheries Statistics of Indonesia 2010 (DGCF, 2011).

The catch per unit effort (CPUE) of drifting gillnets on frigate and bullet tuna based at Cilacap Fishing Port is represented by its catch rate. Result of catch monitoring during six past year (2006-2011) showed that the catch rate of drifting gillnets on both species frigate and bullet tuna decreased year by year. As described in the Table 4 that the catch rate of drifting gillnets on the frigate tuna was 0.364 mt/trip in 2006 decreased to 0.054 mt/trip in 2011 (decreased average 17% per year). The situation on the resource of bullet tuna is also similar to the frigate tuna. The catch rate of drifting gillnets on the bullet tuna was also decreased from 0.178 mt/trip in 2006 to 0.013 mt/trip in 2011.

Table 4 Catch rate of drifting gillnets to frigate and bullet tuna.

Year	Registered Vessel	Active Vessel	Number of Trip	Catch (TON)		Catch Rate (TON/Trip)	
				Frigate Tuna (FRI)	Bullet Tuna (BLT)	Frigate Tuna (FRI)	Bullet Tuna (BLT)
2006	63	61	427	270.646	75.925	0.634	0.178
2007	196	144	1008	160.252	88.2	0.159	0.088
2008	184	131	1279	232.558	11.440	0.182	0.009
2009	183	102	603	69.050	48.000	0.115	0.080
2010	165	98	492	42.600	16.000	0.087	0.033
2011	205	127	1054	57.346	13.22	0.054	0.013

Source: Cilacap Fishing Port Annual Report (Anon. 2006-2011)

Result of catch monitoring on drifting gillnet fishery based at Cilacap Fishing Port in 2011 showed that catch composition of the drifting gillnet dominated by skipjack tuna i.e. 68.5% from total 3358.878 mt, whilst frigate and bullet tuna were only 1.6% and 0.4% respectively (Figure 3) and the detail of species caught by drifting gillnet presented in the Table 5 which was at least 50 species identified during catch monitoring in 2011.

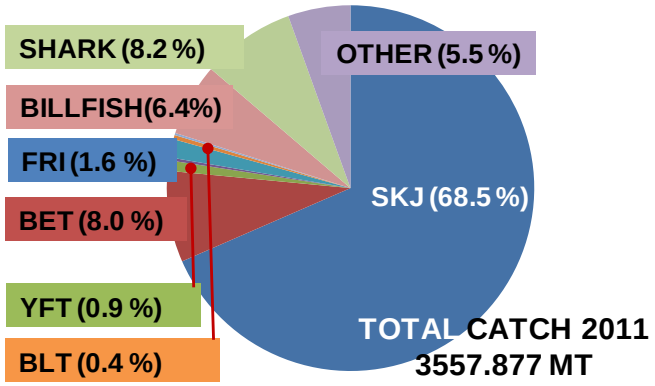


Figure 3 Catch composition of drifting gillnets based at Cilacap Fishing Port.

Table 5 Catch compositions of drifting gillnet based at Cilacap Fishing Port.

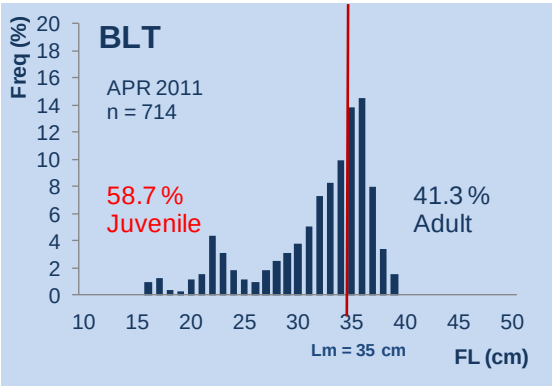
		CATCH (TON)					
SPECIES		**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Lokal Name	**Common Name**						
TUNA							
Cakalang	Skipjack tuna	4650.960	3265.375	2240.190	1835.674	350.681	2435.895
Tuna Mata Besar	Bigeye Tuna	136.131	101.54	401.8166	894.94302	378.15539	286.31396
Madidihang	Yellowfin Tuna	5.472	6.814	12.96723	76.03145	100.78909	32.49647
Albakor	Albacore	0.035	0.072	3.065	5.392	2.696	9.2708
NERITIC TUNA							
Tongkol Lurik	Frigate Tuna	270.646	160.252	232.558	6.905	1.260	57.346
Tongkol Lisong	Bullet Tuna	75.925	88.82	11.440	48.000	16.000	13.22
SHEERFISH							
Tenggiri	Narrow Barred Spanish Mackerel	0.681	5.287	9.747	10.397	5.118	6.635
BILLFISH							
Ikan Pedang	Swordfish	3.425	9.5279	27.329	24.187	24.514	26.68157
Setuhuk hitam	Black Marlin	70.378	86.832	117.095	109.777	21.448	89.98505
Setuhuk loreng	Indo Pacific Blue Marlin	5.642	8.095	13.259	16.034	3.659	9.5493
Setuhuk putih	Striped Marlin	31.110	57.241	81.712	41.106	15.975	44.78394
Layaran	Sailfish	38.707	37.295	28.358	64.845	8.652	56.60665
Ikan Tumbuk	Shortbill Spearfish	0.110	0.436	0.742	0.536	0.063	0.071
SHARK							
Cucut Tikusan	Smalltooth Thressher Shark	120.423	83.556	85.019	63.924	11.669	108.4796
Cucut Pahitan	Bigeyed Thresher Shark	63.614	11.52	29.894	15.411	2.250	45.118
Cucut Lanyam Super	Spottail Shark	4.836	4.718	7.529	0.672	0.190	1.2
Cucut Lanjaman	Silky Shark	1.702	4.258	3.246	4.515	3.618	4.782
Cucut Selendang	Blue Shark	6.153	3.447	3.291	0.673	0.624	0.901
Cucut Cakilan	Shortfin Mako Shark	4.156	4.709	0.000	3.714	1.183	6.725
Cucut Cakilan Air	Longfin Mako Shark	0	0	0	0	0	0.592
Cucut Macan (Cucut Buas)	Tiger shark	0.436	0.57	0.000	0	0	0.077
Cucut Koboy	Oceanic Whitetip Shark	0.079	0.195	0.185	0.127	0	0.211
Cucut Botol	Crocodille Shark	0.079	0	0.953	0	0	0.394
Cucut Caping	Scalloped Hammerhead Shark	7.426	5.417	6.648	2.573	0.680	0
Cucut Botol	Crocodille Shark	0	0.262	0	1.715	0.010	0
Cucut Kapukan	Sharpnose Sevengill Shark	1.172	0	0	0	0	0
Cucut Isabela	Western Angel Shark	2.063	0	0.086	0	0	0
Cucut Londer	Gummy Shark	0.430	0	0	0	0	6.644
RAYS							
Pari Plampangan (Pari Hantu)	Manta Ray	51.474	82.698	65.353	71.199	56.375	110.3099
Pari Kelapa	Cowtail Ray	2.404	0	0	0	0	0
Pari Bluju	Mobula Tarapacana	0	0	1.860	3.553	4.411	5.576
Pari Kasab	Manta birostris	0	0	0.000	3.242	0.411	1.703
OTHER							
Lemadang	Common Dolphinfish	6.698	17.391	26.029	24.154	19.345	42.582
Ikan Setan	Escoler	0.187	0.47	4.873	0	0	8.789
Kakap hitam	Triple tail	4.586	5.4819	13.418	15.488	11.097	23.369
Sunglir	Rainbow runner	0.131	0.051	1.825	0.578	4.582	0.375
Cumi-Cumi	Squid	31.460	77.738	134.950	95.684	13.506	114.535
Ikan Kempar pati	Moonfish	0.330	0	0.480	0	0.000	0
Kakak Tua (Etong)	White Spotted Trigerfish	0.709	0.871	0.717	3.184	10.678	2.2555
Jahan (Manyung)	Giant Catfish	27.906	9.638	0.000	0.000	0	0
Ikan Sebelah (Ikan Pihi)	Indian halibut	2.565	0	0.000	0	0	0
Gogokan	Black Jew	5.112	0	0.240	0	0	0
Gerok	Barret Gruntel	0.455	0	0	0	0	0
Kuwe	Bigeye Trevally	0.518	0	0.640	0	0	0
Tetengkek	Finny Scad	0.280	0	0	0	0	0
Patilan	Dog Fish	5.705	0	0	0	0	0
Casper	Angel Fish	0	0.455	4.211	1.915	0.116	4.377
Slengseng	Slimy Mackerel	0	4.232	2.000	0	0.000	0
Layur	Hair Tail	0	0.165	3.101	0.040	0	0
Opah	-	0	0	0.214	0.065	0	0.028
Gindara (Ikan Setan)	Escoler	0	0	0	5.095	4.225	0

c. Catch Size

Result of sampling activity (part of the catch monitoring) in 2011 shows that the size (fork length-FL) both species frigate and bullet tuna species caught by gillnet mesh size 5 inch varied corresponds to month and fishing area as presented below:

Bullet Tuna

Size (FL) of bullet tuna caught on April, August and December 2011 ranged between 16-39 cm with mode at 36 cm, 36 cm and 35 cm respectively (Figure 4). It is compared to the result of onboard observation in 2008-2010 (Widodo et al., 2011) that the size of bullet tuna caught in 2011 was relative smaller. The smallest size of bullet tuna caught in 2008 was ranged 24-45 cm with mode at 42 cm. The first maturity size has been stated as 35 cm (FL), when the fish is two years old (Rodriguez-Roda, 1983 in Kahraman, 2010) that was in line with result of the research by Kahraman et al. (2010) which determined that sexually mature bullet tuna specimens were always well over 35 cm FL. The result of research was in line with the behavior of bullet tuna. The bullet tuna is an epipelagic, neritic as well as oceanic species with strong schooling behavior. Adults are principally caught in coastal waters and around islands (Anon., 2006). Base on the information of maturity size as mentioned above, so that <50% of bullet tuna caught by drifting gillnet in April was juvenile fish, whilst in August and December mostly of bullet tuna caught at matured size.



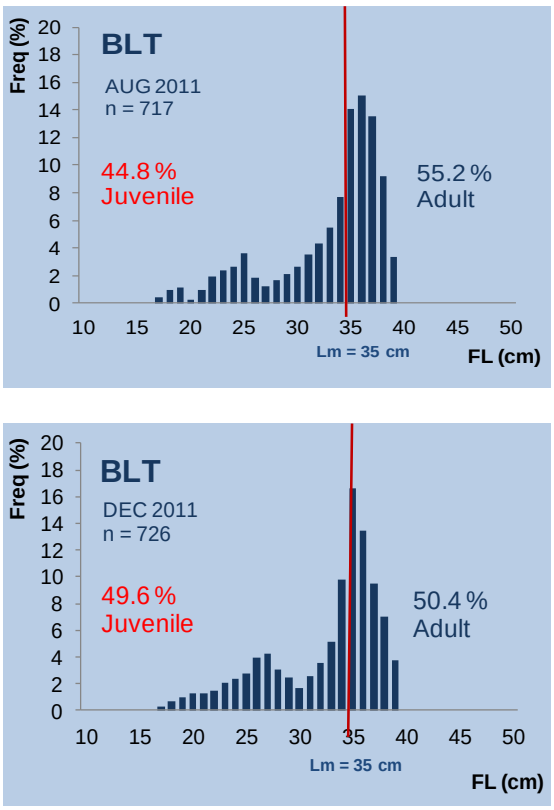


Figure 4 Size (FL) distribution of bullet tuna caught by drifting gillnets based at Cilacap Fishing Port in 2011.

Frigate Tuna

In April, August and December 2011 the size (fork length-FL) distribution of frigate tuna caught ranged 25-46 cm with the mode 32cm, 33cm and 33cm respectively (Figure 5). The size was smaller than the common size frigate tuna i.e. 60 cm that as mentioned by Figueiredo et al. (2002). Maximum length of frigate tuna (unsexed) reaches 65 cm (Cayrè, 1993). According to Jude et al. (2002) that males and females frigate tuna were found to attain maturity at slightly different length. Males attained maturity at slightly smaller length than females. Males attain maturity at 30.8 cm while females at 32.8 cm. If assumed that all frigate tuna catch was females with length at first matured (L_m) 32.8 cm, so that number of matured frigate tuna caught by drifting gillnet was reached 61.3% in April, whilst in August and December were 69.6% and 74.6% respectively. It means that mostly of frigate tuna caught by drifting gillnet at matured size.

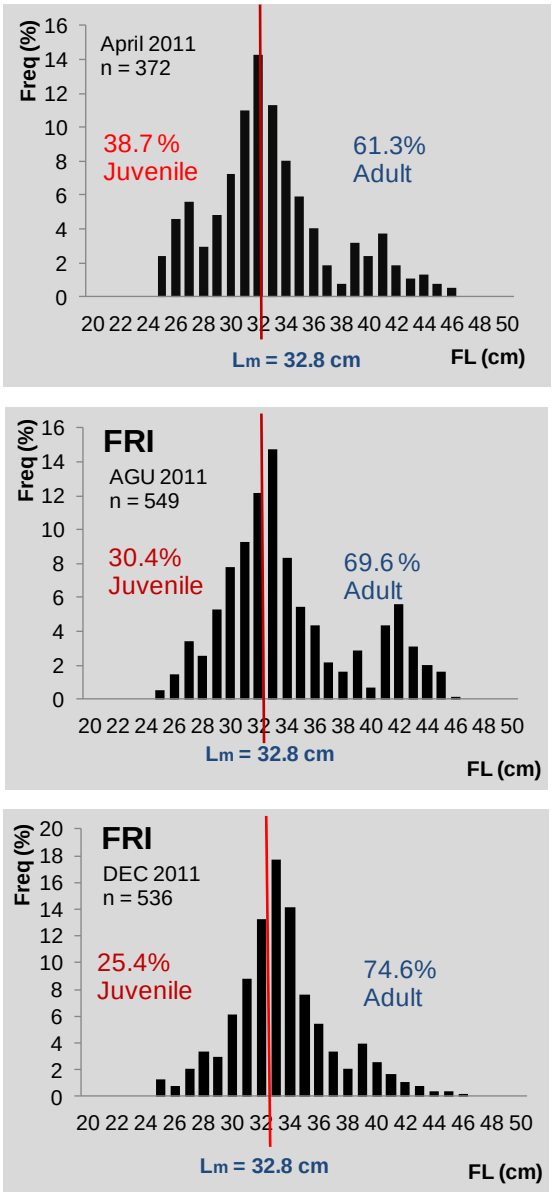


Figure 5 Size (FL) distribution of frigate tuna caught by drifting gillnets based at Cilacap Fishing Port in 2011.

CONCLUTION

Bullet and frigate tuna caught by drifting gillnet in Indian Ocean based at Cilacap Fishing Port as byproduct, accounted 0.4% and 1.6% of the total catch. The catch fluctuated between months and peak season experienced on December. The catch rate of both species bullet and frigate tuna decreased year by year since 6 past year, in

2011 the catch rate of bullet tuna 0.013 mt/trip/vessel and frigate tuna was 0.054 mt/trip/vessel. Both of species bullet and frigate tuna caught by drifting gillnet mostly as adult fish.

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