

CATCH AND SIZE OF BULLET AND FRIGATE TUNA CAUGHT BY USING DRIFTING GILLNET IN INDIAN OCEAN OF INDONESIA BASED AT CILACAP FISHING PORT

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ABSTRACT

Pelagic fishes such as bullet and frigate tuna in the Indian Ocean were caught in Indian Ocean of Indonesian jurisdiction using various 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, tuna drifting gillnet fishery is fishing bullet and frigate tuna as by product. The current work describes the 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 drifting gillnet fishery is about 3.220 and 47.346 tons respectively. 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 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. The FL of bullet and frigate tuna ranged respectively between 16-39cm and 25-46cm. Both species were mostly caught by drifting gillnet in adult size condition.

KEYWORD: Catch and size distribution, bullet and frigate tuna, drifting gillnet, Indian Ocean, Cilacap fishing port.

INTRODUCTION

Drifting gillnet was developed in Cilacap (Southern coastal of central Java) since ten years ago. The fishing ground of drifting gillnet based at Cilacap is in Indian Ocean. The main target of this fishing gear is tuna and tuna like including neritic tuna and sheerfish. Based on the 'Cilacap Fishing Port Annual Report of 2011', the number of drifting gillnetter based at Cilacap Fishing Port is 205 fleets. This number has increased significantly compared to that in 2010 when it was 165 fleets. The drifting gillnet was nylon multifilament with mesh size 5 inch and operated by wooden boat 20-30 GT. Each boat operates about 50-60 piece of drifting gillnet.

There are 4 species of neritic tuna and 2 species 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 six 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 lines gear.

Statistic of Marine Fisheries of Cilacap Fishing Port (2012) reported that mostly of bullet tuna (*Auxis rochei* Risso, 1810) and frigate tuna (*Auxis thazard* Lacepède, 1800) caught by drifting gillnet. Total production of the drifting gillnets fisheries landed in Cilacap Fishing Port on 2012 reached 101 mt and 6 mt for bullet and frigate tuna respectively. The production drifting gillnet contributed about 0.20% and 0.26% of total catch of bullet and frigate tuna from Indian Ocean West of Sumatera and South Java, Bali and Nusa Tenggara.

Availability the information of catch by species, gear and fishing ground as well as the size of fish was important aspects in the fish stock assessment work. This paper describes the 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, Central Java.

MATERIALS AND METHODS

The primary data were gathered in 2010 from catch monitoring and landing report of drifting gillnetters operated in Indian Ocean based at Cilacap Fishing Port where the field survey was conducted in 2011. The data covered fishery and fish biology aspects. Fishery data consisted of fishing operational and

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catch (effort data and trip catch, the biological data consisted of species and size (fork length-FL). The samplings were conducted in April, August and December, it was done by two enumerators.

The enumerator did the record of data/information including vessel name, number of piece of net, trip duration, main fishing ground) and total catch (weight) for all drifting gillnetter arriving in port after fishing. Those data and were information obtained from the skippers through interview and available log book. The biological aspects of data were obtained through the random sampling of catch. Number of sample was three boxes (about 30-50 kg/box) taken on the beginning, middle and the end times of catch unloading. The secondary data were noted from National Fisheries Statistics 2005-2010 published by DGCF and Annual Report of Cilacap Fishing Port for the period of 2005-2011.

RESULTS

Fishery (Fleet, Gear and Season)

Mostly drifting gillnet fleets based at Cilacap Fishing Port are fishing in Indian Ocean within Indonesian Fisheries Management Area-FMA 573. The number of registered fishing fleet based at Cilacap Fishing Port in 2011 was 892 with detail of 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 every year about 5.7% in average.

Table 1. Fishing fleet structure based at Cilacap Fishing Port in 2005 to 2011.

Fishing Fleet	2005	2006	2007
Tuna Long Liner	161	128	156
Drifting Gillnetter	63	196	184
Set Gillnetter	84	103	105
Trammel Netter	327	199	115
Pelagic Danish Seine	6	8	10
Botton Danish Seine	39	40	50
Portablel Trapper	0	0	64
Lift Netter	0	0	0

Drifting gillnet fleets were wooden boat size 10-30 GT with the main engine 120-160 HP and generator engine 24-30 HP. Fish hold of the boats is not equipped with refrigeration machine, the freshness of catch is preserved with the ice. Drifting gillnet fleets are generally equipped by compass and GPS for the navigation purpose and SSB radio for communication. Number of crew each boat about 12-14 persons. 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.

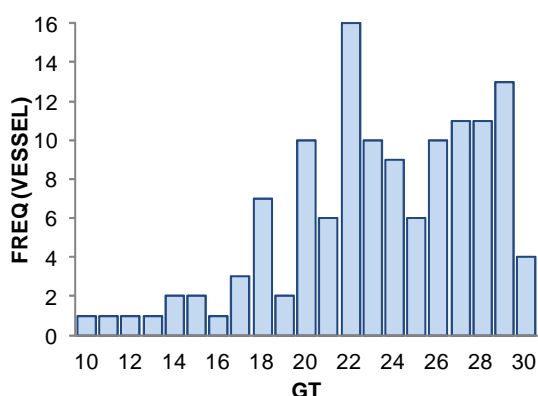


Figure 1. Size (GT) structure of 127 active gillnetters based at Cilacap Fishing Port 2011.

The drifting gillnet is a wall of fine, large-meshed synthetic netting with a series of floats attached in the corks line at the top and a series of weights (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 per piece of drifting gillnet. 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. Generally, a drifting gillnet fleet operates 50-60 piece gillnets or about 1.5-2.5 kilometer in total length.

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

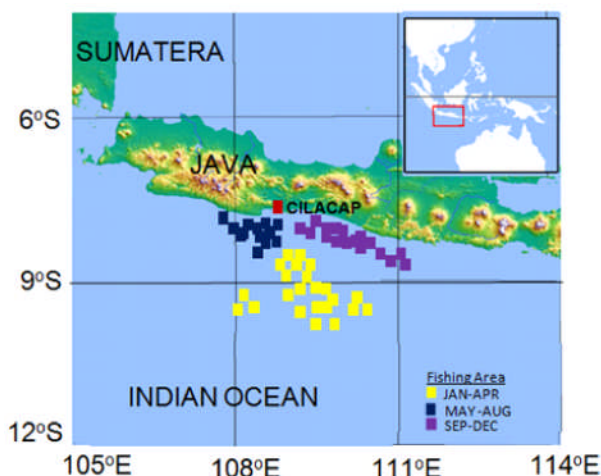


Figure 2. Drifting gillnet fishing area based at Cilacap Fishing Port in 2011.

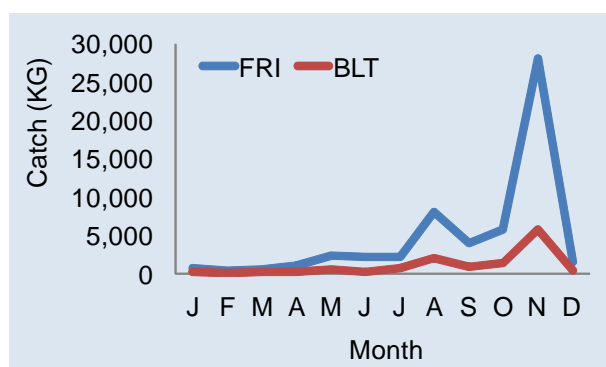


Figure 3. The fluctuation of bullet and frigate tuna catch on drifting gillnet fishery based at Cilacap Fishing Port during 2011.

Catch

In Indonesian Fisheries National Statistic is reported that annual catch of the 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. The catch in 2010 is estimated 2,445 and 47,113 mt for bullet and frigate tuna respectively as described in Table 2. Compared to the previous year annual catch, annual catch of bullet in 2010 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 reaching about 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 Table 3.

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) shows that the catch rate of drifting gillnets on both species frigate and bullet tuna decreased year by year. As described in Table 4 that the catch rate of drifting gillnets on the frigate tuna was 0.364 mt/trip in 2006, this value decreased to 0.054 mt/trip in 2011 (decreasing average of 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.

In term of catch composition, drifting gillnet fish landing is 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 is presented in Table 5 which was at least 50 species identified during catch monitoring in 2011.

Fish Size

The size (fork length-FL) both species frigate and bullet tuna caught by gillnet mesh size 5 inch varied with month and fishing area as presented below:

a. Bullet Tuna

The 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.

b. 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).

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	47,797	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).
 Note: FRI=frigate tuna, BLT=bullet tuna, LOT=longtail tuna, KAW= kawa-kawa, COM=narrow-barred Spanish mackerel and GUT=Indo-Pacific king mackerel.

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

Landing Places	Production (ton)	
	FRI	BLT
NA TIONAL	132,733	3,696
INDIAN OCEAN	47,113	2,445
Sub Total		
West Sumatera	19,516	2,296
Aceh (Aceh)	4,169	1,835
Sumatera Utara (North Sumat)	1,528	-
Sumatera Barat (West Sumat)	12,102	399
Bengkulu (Bengkulu)	1,645	36
Lampung (Lampung)	72	26
Sub Total		
South of Java	149	121
Banten (Banten)	0	0
Jawa Barat (West Java)	5	120
Jawa Tengah (Central Java)	25	1
DI Yogyakarta (Yogyakarta)	119	0
Jawa Timur (East Java)	0	0
Sub Total		
South of Bali-Nusatenggara	27,448	28
Bali (Bali)	15,475	0
NTB (West Nusatenggara)	922	27
NTT (East Nusatenggara)	11,051	1

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

Table 4. Catch rate of drifting gillnets to frigate and bullet tuna base at Cilacap Fishing Port year 2006-2011.

Year	Registere d 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
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 (Anonymous. 2006-2011)

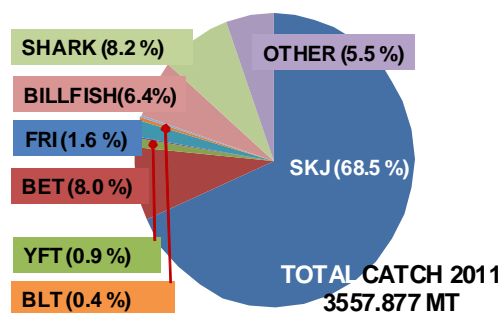


Figure 3. Catch composition of drifting gillnets based at Cilacap Fishing Port.

Table 5. The 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 Thresher 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	Crocodile 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	Crocodile 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 Dolphin	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 Tigerfish	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 Pih)	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

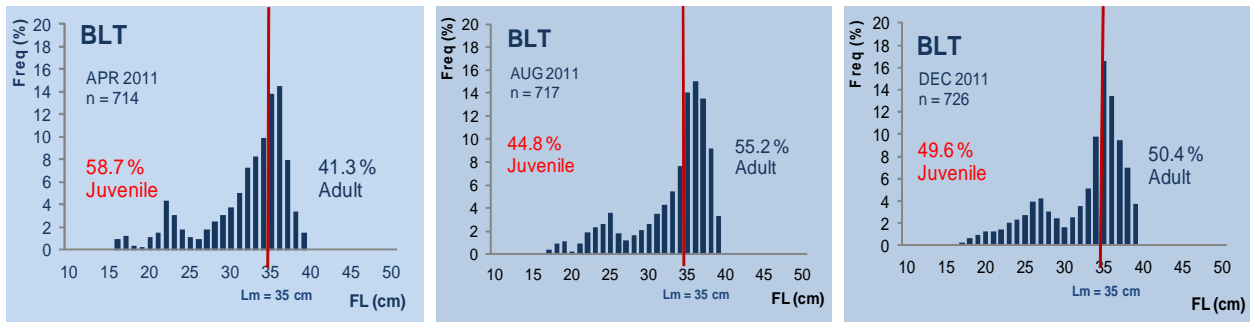


Figure 4. Size (FL) distribution of bullet tuna caught by drifting gillnets based at Cilacap Fishing Port in 2011.

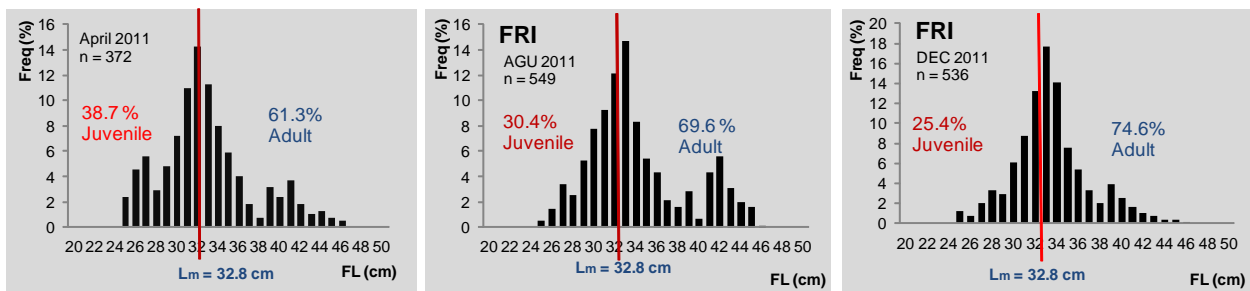


Figure 5. Size (FL) distribution of frigate tuna caught by drifting gillnets based at Cilacap Fishing Port in 2011.

DISCUSSION

Catch

Frigate and bullet tuna was species that mostly spend in inshore water, but they are probably cosmopolitan in warm waters; it is an epipelagic, neritic as well as oceanic species (Anonymous., 2006). Drifting gillnet based at Cilacap targets tuna and tuna like, whereas neritic tuna (frigate and bullet tuna) caught as *by product*. Catch rate of the frigate tuna was 0.364 mt/trip in 2006, this value decreased to 0.054 mt/trip in 2011 (decreasing average of 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.

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.

Widodo (2011) noted that based on onboard observation conducted in 2008, 2009 and 2010 the drifting gillnet fleets based at Cilacap have similar fishing ground pattern in those years. 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 gillnets fleets in 2011 ranged 7.0°-11.0°S and 107.0°-111.0°E (Figure 2). Since 2010 drifting gillnets fisheries experienced fishing pressure by the operation of purse seiners that are fishing in the drifting gillnet fishing ground. The purse seiners deploy FADs in the conventional drifting gillnet fishing ground and since that time most drifting gillnet fleets move to the inshore waters.

Fish Size

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. Adults are principally caught in coastal waters and around islands (Anonymous., 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.

Maximum length of frigate tuna (unsexed) reaches 65 cm (CayrP, 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 tunas caught were females with length at first matured (L_m) 32.8 cm, so that the 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.

CONCLUSION

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 six past years, 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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