INDONESIAN FISHERIES RESEARCH JOURNAL

Volume 19 Number 2 December 2013
Acreditation Number: 503/AU2/P2MI-LIPI/10/2012
(Period: October 2012-October 2015)

Indonesian Fisheries Research Journal is the English version of fisheries research journal. The first edition was published in 1994 with once a year in 1994. Since 2005, this journal has been published twice a year on JUNE and DECEMBER.

Head of Editor Board:
Prof. Dr. Ir. Ngurah Nyoman Wiadnyana, DEA

Members of Editor Board:
Prof. Dr. Ir. Hari Eko Irianto
Prof. Dr. Ir. Gadis Sri Haryani
Dr. Ir. Subhat Nurhakim, M.S.
 Ir. Badrudin, M.Sc
Dr. Purwito Martosubroto

Referees for this Number:
Prof. Dr. Ir. Ari Purbayanto, M.Sc (Bogor Agricultural Institute)
Prof. Dr. Ir. Setyo Budi Susilo, M.Sc. (Bogor Agricultural Institute)
Dr. Ir. Agy Syahailatua (Research Center for Oceanography-The Indonesian Institute of Sciences)
Dr. Sudarto (Research Center and Development Aquaculture)
Dr. Estu Nugroho (Research Center and Development Aquaculture)

Language Editors:
Dr. Lilis Sadiyah (Research Center for Fisheries Management and Conservation)

Managing Editors:
Dra. Endang Sriyati
Darwanto, S.Sos

Graphic Design:
Kharisma Citra Partadinata, S.Sn.

Published by:
Agency for Marine and Fisheries Research

Manuscript send to the publisher:
Indonesian Fisheries Research Journal
Research Center for Fisheries Management and Conservation
Gedung Balitbang KP II, Jl. Pasir Putih II, Ancol Timur Jakarta 14430 Indonesia
Phone: (021) 64700928, Fax: (021) 64700929
Email: drprpt2009@gmail.com

PREFACE

Indonesian Fisheries Research Journal Volume 19 Number 2 December 2013 is the first publication of English journal of the Research Center for Fisheries Management and Conservation in 2013. The journal is expected to be a source of newest science and technology for all scientists and researchers in Indonesia and other countries. The financial for publication is provided by the Research Center for Fisheries Management and Conservation budget in the fiscal year of 2013.

This volume contain; The distribution and biodiversity of fishes in Lebak Pampangan Swamp South Sumatera Province; Impact of climate anomaly on catch composition of neritic tuna in Sunda Strait; Catch and size of bullet and frigate tuna caught by using drifting gillnet in Indian Ocean of Indonesia based at Cilacap fishing port; The change of mangrove coverage in Segara Anakan Lagoon of Cilacap – Central Java; Fishing ground, catch composition, hook rate and length distribution of billfishes caught by tuna long line in Indian Ocean; Biology and population dynamics of banana shrimp (Penaeus merguiensis) in the Tarakan Waters, East Borneo; Benefits of mangrove management for prawn fishing and timber production.

We hope that all the articles on this volume may contribute significantly to the development of fishery science and technology in Indonesia. We are grateful to the editorial board for their improvement and suggestion on reviews of the manuscripts.

Editor
# INDONESIAN FISHERIES RESEARCH JOURNAL
Volume 19 Number 2 December 2013

## CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>i</td>
</tr>
<tr>
<td>CONTENTS</td>
<td>iii</td>
</tr>
<tr>
<td>The Distribution and Biodiversity of Fishes in Lebak Pampangan Swamp South Sumatera Province By: Dina Muthmainnah, Zulkifli Dahlan, Robiyanto H. Susanto, Abdul Karim Gaffar and Dwi P. Priadi</td>
<td>55-60</td>
</tr>
<tr>
<td>Impact of Climate Anomaly on Catch Composition of Neritic Tuna in Sunda Strait By: Khairul Amri and Fayakun Satria</td>
<td>61-72</td>
</tr>
<tr>
<td>Catch and Size of Bullet and Frigate Tuna Caught by Using Drifting Gillnet in Indian Ocean of Indonesia Based at Cilacap Fishing Port By: Agustinus Anung Widodo and Fayakun Satria</td>
<td>73-79</td>
</tr>
<tr>
<td>The Change of Mangrove Coverage in Segara Anakan Lagoon of Cilacap – Central Java By: Bagus Oktori Sutrisno dan Slamet Budi Prayitno</td>
<td>81-84</td>
</tr>
<tr>
<td>Fishing Ground, Catch Composition, Hook Rate and Length Distribution of Billfishes Caught by Tuna Long Line in Indian Ocean By: Fathur Rochman, Abram Barata and Budi Nugraha</td>
<td>85-97</td>
</tr>
<tr>
<td>Biology and Population Dynamics of Banana Shrimp (Penaeus merguiensis) in the Tarakan Waters, East Borneo By: Duranta Diandria Kembaren and Ali Suman</td>
<td>99-105</td>
</tr>
<tr>
<td>Benefits of Mangrove Management for Prawn Fishing and Timber Production By: Bagus Oktori Sutrisno, Slamet Budi Prayitno</td>
<td>107-113</td>
</tr>
</tbody>
</table>
ABSTRACT

Billfishes are by-catch of tuna long line vessels in Indian Ocean. Billfish are consist of swordfish Xiphiasgladius, black marlin Makairaindica, Indo-Pacific blue marlin Makairamazara, stripe marlin Tetraptrurusaudax, Indo-Pacific sailfish Istiophorus platypterus and shortbill spearfish Tetrapturusanguistrostris. Besides that, billfishes also have important economic value compared with tuna as an exported species such as swordfish and marlin. To optimize the catch of billfishes in Indian Ocean, data and information of potential fishing ground, size and catch composition of this species are needed. The billfishes catch composition collected in 2011 were dominated by 45% swordfish, 20% black marlin, 19% blue marlin, 9% short bill spearfish, 6% sailfish and 1% stripe marlin. The billfishes size range which were caught between 60 - 280 cm LJFL (Lower Jaw Fork Length). The sword fish average length was 150 cm, blue marlin 197 cm, black Marlin 189 cm, sailfish 150 cm, short bill spearfish 144 cm and stripe marlin 159 cm. From this observation, it was found that most of billfishes caught were in mature.

KEYWORDS: Billfishes, Fishing Ground, Indian Ocean, Long line and By-catch

INTRODUCTION

The term “BillFishes” has been widely accepted by both commercial and sport fisherman as well as scientist, to apply to the large fishes of the xiphiidae and istiophorididae families, characterized by the prolongation of the upper jaw, much beyond the lower jaw, into a long rostrum which is flat and sword like (swordfish) or rounded and spear like (sailfishes, spearfish and marlin). Billfishes tend to inhabit waters further below the surface during the day than at night, and they tend to inhabit frontal zones. Billfishes tolerate water temperatures from 5° to 27°C, with their optimum range between 18° to 22°C, while bill fish eslarvae have been found only at temperatures exceeding 24°C (Nakamura, 1985).

The contribution of BillFishes to the Indonesian fishery was significant. The catch of BillFishes in 2007 by all fleets was 400.000 MT (Mahiswara & Prisantoso, 2009). In 2008, the catch of BillFishes decreased to 22.548 MT, that mainly landed in port of Benoa, Cilacap, Palabuhanratu, Jakarta and Bungus (Widodo et al., 2011).

Knowledge of the Indian Ocean BillFishes biology and fisheries especially in Indonesia, and the status of BillFishes species remains unclear due to the lack of data and information of the fishery. This research aimed to analyze the catch composition, potential fishing ground, length distribution of billfishes caught by long line gear in Indian Ocean in 2010-2011.

The unit of catch composition based on a number of fish (N/pcs) that was collected. This observation showed that catch were dominated by swordfish (Xiphias gladius) 45%, black marlin (Makaira indica) 20%, blue marlin (Makairamazara) 19%, shortbill spearfish (Tetrapurus angustirostris) 9% and followed by sailfish (Istiophorus platypterus) 6% and stripe marlin (Tetrapurus audax) 1%. (Figure 2).

Figure 1. Type of measurement used for billfish remarks:
- PAL: Pectoral Anal Length
- PFL: Pectoral Fork Length
- EFL: Eye-Fork Length
- LJFL: Lower Jaw-Fork Length
- DFL: Dorsal-Fork Length
- PDL: Pectoral-Dorsal Length
- D2FL: Second Dorsal Fork Length


Figure 2. Catch composition of billfishes in Indian Ocean based on observer data from (March 2010 – December 2011).
Remarks: SWO (swordfish; Xiphias gladius), BLM (black marlin; Makaira indica), BLZ (blue marlin; Makairamazara), MLS (stripe marlin; Tetrapurus angustirostris), SFA (sailfish; Istiophorus platypterus), SSP (shortbill spearfish; Tetrapurus angustirostris).
The detailed information of catch composition in each coordinate/position of fishing grounds showed in the following table 1.

### Hook Rate

Hook Rate is (a Number of fish per 100 hooks). According to the data analyzed, the Hook Rate Values of billfishes species are shown on table 2.

Table 1. Catch composition of billfishes depend on different position in Indian Ocean from March 2010 – December 2011.

<table>
<thead>
<tr>
<th>Fishing Ground</th>
<th>Number of Species (pcs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lat. (°SE)</td>
</tr>
<tr>
<td>8 sd 9</td>
<td>112-114</td>
</tr>
<tr>
<td>9 sd 12</td>
<td>111-116</td>
</tr>
<tr>
<td>12 sd 13</td>
<td>117-120</td>
</tr>
<tr>
<td>13 sd 14</td>
<td>116-118</td>
</tr>
<tr>
<td>14 sd 15</td>
<td>115-117</td>
</tr>
<tr>
<td>15 sd 16</td>
<td>114-116</td>
</tr>
</tbody>
</table>

Table 2. Hook Rate of billfishes depend on different position in Indian Ocean from March 2010 – December 2011.

<table>
<thead>
<tr>
<th>Latitude (°S)</th>
<th>Longitude (°E)</th>
<th>Area (Km²)</th>
<th>SWO</th>
<th>BLZ</th>
<th>BLM</th>
<th>MLS</th>
<th>SFA</th>
<th>SSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>112-114</td>
<td>223</td>
<td>0.161</td>
<td>0.000</td>
<td>0.109</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>9</td>
<td>111-116</td>
<td>1,670</td>
<td>0.136</td>
<td>0.074</td>
<td>0.071</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>12</td>
<td>117-120</td>
<td>334</td>
<td>0.129</td>
<td>0.116</td>
<td>0.104</td>
<td>0.063</td>
<td>0.104</td>
<td>0.000</td>
</tr>
<tr>
<td>13</td>
<td>116-118</td>
<td>223</td>
<td>0.106</td>
<td>0.100</td>
<td>0.096</td>
<td>0.465</td>
<td>0.072</td>
<td>0.127</td>
</tr>
<tr>
<td>14</td>
<td>115-117</td>
<td>223</td>
<td>0.111</td>
<td>0.092</td>
<td>0.128</td>
<td>0.000</td>
<td>0.123</td>
<td>0.083</td>
</tr>
<tr>
<td>15</td>
<td>114-116</td>
<td>223</td>
<td>0.094</td>
<td>0.098</td>
<td>0.097</td>
<td>0.000</td>
<td>0.000</td>
<td>0.083</td>
</tr>
</tbody>
</table>

### Swordfish (Xiphiasgladius)

The total length distribution of this species caught in various position in the Indian Ocean collected by observers onboard between 2010 to 2011.

### Blue marlin (Makairamazara)

The data showed that hook rates of blue marlin range between 0.000-0.116% from various fishing ground. The hook rates tend to increase from lower latitude 8p -12p S and more stable at 12-15p S.
The distribution of Hook Rate of Billfishes could be described in Figure 3 below.

Figure 3. Distribution of swordfish in the Indian Ocean in latitude 8° - 15° SE and longitude 111-120 E. Circles indicate mean of Hook Rate (Number of fish per 100 hooks).
**Length Class Distribution**

Total length class distribution of billfishes showed in table 3.

Table 3. Length Class distribution of billfishes of tuna long line vessels in Indian Ocean.

<table>
<thead>
<tr>
<th>Length Class (Cm)</th>
<th>SWO</th>
<th>BLZ</th>
<th>BLM</th>
<th>MLS</th>
<th>SFA</th>
<th>SSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>61-70</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>71-80</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>81-90</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>91-100</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>101-110</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>111-120</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>121-130</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>131-140</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>141-150</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>151-160</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>161-170</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>171-180</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>181-190</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>191-200</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>201-210</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>211-220</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>221-230</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>231-240</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>241-250</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>251-260</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>261-270</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>271-280</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Figure 4. Swordfish length distribution from various position/coordinate in Indian Ocean.
Figure 5. Blue marlin length distribution from various position/coordinate in Indian Ocean.
**Black marlin (Makaira indica)**

Figure 6. Black marlin length distribution from various position/coordinate in Indian Ocean.
DISCUSSION

The abundant and distribution of these species have been hypothesized to correlate with several factors such as temperature, oxygen content, prey availability, ocean fronts, zooplankton, salinity, island, seamount, and presence of other organisms (sea bird, porpoises, etc.) (Worm et al., 2005). Billfishes will more frequently conduct long distance migrations. These large billfishes tend to seasonally migrate each year between the feeding zone (most often in cold water, often located at temperate latitude) and the spawning zone. The spawning zone is most often located in warm waters in subtropical or equatorial area. This zone has environmental conditions that allow good survival for their larva and early juvenile (Fontenneau et al., 1998).

The billfish distribution is dependent on horizontal and vertical movement. The distribution of billfishes do not form school, but they do apparently aggregate along specific oceanic features, such as temperature fronts, which can be areas of increased productivity and relatively high prey abundance (Podesta et al., 1993; Olson et al., 1994; Bigelow et al., 1999).

According to Barata et al. 2011, based on the results of measurements using minilogger, known in term of “depth operation”, tuna long line vessel divided into 3 types: shallow long line, halfway long line and deep long line. The fishing depth range of shallow long line is 90-185 m with temperature range 21.84-26.80 °C. Halfway long line is 90-350 m depth with temperature range 10.22-21.83 °C. Deep long line is 85-450 m depth with temperature range 8.34-25.50 °C figure 1.

Most of tuna long line vessel at benoa port dominated by halfway long line with deep range 90-350 m with average range temperature 10.22-21.83 °C.
Most of the observation area was still in subtropical or equatorial zone with the coordinate between 8-16°S and 100-120°E and the coverage zone was about 17,800 km². The catch composition was dominated by this species and reaching up to 45% of the total catch of billfishes. Approximately at coordinate 8-12°S and 100-120°E swordfish was dominated by 80% of the total billfishes catch. It’s accordanced with Widodo et al. (2011) Base on the data collected onboard by observer in the year of 2010, the catch composition of billfish of tuna long line fleets were dominated by swordfish \textit{Xiphias gladius} 55.56% followed by blue marlin \textit{Makaira mazara} 33.33% and black marlin \textit{Makaira indica} 11.11%.

The hook rate of this species was 0.094-0.161%. The hook rate tend to decreased at higher latitudes (Table 2), but from the data indicated that although lower latitude has higher of hook rates (0.106-0.161%) but referring to length composition indicated swordfish collected from this position were immature (<150 cm LJFL) and dominated by juvenile. According to Poisson et al. 2009, size of the first maturity (L-50) of female and male of swordfish was estimated in Indian Ocean for the first time. L-50 was 170 cm LJFL for female and 120 cm for male. The spawning season of swordfish in Indian Ocean occurred from October to April.

The swordfish has a very wide range area in this water with length class distribution between 61-240 cm of LJFL. According to mid length class distribution, swordfish has 3 mode value, there were 105.5 cm, 145.5 cm and 175.5 cm. Mode of mid length class distribution was increase as the increasing of fishing latitude coordinate. Latitude 8°S (105.5 cm), latitude 9°S (125.5 cm), latitude 12°S (135.5 cm), latitude 13°S (145.5 cm), latitude 14°S (175.5 cm), latitude 15°S (195.5 and 225.5 cm).

At latitude 8-12°S, the SWO population was dominated by immature species of swordfish and we found a lot of swordfish juvenile with length under 135.5 cm. It is not recomended to catch this species at this position, to give the opportunity for juvenile to grow and reaching mature brood stock. It is likely that this area provide nursery ground of the fish. At coordinat 13-15°S dominated by mature species with length class over 150 cm LJFL. The average length of total onboard observation was 150.82 cm. This is indicated that swordfish catch from Indian ocean was mature species.

Juvenile sword fish are commonly found in tropical and sub tropical water and migrate to higher latitude as they mature. Swordfish grow in length very rapidly, with both males and the faster-growing females reaching lower-jaw-fork lengths (LJFL) of more than one meter during their first year. Swordfish begin reaching maturity at about five years of age, when they are about 150 to 170 cm in length, and all are...
Blue Marlin (Makairamazara)

It’s about 19% of the total catch of billfishes was blue marlin. Blue marlin was dominant over latitude 12–14° S with hook rate between 0.092-0.116%. The average of total length distribution LJFL (Lower Jaw Fork Length) was 197 cm (Figure 5). The blue marlin also has a wide range area in this ocean with length class distribution between 121-280 cm of LJFL and mode of mid length class distribution was 205.5 cm. Mode of mid length class distribution was increase as the increasing of fishing latitude coordinate. Latitude 12° S (125.5 cm), latitude 13° S (205.5 cm), latitude 14° S (185.5 cm), latitude 15° S (215.5 cm).

Nakamura (1985) mentioned that size at first maturity of blue marlin males was estimated to range from 130 – 140 cm eye fork-length EFL or (over 150 cm for LJFL) Sun et al. (2002). The indication showed that mature species dominated in this observation especially over latitude coordinate 13° S.

According to Sun et al. (2002), The estimated sizes-at-maturity (EFL-50) of blue marlin in Western Pacific Ocean were 179.76 ±1.01 cm (mean ±standard error) for females and 130 ±1 cm EFL for males or (LJFL-50, 206.45 for female and 150.15 for male).

According to IOTC. 2012, the Indo-Pacific sailfish is one of the smallest-sized billfish species, but is relatively fast growing. Individuals may grow to over 3 m and up to 100kg, and live to around 7 years. Young fish grow very quickly in length then put on weight later in life. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males.

The catch composition of sailfish only 6% of the total billfishes catch of tuna long line vessels. Sailfish only caught at coordinate 12-14 (p SE) with hook rate lowest at 13(p SE) 0.072% and highest at 14 (p SE) 0.123% with average 0.050%. While At latitude 8-9(p SE) the hook rate of sailfish was zero. The average length class distribution was 150cm with mode of mid length class distribution was 165.5 cm LJFL.
maturity of sailfish was 175 cm FL or (158.49 cm LJFL according to Zhu et al. 2008). This study determined that majority of this species in mature condition.

The catch composition of short bill spearfish only 9% of the total billfishes catch of tuna long line vessels in Indian Ocean. Short bill spearfish only caught at latitude 13-15 (p SE) with hook rate lowest at 15 (p SE) 0.083% and highest at 13 (p SE) 0.127% with average 0.049%. While at latitude 8-12 (p SE) the hook rate of sail fish is zero. The average length class distribution was 144 cm with mode of mid length class distribution was 165.5 cm LJFL (Lower Jaw Fork Length).

Nakamura. (1985), said that based on long line catches, it catch range is between 40ÚN to 35ÚS in the Pacific Ocean and from 20ÚN to 35-45ÚS in the Indian Ocean. Short bill spearfish is thought to be strongly oceanic, preferring deeper mesopelagic waters, and is rarely encountered in coastal waters. Short bill spearfish is rarely targeted directly, but is incidentally caught by sport fishers targeting game fish, commercial long liners targeting tuna, and to a lesser extent, by purse seine, troll, and hand line fishers. Because it is not a major target of any fishery, very little is known about its biology or population structure. There are no literature mentioned about Lm (length at first maturity) of this kind of species.

The average length of Stripe marlin (Tetrapturusaudax) from the observation is 159 cm. Nakamura (1985) mentioned that size at first males maturity T. audax was approximately 80 cm eye-fork length. Size at first maturity generally estimated between 140 – 150 cm eye-fork length (Bromhead et al., 2004; Nakamura, 1985) (over 160 cm for LJFL according to the relationship between LJFL and PFL in Sun et al (2002).

CONCLUSION

According to the onboard observation data collected during 2010-2011, catch composition of billfishes was dominated by Swordfish (Xiphiasgladius) of 45%, Black marlin (Makairaindica) of 20%, Blue marlin (Makairamazara) of 19%, Shortbill spearfish (Tetrapturusangustirostris) of 9% and followed by Sailfish (Istiophorusplatypterus) 6% and Stripe marlin (Tetrapturusaudax) 1%. The size of billfishes caught in range between 60 - 280 cm LJFL (Lower Jaw Fork Length). The swordfish (Xiphiasgladius) average length was 150cm, Blue marlin (Makairamazara) of 197 cm, Black Marlin (Makairaindica) of 189 cm, Sailfish (Istiophorusplatypterus) of 150 cm, Shortbill spearfish (Tetrapturusangustirostris) of 144 cm and Stripe marlin (Tetrapturusaudax) of 159 cm. Most of the BillFishes caught through the observation were sexual mature.

The fishing ground range of the observation between 8-15p S latitude and 110-120 longitude. The increasing of this position followed by increasing of length but decreased in hook rate. The increasing of length followed by the increase of maturity stage.

ACKNOWLEDGEMENT

The authors would like to thank to all observer members in Research Institute for Tuna Fisheries Benoa for their contribution in collecting data throughout the year.

REFERENCES


