Stock structure of billfishes observed during the exploratory surveys in the Indian Exclusive Economic Zone- A Decadal study

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Abstract

The billfishes such as Sailfish (*Istiophorus platypterus*), Swordfish (*Xiphias gladius*) and Marlins (*Makaira nigricans, Makaira Indica* and *Tetrapturus audax*) are observed to be occurring in the Indian Exclusive Economic Zone (EEZ) as revealed through the exploratory surveys. In the Indian EEZ, the area between 4° and 23°N covering the Arabian Sea in the west, and 2°-21°N covering the Bay of Bengal and Andaman & Nicobar Islands in the east have been surveyed and the results derived are presented. The exploratory survey data collected during three decadal periods (1989-2019) have been considered for the study. Area-wise (latitude) distribution, CPUE and Hooking rates were drawn and are presented. The Catch Per Unit Effort (CPUE) recorded in the Indian EEZ for the billfishes was 34.75 kg/ 1000 hooks and hooking rate was 0.12%, whereas in West coast the CPUE was 41.83 kg/1000 hooks and the hooking rate was 0.16%, in the East coast the CPUE of 11.73 kg/1000 hooks and the hooking rate of 0.05%, while in Andaman and Nicobar waters the CPUE of 40.62 kg/1000 hooks and the hooking rate of 0.13% were recorded. This paper presents species composition; distribution and abundance in time and space are presented.

Keywords: *Billfishes, Exploratory surveys, Catch per Unit Effort, Hooking rate, distribution and abundance*

Introduction:

Geographically India having the dimension of subcontinent lies between Latitude 03°and 23.40°N and Longitude 65°-97°E. India has a coastline of 8118 kms with an EEZ area of 2.02 million km^2. The EEZ in the west coast of India covering 0.86 million km^2, along the east coast 0.56 million km^2, and the area around Andaman & Nicobar Islands is 0.60 million km^2. Fishing in Indian Ocean has always played a crucial role in meeting the livelihood of people. During the past decade, the fish production ranged between 32.0 and 37.0 million tonnes (MoF, 2018). The billfishes such as sailfish (*Istiophorus platypterus*), swordfish (*Xiphias gladius*) and marlins (*Makaira nigricans*, *Makaira Indica* and *Tetrapturus audax*) together contributing to the tune of 14,765 tonnes (CMFRI, 2019).

The fishing pressure within 100m depth zone found to be increased; diversification towards deep sea has become more concern in India. There is an urgent need to understand the resources occurring in the oceanic realm (beyond 500m depth) and the magnitude of resources

available in the oceanic region and to provide the awareness to the user groups in order to harvest the resources sustainably and economically. Through this endeavour, the Fishery Survey of India (FSI) has been conducting exploratory surveys since 1989 till date in the oceanic region by deploying four Tuna long line fishing vessels (M.F.V. *Blue marlin,* M.F.V. *Yellow fin,* M.F.V. *Matsya Vrushti and* M.F.V. *Matsya Drushti*). In India the billfishes are confined to off shore i.e. oceanic region. In India the billfish fishery is contributing in the range of 0.12 to 0.16 mt. during the period 2015-2019 forming 0.30% to 0.47% of total marine fish production of the country (CMFRI, 2019). The potential yield estimated for oceanic tuna and allied resources including billfishes was estimated at 2.30 million tonnes (MoF, 2018) of which the percentage share of potential for billfishes is 7.93%. Though the billfish fishery habitat is oceanic region it has been reported that they migrate to the coastal waters for feeding and spawning thereby, many countries of the Indian Ocean including India, considered this fishery also forms a part of coastal fisheries (Campbell & Truck, 1998). In the coastal waters the billfish fishery is presently harvested by hook and line, Gillnet and previously purse-seine nets. Among the high pelagic predators billfishes are formed to be reduced in abundance due to exploitation by commercial fisheries (Myers & Worm, 2003; Hampton *et.al.,* 2005).

Although many studies on billfish fishery was attempted by Maite *et.al.,* (2016) on the effects of biological, economic and management factors on tuna and billfish stock status, Sharma (2013) on the stock assessment of billfish species, blue, black and stripped marlins using stock reduction methods, Davies *et.al.,* (2013) on the stock assessment of sword fish (*Xiphias gladius*) in the south west pacific ocean. Keitchell *et.al.,* (2006) evaluated the role of billfishes as per the ecosystem context. Sijo *et.al.,* (2014) on the diet composition, feeding niche partitioning and trophic organisation of large pelagic predator fishes in the eastern Arabian sea. In the Indian EEZ, Sudarsan *et.al.,* (1988), John *et.al.,* (1995), Somvanshi *et.al.,* (1998), Sivaraj *et.al.,* (2005), Varghese *et.al.,* (2005), Ramalingam and Kar (2011), Premchand *et.al.,* (2015), Pradeep *et.al.,* (2017), Ramachandran and Ramalingam (2019) have worked on billfish fishery at regular intervals. This paper presents the decadal observations on the distribution, availability, hooking rates, CPUE of billfishes from the past three decades (1989 – 2019) in order to understand the status of the bill stocks in the Indian EEZ.

Material and Methods

The exploratory survey data collected through survey vessels such as MFV *Yellow Fin* and MFV *Blue Marlin* (Multifilament tuna longliners), MFV *Matsya Drushti* and MFV *Matsya Vrushti* (Monofilament tuna longliners) for the period from 1989 to 2019 (Three decades) had been considered for this report. The Hooking Rate (HR) has been considered as percentage of

fish caught in 100 hooks. The Catch per Unit Effort (CPUE kg/ 1000 hooks) has also been calculated using weight of the fish per 1000 hooks. The region-wise, coast-wise, decade-wise, species-wise, month-wise and season-wise historical geo-referred data collected during the period 1989-2019 has been compiled and analysed.

Results

As per the Table 1, it is observed that, the billfishes potential estimated during 1991 was 3800 and the recent estimates accounted for 18300 tonnes forming the percentage share of potential estimates increased from 1.54 to 7.93 % of the total potential estimates of oceanic resources.

Table 1. Potential yield estimates for billfishes for 4 decades.

Year	Billfishes potential (Tonnes)	Total potential of oceanic resources (Tonnes)	% share of potential of billfishes
1991	3800	246000	1.54
2000	5100	243800	2.09
2011	14400	216500	6.65
2018	18300	230832	7.93

As per the Table 2, the total marine fish production in India was hovering between 34.04 MT and 3.834 MT (2015-2019). Of which, the bill fish production found to be between 11,328 tonnes and 16,815 tonnes. It clearly indicated that, the billfish fishery is contributing to the commercial marine fish landings harvested from inshore waters.

Table 2. Total marine fish production and billfish catch in India

Year	Total Marine Fish Production (Tonnes)	Billfish catch (Tonnes)	% of billfish catch
2015	3404771	12033	0.35 %
2016	3629823	16815	0.46 %
2017	3834574	11328	0.30 %
2018	3487614	16382	0.47 %
2019	3690100	14765	0.40 %

As per the Table 3 & Fig. 1, the exploratory survey data on distribution of billfishes in the Indian EEZ revealed that, the highest CPUE of 41.83 and hooking rate 0.16 was observed in the Arabian Sea followed by Bay of Bengal including Andaman and Nicobar waters (CPUE- 40.62 and HR- 0.13%). Bay of Bengal alone contributed the CPUE of 11.73 and HR of 0.05. Total Indian EEZ contributed the CPUE of 34.75 and HR of 0.12.

Area	CPUE (kg/1000 hooks)	Hooking Rate (%)
Arabian sea	41.83	0.16
Bay of Bengal	11.73	0.05
Andaman & Nicobar Waters	40.62	0.13
Indian EEZ	34.75	0.12

Table 3. Distribution of billfish resources in different coasts and Indian EEZ

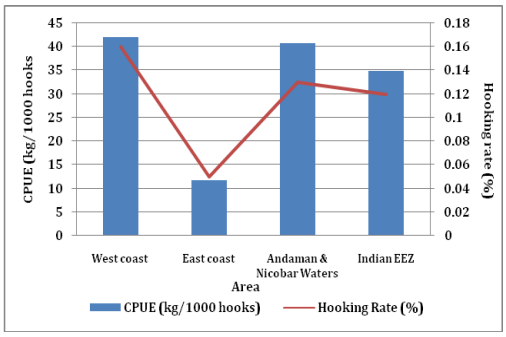


Figure 1. Distribution of billfish resources (Area-wise)

As per the Table 4 & Fig.2, the sailfish found to be highest contributor with the CPUE of 20.99 and HR of 0.08 followed by blue marlin with CPUE of 5.08 and HR of 0.01, swordfish CPUE of 4.25 and HR of 0.02, black marlin CPUE of 2.35 and HR of 0.01, marlin striped CPUE of 1.37 and HR is negligible. This indicates that, the sail fish is more dominant species when compared to other billfishes during the period under report (Fig. 2) .

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	4.25	0.02
Sail fish (*Istiophorus platypterus*)	20.99	0.08
Marlin striped (*Tetrapturus audax*)	1.37	0.00
Blue Marlin (*Makaira nigricans*)	5.08	0.01
Black Marlin (*Makaira indica*)	2.35	0.01

Table 4. Catch per Unit Effort and Hooking Rate of billfishes in Indian EEZ

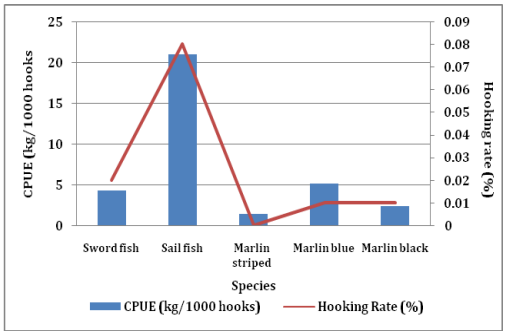


Figure 2. Species-wise CPUE & Hooking Rate (Indian EEZ)

As per the Table 5 & Fig. 3, it is observed that, the sailfish was found to be dominated with CPUE of 29.01 kg and HR of 0.11%, followed by blue marlin CPUE of 5.90 and HR of 0.01, swordfish CPUE of 3.29 and HR of 0.02, black marlin and striped marlin recorded with lowest CPUE 1.46 and 1.36 respectively and the HR was negligible. The sailfish was found to be abundant in the Arabian Sea as revealed by highest CPUE and Hooking rate (Fig. 3).

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	3.29	0.02
Sail fish (*Istiophorus platypterus*)	29.01	0.11
Marlin striped (*Tetrapturus audax*)	1.36	0.00
Blue Marlin (*Makaira nigricans*)	5.90	0.01
Black Marlin (*Makaira indica*)	1.46	0.00

Table 5. Catch per Unit Effort and Hooking Rate of billfishes in West coast

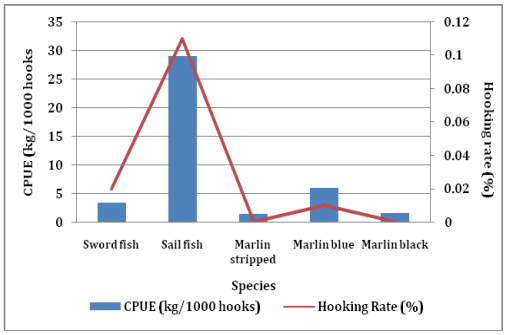


Figure 3. Species-wise CPUE & Hooking Rate (west coast)

As per the Table 6 & Fig.4, the sailfish found to be the higher CPUE of 5.72 and HR of 0.02, followed by black marlin CPUE of 1.80 and HR of 0.01, sword fish CPUE of 1.66 and HR of 0.01 and blue marlin CPUE of 1.33 and HR of meagre values. The Bengal of Bengal, the Catch per Unit Effort and Hooking Rate are found to be less, therefore in this region the billfishes are recorded in lesser quantities.

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	1.66	0.01
Sail fish (*Istiophorus platypterus*)	5.72	0.02
Blue Marlin (*Makaira nigricans*)	1.33	0.00
Black Marlin (*Makaira indicaMakaira indica*)	1.80	0.01

Table 6. Catch per Unit Effort and Hooking Rate of billfishes in East coast

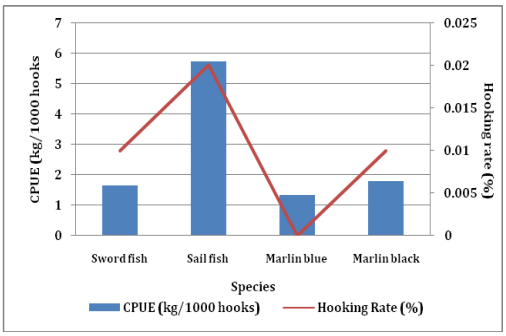


Figure 4. Species-wise CPUE & Hooking Rate (East coast)

As per the Table 7 & Fig.5, the Catch Per Unit Effort (CPUE) and Hooking Rate (HR) of Billfishes in Andaman & Nicobar waters including Bay of Bengal, it was observed that, sailfish dominated with CPUE 21.07 kg/1000 hooks, and a hooking rate of 0.07%, followed by swordfish CPUE of 6.94 and HR of 0.03, blue marlin CPUE of 6.42 and HR of 0.01, black marlin CPUE of 3.72 and HR of 0.01 and striped marlin CPUE of 2.23 and HR of 0.01. In this region sailfish found to be abundant more as it has recorded the highest CPUE.

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	6.94	0.03
Sail fish (*Istiophorus platypterus*)	21.07	0.07
Marlin striped (*Tetrapturus audax*)	2.23	0.01
Blue Marlin (*Makaira nigricans*)	6.42	0.01
Black Marlin (*Makaira indica*)	3.72	0.01

Table 7. Catch per Unit Effort and Hooking Rate of billfishes in A & N water including Bay of Bengal.

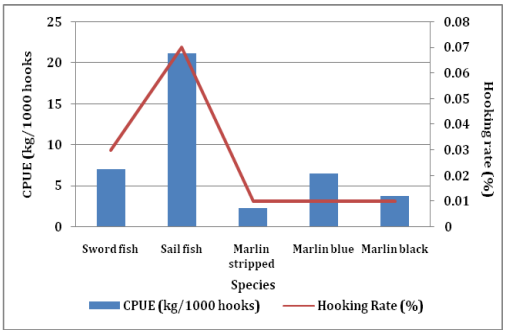


Figure 5. Species-wise CPUE & Hooking Rate (A&N Waters including Bay of Bengal)

Species-wise percentage contribution of billfishes:

As per the Fig. 6, it is observed that in the Indian EEZ, the Sailfish has been found to be dominated with 65% contribution followed by Swordfish (17%), Blue Marlin (9%), Black Marlin (5%), and Stripped Marlin (3%) in the total bill fish catch. Similarly, in the west coast and east coast including Andaman Nicobar Islands are also contributing the highest percentage of 74% and 55% respectively for Sailfish followed by Swordfish (14% & 26%) and the rest billfishes reported to be in the megre quantities (Fig. 7 & 8). The decadal period 1999-2008 (Table 15-16) was more productive (Fig. 14).

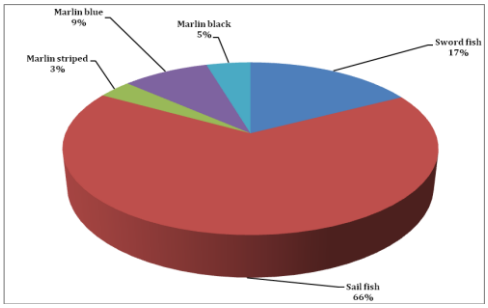


Figure 6.Species contribution in the Indian EEZ during 1989-2019

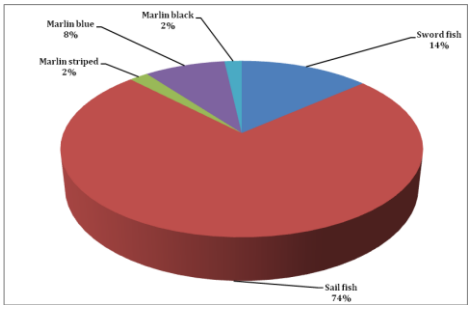


Figure 7.Species contribution of Entire west coast during 1989-2019

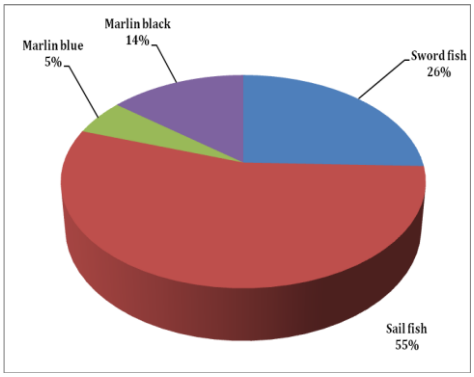


Figure 9. Species contribution of East coast including Andaman Nicobar Islands during 1989-2019

SPECIES-WISE ABUNDANCE:

The species-wise abundance reveals that the CPUE and hooking rate in respect of *I. platypterus* was found to be higher in the Indian EEZ (CPUE 20.99, HR 0.08), West Coast (CPUE 29.01, HR 0.11), East Coast (CPUE 5.72, HR 0.02) and Andaman & Nicobar Islands (CPUE 21.07, HR 0.07) (Table 8-11 & Fig. 10-13).

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	4.25	0.02
Sail fish (*Istiophorus platypterus*)	20.99	0.08
Marlin striped (*Tetrapturus audax*)	1.37	0.00
Blue Marlin (*Makaira nigricans*)	5.08	0.01
Black Marlin (*Makaira indica*)	2.35	0.01

Table 8. Species-wise distribution of oceanic and allied resources in the Indian EEZ

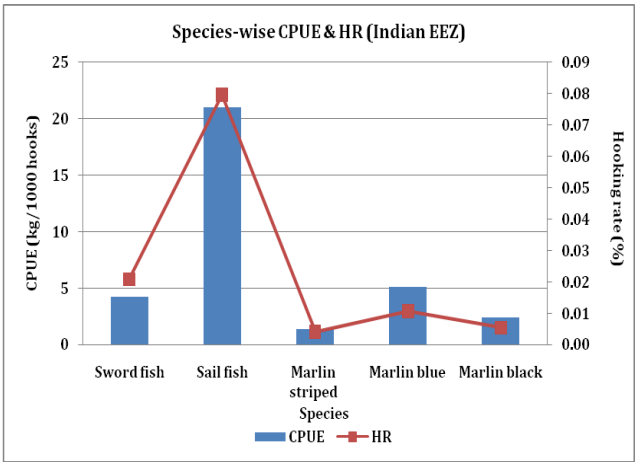


Figure 10. Species-wise distribution of oceanic and allied resources in the Indian EEZ

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	3.29	0.02
Sail fish (*Istiophorus platypterus*)	29.01	0.11
Marlin striped (*Tetrapturus audax*)	1.36	0.00
Blue Marlin (*Makaira nigricans*)	5.90	0.01
Black Marlin (*Makaira indica*)	1.46	0.00

Table 9. Species-wise distribution of oceanic and allied resources in west coast

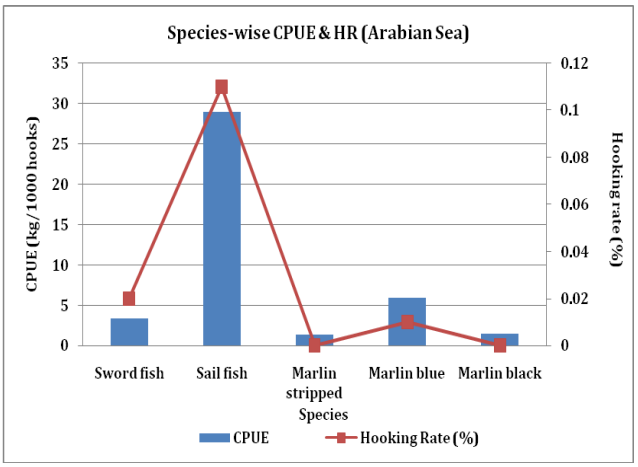


Figure 11. Species-wise distribution of oceanic and allied resources in west coast

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Sword fish	1.66	0.01
Sail fish	5.72	0.02
Blue Marlin	1.33	0.00
Black Marlin	1.80	0.01

Table 10. Species-wise distribution of oceanic and allied resources in east coast

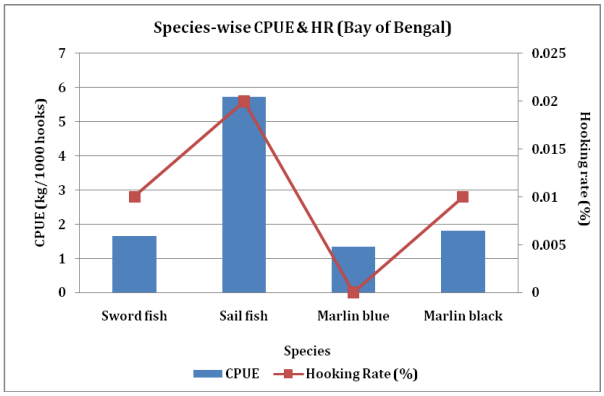


Table 12. Species-wise distribution of oceanic and allied resources in east coast

Species	CPUE (kg/1000 hooks)	Hooking Rate (%)
Swordfish (*Xiphias gladius*)	6.94	0.03
Sail fish (*Istiophorus platypterus*)	21.07	0.07
Marlin striped (*Tetrapturus audax*)	2.23	0.01
Blue Marlin (*Makaira nigricans*)	6.42	0.01
Black Marlin (*Makaira indica*)	3.72	0.01

Table 11. Species-wise distribution of oceanic and allied resources along the A & N waters

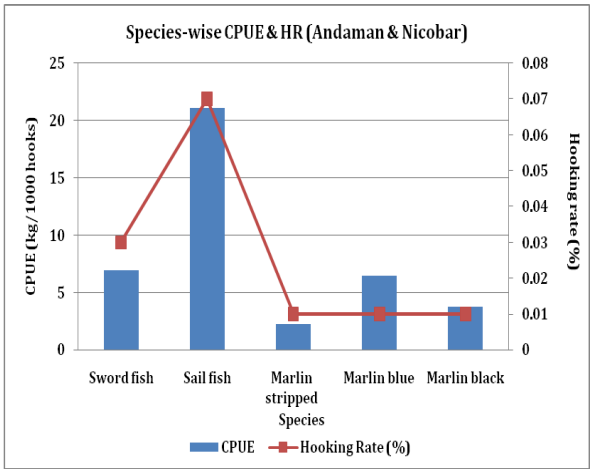


Figure 13. Species-wise distribution of oceanic and allied resources along the A & N waters

DECADE-WISE, COAST-WISE SPECIES COMPOSITION:

Analysis of decadal tuna long line catch data revealed that the higher catch rate of sail fish (table 15, fig. 14) was recorded in all three decades (1989-1998; 1999-2008; 2009-2019) in west coast. In west coast, Blue marlin ranked second in contribution of total bill fish abundance (catch rate) during all the above said three decades (Table 15).

Table 15. Decade-wise, species-wise CPUE & HR of billfish resources along west coast

Decade / Species	1989-1998		1999-2008		2009-2019	
	CPUE	HR	CPUE	HR	CPUE	HR
Sword fish	0.48	0.11	0.59	0.13	1.83	0.03
Sail fish	31.86	0.13	41.52	0.16	10.24	0.04
Marlin stripped	2.27	0.01	1.77	0	0	0
Blue Marlin	11.02	0.03	3.61	0.01	4.33	0.01

Black Marlin	1.74	0	1.57	0	1.06	0

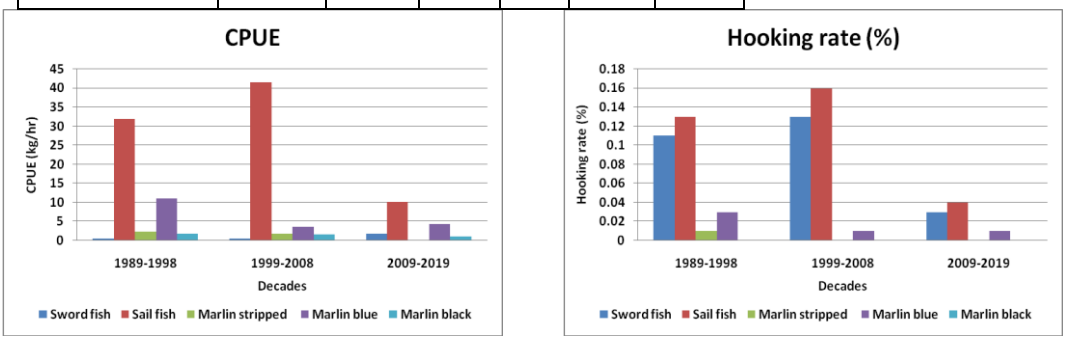


Figure 14. Decade-wise, species-wise CPUE & HR of billfish resources along west coast

EAST COAST INCLUDING ANDAMAN & NICOBAR WATERS:-

The contribution of sword fish in total abundance of billfish was observed to be higher in East coast and Andaman waters during the decades (1989-1998; 1999-2008; 2009-2019) in west coast (table 16, fig.15). However, the *Makaira* spp. (stripped marlin, blue marlin and black marlin)

Table 16. Decade-wise, species-wise CPUE & HR of billfish resources along the East coast including Andaman & Nicobar waters

Decade / Species	1989-1998		1999-2008		2009-2019	
	CPUE	HR	CPUE	HR	CPUE	HR
Sword fish	12.51	0.02	3.6	0.01	0.61	0.15
Sail fish	39.97	0.13	12.77	0.05	3.1	0.3
Marlin stripped	5.17	0.02	0.36	0	0	0
Blue Marlin	0	0.01	0.05	0.01	1.4	0
Black Marlin	8.04	0.02	1.99	0	0.87	0

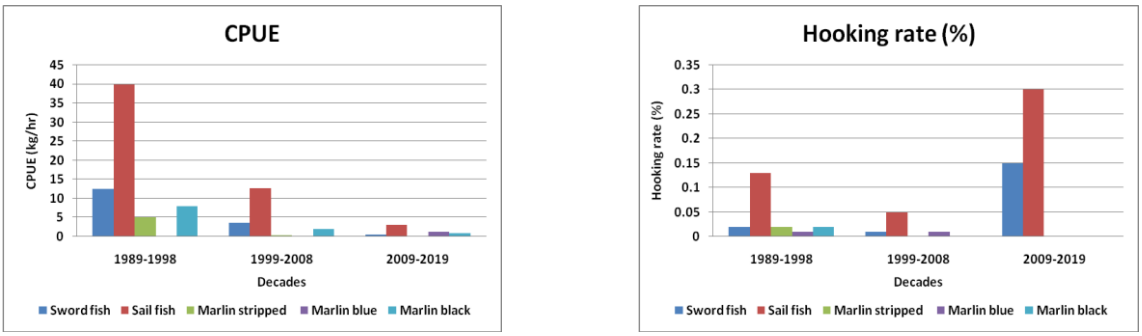
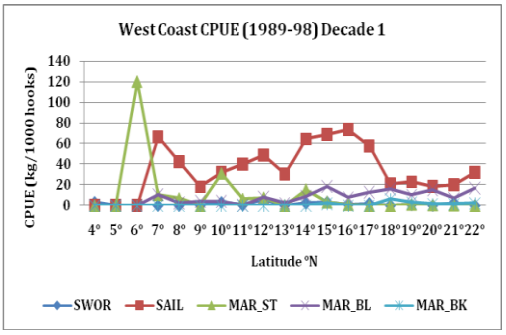


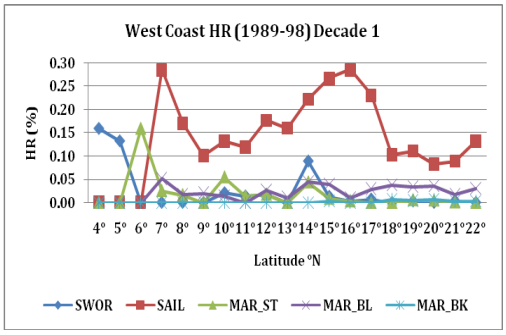
Figure 15. Decade-wise, species-wise CPUE & HR of billfish resources along the East coast including Andaman & Nicobar waters

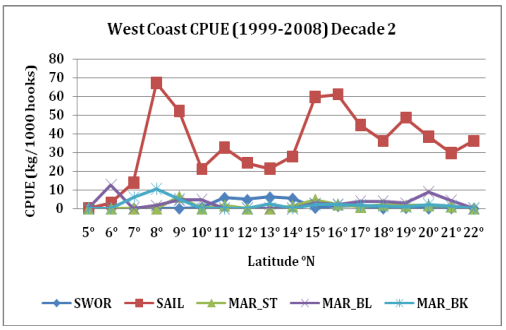
DECADE-WISE, LATITUDE-WISE SPECIES COMPOSITION:-

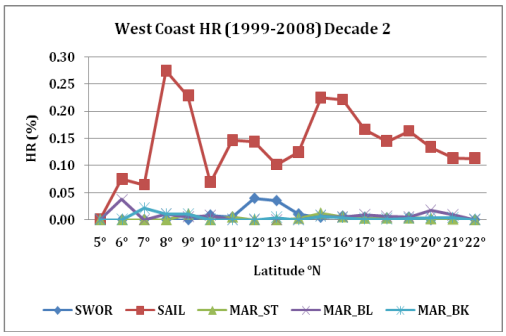
While analysing the Exploratory catch data on latitude- wise during the past three decades from 1989 to 2019 the Hooking rate and CPUE are shown clear variation among the latitude. During the decade 1989-1998 and 1999-2008 the sail fish had moderate hooking rate of 0.1 to 0.3% from the Lat. 4°N to 22°N and also have comparatively higher CPUE in west coast of India followed by sword fish (Fig. 16). During the decade 2009-2019, though the CPUE and Hooking rate were comparatively lesser than the previous decade. In regard to contribution of all billfish species are overlapping with latitude in the West coast. In the East coast, the higher catch rate and hooking rate for bill fish species was observed in northern latitudes from 13°N to 19°N, where as the sail fish dominated in the catches in most of the latitudes (Fig. 17).

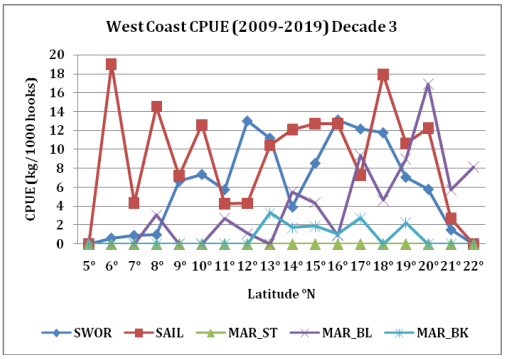
WEST COAST











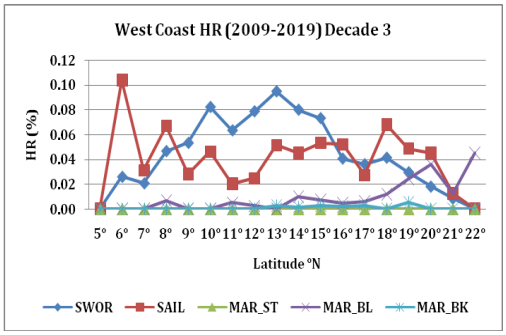
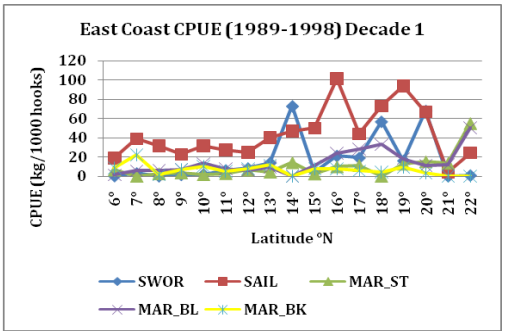
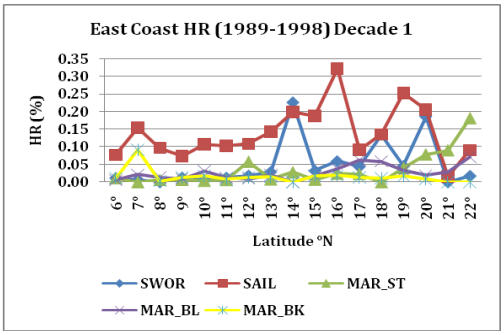
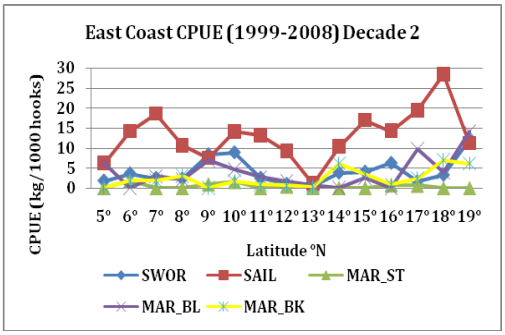


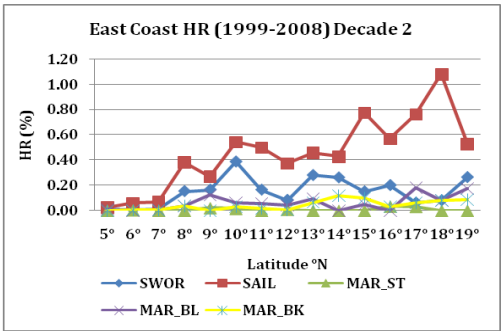
Figure 16. Decade-wise, Latitude-wise species composition, CPUE & HR West coast

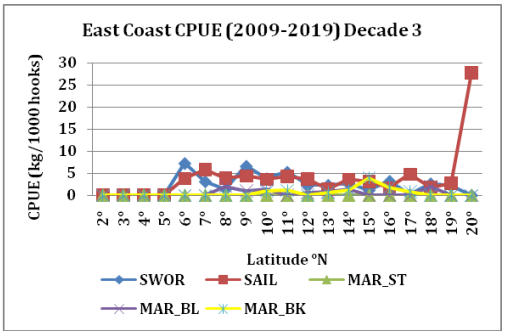
EAST COAST











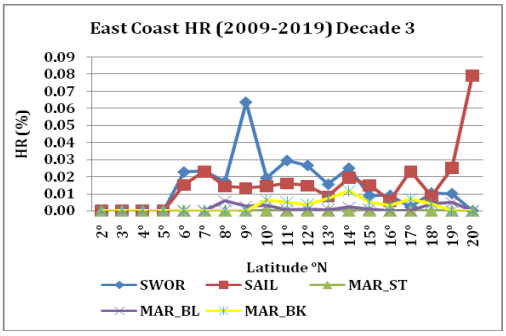


Figure 17. Decade-wise, Latitude-wise species composition, CPUE & HR East coast

DECADE-WISE, MONTH-WISE, QUARTER-WISE, SPECIES DISTRIBUTION:-

Month wise catch rate and hooking rate of bill fishes in west coast during the three decades from 1989-2019 were analysed and it was very clear that higher catch rate of sail fish was observed during April to June (Fig. 18), whereas, in East coast peak season for sail fish was reported during March to May in the Decade I (1989-1998) and Decade III (2009-2019) and June & July during Decade II (1999-2008) (Fig. 19). The quarter-wise Analysis of the catch rate of bill fish species data (i.e. Jan. to March; April to June; July to Sep; Oct. to Dec.), it is revealed that sail fish was dominated during all the quarters during Decades I and II (Fig. 20) in west coast, whereas, sword fish dominated by hooking rate in all quarters during the decade III in west coast of India. Same trend was also observed in East coast of India (Fig. 21).

West Coast

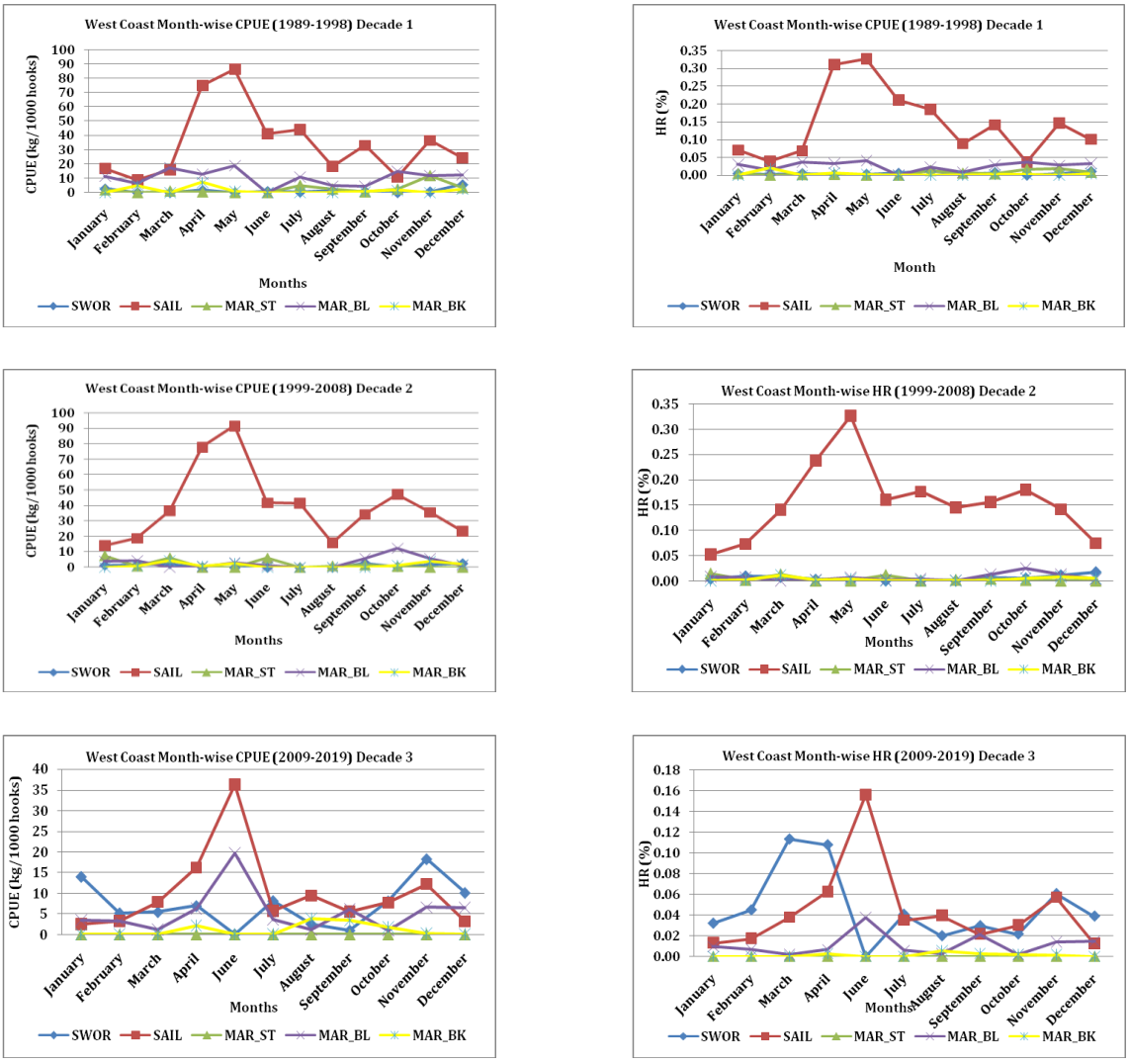


Figure 18. Decade-wise, species-wise CPUE and Hooking rates of billfishes in the West coast

East Coast

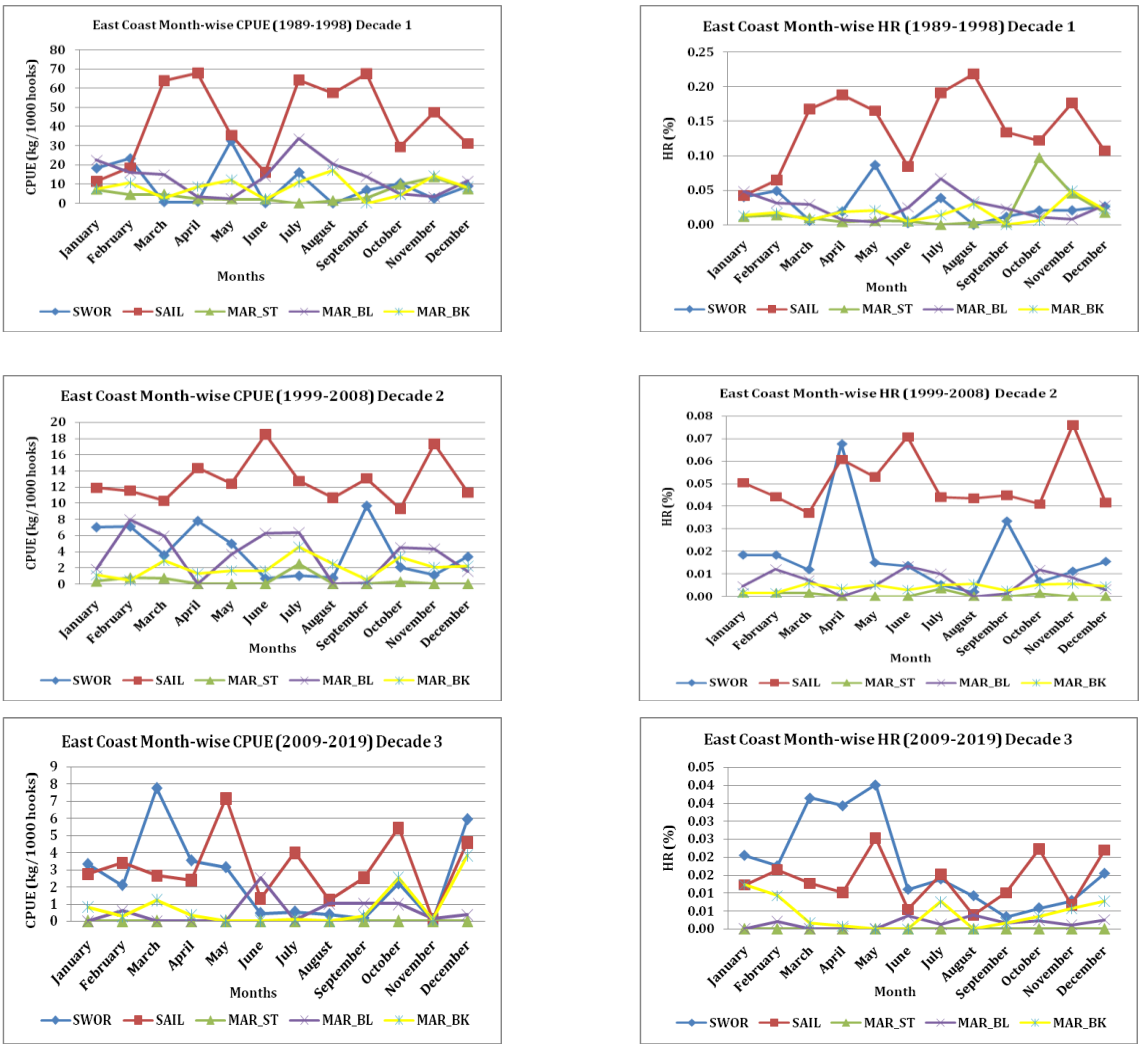
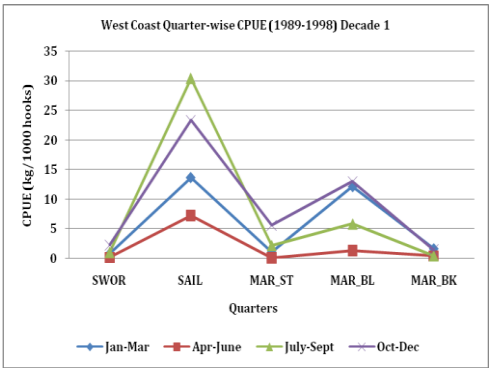
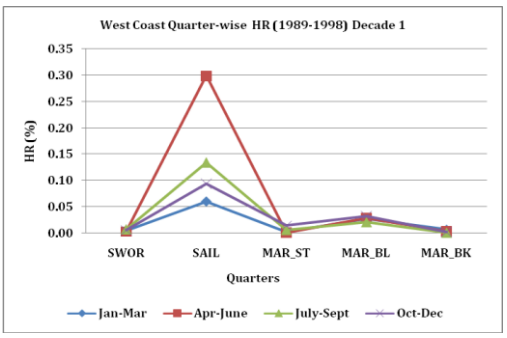
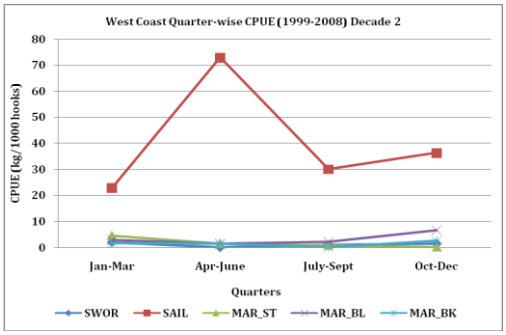


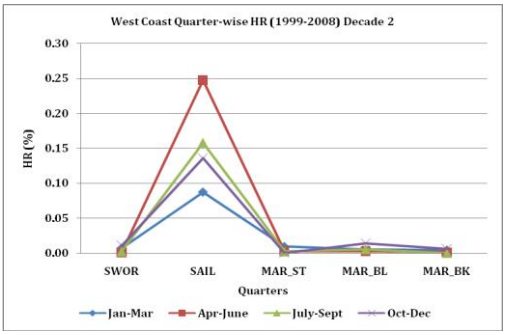
Figure 19. Decade-wise, species-wise CPUE and Hooking rates of billfishes in the East coast

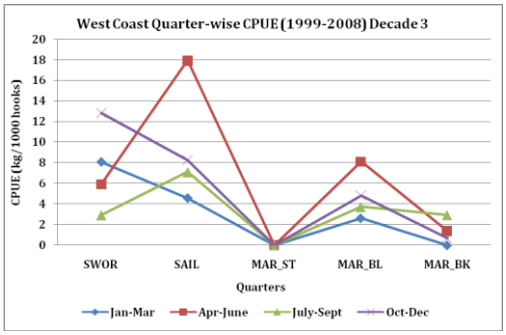
West Coast


West Coast Quarter-wise CPUE (1989-1998) Decade 1
CPUE (kg/1000 hooks)
35
30
25
20
15
10
5
0
SWOR
SAIL
MAR_ST
MAR_BL
MAR_BK
Quarters
Jan-Mar
Apr-June
July-Sept
Oct-Dec


West Coast Quarter-wise HR (1989-1998) Decade 1
HR (%)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
SWOR
SAIL
MAR_ST
MAR_BL
MAR_BK
Quarters
Jan-Mar
Apr-June
July-Sept
Oct-Dec


West Coast Quarter-wise CPUE (1999-2008) Decade 2
CPUE (kg/1000 hooks)
80
70
60
50
40
30
20
10
0
Jan-Mar
Apr-June
July-Sept
Oct-Dec
Quarters
SWOR
SAIL
MAR_ST
MAR_BL
MAR_BK


West Coast Quarter-wise HR (1999-2008) Decade 2
HR (%)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
SWOR
SAIL
MAR_ST
MAR_BL
MAR_BK
Quarters
Jan-Mar
Apr-June
July-Sept
Oct-Dec


West Coast Quarter-wise CPUE (1999-2008) Decade 3
CPUE (kg/1000 hooks)
20
18
16
14
12
10
8
6
4
2
0
SWOR
SAIL
MAR_ST
MAR_BL
MAR_BK
Quarters
Jan-Mar
Apr-June
July-Sept
Oct-Dec

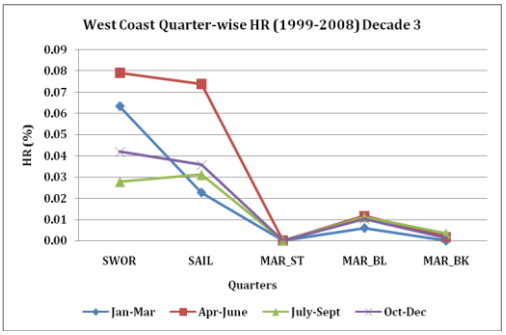

West Coast Quarter-wise HR (1999-2008) Decade 3
HR (%)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
SWOR
SAIL
MAR_ST
MAR_BL
MAR_BK
Quarters
Jan-Mar
Apr-June
July-Sept
Oct-Dec

Figure 20. Decade-wise, species-wise and quarter-wise CPUE and Hooking rates of billfishes in the West coast

East Coast

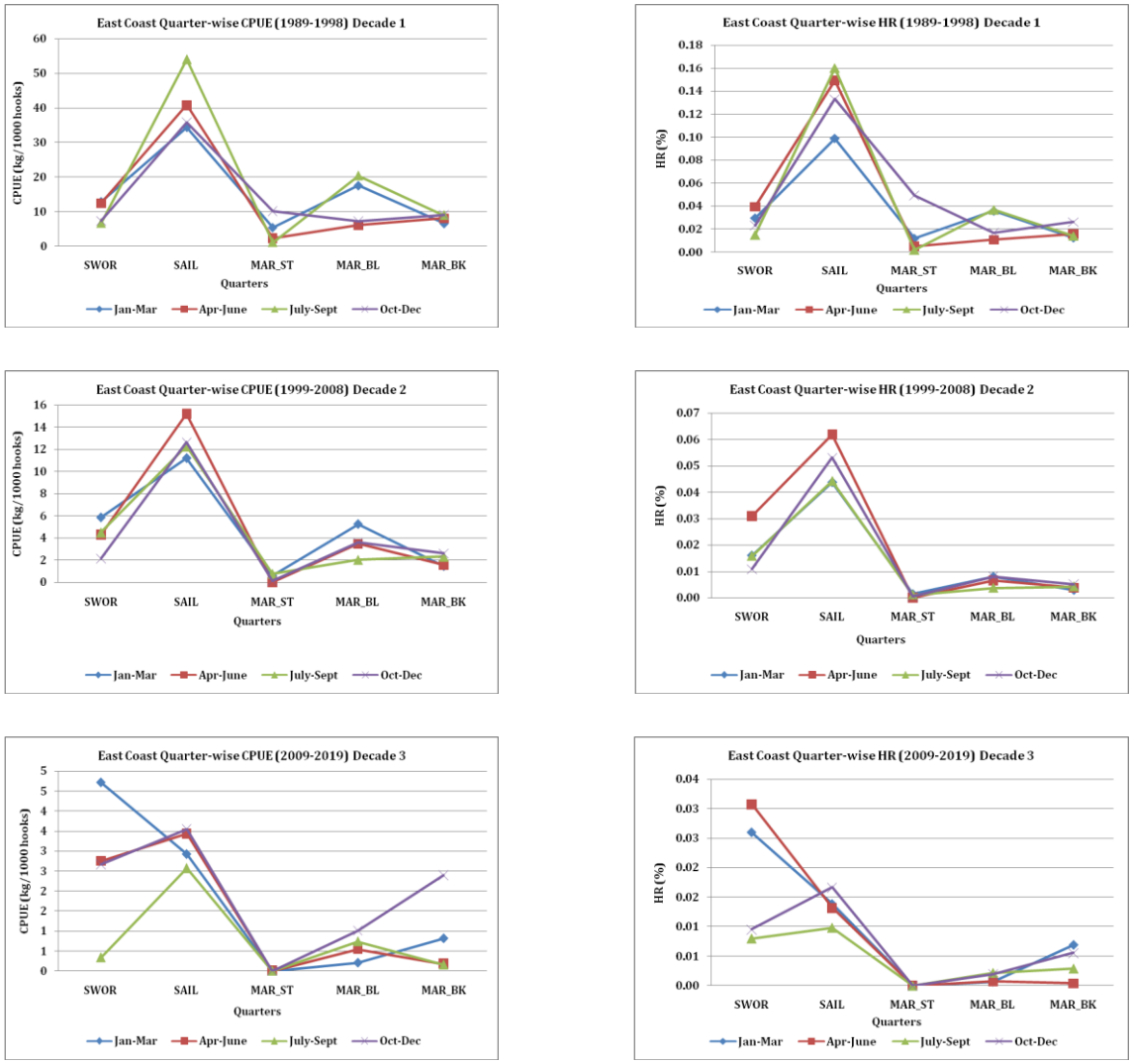


Figure 21. Decade-wise, species-wise and quarter-wise CPUE and Hooking rates of billfishes in the East coast

DISCUSSION

The billfish catches reported to be higher in the western region of Indian Ocean (FAO area 51) compare to the eastern region (FAO area 57) and was observed in the studies conducted by Ganga *et.al.,* (2008) and Ramachandran and Ramalingam (2019) and Ramachandran *et.al.,* (2020). The present study also in conformity with the observations made by earlier researchers which is revealed that the highest hooking rate and CPUE obtained from the Arabian Sea for the billfishes at 0.36% and 35kg/1000 hooks during the period 2019 (Fig. 18) whereas, the hooking rate and CPUE obtained from Bay of Bengal was 0.04% and 8 kg/1000 hooks during 2019 (Fig. 19). Among the bill fishes *I. platypterus* dominated in the catches irrespective of season and area i.e. both east and west coast its contribution in the total bill fish catch was more than 50% during 1989- 2008 (Fig. 18 and 19). However more contribution of sailfish (*I. Platypterus*) was observed during south west monsoon in west coast and during May in East coast (Fig. 18-19), whereas catch of stripped Marlin was reported to be higher than sail fish in East coast (Fig. 19) which varying significantly with season (Fig. 20–21). The survey undertaken in Andaman water revealed that sail fish was dominated in catches with maximum CPUE of 21.07kg/1000 hooks (Table 11 and Fig. 13), whereas Ramachandran and Ramalingam (2019) reported that Swordfish (*X. gladius*) was dominated among the bill fish catches in Andaman waters during the period 2018. In general more productive area in west coast of India was Lat.5°N, 8°N and 18°N (Fig. 16) and in East coast Lat.9°N and 20°N (Fig. 17) which are corroborated with existing studies (Ramachandran *et.al.,* 2020 and Gulati *et.al.,* 2020).

CONCLUSION

The billfishes such as sailfish, swordfish and marlins are not targeted fishery in both inshore and oceanic waters in India. These species are caught as a by catch in longline operations whereas, in inshore waters, they are caught through hook and line and gillnet. Exploratory surveys revealed that the billfish potential is available in the Indian EEZ. As billfish fishery has been found to be important resource which could get export earnings if it is sustainably harvested. Over the years, the billfish fishery found to be contributing in the fish production substantially. Appropriate management and conservation strategies need to be derived for harvesting these resources at sustainable level.

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Computer and Statistical officials of Fishery Survey of India for contributing their might in survey collection of data are heartfully acknowledged.

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