Present status of Billfish fishery in Sri Lanka

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Abstract

Sri Lanka has a well-established offshore fishery targeting tuna and shark. The annual production of large pelagics in Sri Lanka was 126,165mt in 2003. Although there is no target fishery for billfish, Sri Lanka makes considerable contribution to the billfish production in the Indian Ocean. Billfishes make up to 12% 0f the total large pelagic landings in Sri Lanka representing 32% of that of Indian Ocean. Billfish production in Sri Lanka is at increasing trend since early 1980's. In species composition, marlins dominated the catch making up to 50% until late 90's and then sailfish and swordfish has increased contribution over the last 5 years. Gillnet is the dominant gear in all areas, while longline, trolling and handline operates as combination of gears. Gillnet carry up to 150 net pieces and up to 700 hooks for longlining depending on the size of the craft. Majority of the production come from the multiday boats operating offshore fishery. More sailfish is caught as incidental catch in coastal, small-scale fishing targeting other species. In terms of area, more billfish is caught in northeast and eastern areas. Most common type of gear is UN2A and UN2B, which make sup 90% of the production in southwest, south and west. In east, coastal vessels makes 100% contribution to the landings. Length data are very poor for billfish. Maximum recorded length for marlins, sailfish and swordfish is 246cm (cut length), 235cm and 245cm (FL) respectively. Reason for increased catch records from Sri Lanka is not clear, could be due to increased statistical recordings, species mis-identification or increased use of combination of gears.

Introduction

The total catch of tuna and tuna-like species in the Indian Ocean has increased steadily since the early 1980's, in both industrial and artisanal sectors. This increase is mainly due to a substantial increase in the catch of the Western Indian Ocean by coastal nations, in particular the Sri Lankan gillnet fishery. The increase is related to the development of a domestic fleet in Sri Lanka, which is operating further offshore (Campbell *et al.,* 1998). The catch of billfish is generally secondary to the tunas or is a by-catch. Only about 20 or little more countries have reported catches of billfish and annual production of billfish in the Indian Ocean is reported to be in the region of 50 – 55,000 MT in recent years (Anon, 1997). Other than the Japanese and Taiwanese distant water fishing fleets, Sri Lanka is categorized under other countries that catch substantial numbers of billfish. The catch of billfish is often poorly recorded, being lumped together in to single category, misidentified or the fish is discarded (Campbell *et al.,* 1998). Knowledge of Indian Ocean billfish biology and fisheries, the status of billfish species remains unclear due to lack of a targeted fishery on these stocks and uncertainties in the data available.

Fishery for tuna and tuna-like species is a major component in large pelagic fisheries in Sri Lanka. Sri Lanka has a well-established offshore/oceanic tuna fishery, with fleet of locally designed and constructed, small-scale, multi-day boats sailing up to even beyond the edge of the EEZ. There is gillnet and longline combination in operation that targets tunas and pelagic sharks as main target. The island production of tuna and tuna-like species has increased continuously according to the recent statistics. The contribution of billfish to the fishery is significant, and the catch has increased considerably over the years highlighting their importance in the large pelagic/offshore fishery in Sri Lanka. As for other developing countries they represent a significant catch potential being economically very important as a source of high valued flesh. The catch of billfish from Sri Lankan vessels has increased from zero in 1983 to over 20,000 MT in 2001 representing around 30% of the total billfish catch by all fleets in the Indian Ocean. In present day production estimates, billfishes makes up to 12% of the total large pelagic landings in Sri Lanka and around 32% in the Indian Ocean (Campbell *et al.*, 1998) production. Yet there is a general paucity of information on billfish, particularly from small-scale fisheries of the coastal states of the Indian Ocean. In Sri Lanka, production figures are been estimated for the recent years, yet they are not in great details as marlins are categorized in to a single group. Earlier these were lumped with other miscellaneous groups. Maldeniya, *et al*. (1996) and Joseph and Amarasiri (1985) have given some information about species composition and other fishery aspects in earlier publications. Jinadasa (1986) has reported on the species composition, size range and abundance of sailfish and marlins caught in the waters off Negombo. The percentage composition of billfish in the tuna gillnet fishery is given in Joseph, *et al*. (1985) and Joseph and Moyiadeen (1986). No recent research has been carried out on billfishes. Being very important group of fish, but neglected in the sense of research, published information on billfish therefore is very limited. This group billfish (Istiophoridae) includes Marlins, Sailfishes and Swordfishes. This paper analyses the catches of billfish landed in the multi-day fishery

mainly in the offshore and deep-sea waters and also discusses the catches of coastal, small-scale, single day operations.

Material and Methods

Billfish is not the target group in any of the local commercial fisheries directed towards large pelagics. Although there is no such target fishery for billfish, it is an important catch of gillnets, longlines and troll lines operated by mechanized crafts targeting for tuna and shark and several different gear combinations in other types of fisheries such as for small pelagics and demersals. More and more venture towards offshore has resulted an increased catch. This study primarily concerns the data on major fisheries areas west, southwest, south, southeast, east and northeast. Data collected from different sampling stations by NARA samplers covered an area from Negombo in the west to eastern and northeastern areas up to Trincomalee. This sampling programme was established under an FAO Technical Cooperation Programme (NARA/TCP/FAO Project 2251), which enabled the sampling activities to be extended to the east coast. The production discussed in this paper is basically the estimates made by the Large pelagic data base of NARA.

Fishing gear and fleet structure

Joseph and Moyiadeen (1986) have estimated that about 70% of the fishing effort in most of the areas is gillnet while troll lines, pole and line and long-lines account for the rest of the effort. Considerable contribution is made to the billfish production by other combination of gears such as Handlining in small meshed gillnets in mechanized and non-mechanized crafts. Vessels operating these gears are of several types. FRP boats of 6-7 m with out board motors and 9m boats with inboard motors operate one day fishing in coastal waters, less than 30 km from the shore while 10-11 m and >11 m crafts generally operate multi-day fishing in the offshore and deep-sea areas. The majority of catch is brought by the multi-day tuna boats of size ranging from 10-11m and > 11m. Further an increased catch of sailfish is observed in FRP (Fiber Reinforced Plastic), single day operated boats in recent time and are increasing there effort with combination of gears as it fetches high price in the market than flesh of fish caught in multi-day boats. The mechanized craft types operate in Sri Lanka, there size ranges and boat descriptions are given in appendix 1.

Catch and effort data

Fish landed were sampled at 20 major landing centers scattered along the coast in different areas: west (Negombo), southwest (Beruwala, Galle, Dodanduwa), South (Matara, Weligama, Mirissa, Dondra, Gandara, Kottegoda), southeast (Hambantota, Kalametiya, Kirinda, Tangalle, Kudawella), east (Baticaloa, Kalmunai, Malaikadu) and northeast (Codbay, Trincomalee). Map of principal landing centers and the fishing zones considered in this analysis are given in appendix 2. Catch and effort data were collected in all the above centers by stratified random sampling by the samplers, where average of 3-5 days sampling was carried out per month at each center. The catch /effort data and also length-frequency data were collected for about 30% of the total landings of a

particular sampling day and the total catch was recorded as weight, number of fish and species composition. Although there are many types of vessels and gear combinations contribute the total billfish landings all around the country, the analyses were made for all gear types operate for large pelagics. The data are fed to the data base and using a vessel raising factor for each year, production figures are calculated for each month and finally the annual production was estimated for different species, by area, craft type and the total of all large pelagics. Length data for billfish were very poorly gathered as most of the catch landed by the multi-day crafts are cut open at the sea and are de-headed and de-gutted for storage purposes.

Results

Although there are few targeted fisheries for some other important tuna-like species such as Wahoo and Seerfish, there is no such target fishery for billfishes. Billfishes neither form a target group in any of the local commercial fisheries, nor is there a sport fishery on them. Gillnet is the dominant gear in all areas, while longlining in most cases is carried out in combination with gillnet fishing. Gillnet operations carry up to 150 net pieces of 5" to 6" mesh size and up to 700 hooks depending on the craft type. The mechanized craft types operate in Sri Lanka, their average days fished, the gear specifications as number of net pieces, number of hooks, type of gear or combination employed by each craft type is given in Table 1. The type of bait used varies according to target species and also seasonally.

Table 1: Mechanized craft types operate in Sri Lanka, average days fished and gear specifications

Craft type	Days fished	No. of net pieces	No. of hooks	Gear/combination
UN1	1	20 - 35		GN, HL,LL
UN2A	1 – 3	44 - 70		GN, TL, HL, LL
UN2B	1 – 15	22 - 100	450 - 700	GN, HL, TL, LL
UN3A	2 - 27	64 - 150	300 - 700	GN, HL,LL, TL
UN3B	10 – 30	40 - 60	150 - 520	GN, HL,LL, TL
TR5	1	20		GN, HL, RN

GN- Gillnet, HL- Handline, LL- Longline, TL- Troll line, RN- Ring net

The annual production of large pelagics is estimated from 1995 to 2003 using the NARA data base. According to the most recent estimates, total catch of large pelagic fish has shown an increasing trend up to 2001 and then has decreased dramatically (Figure 1). Large pelagic fish landings according to major varieties from 1999-2003 is given in Table 2. Bulk of the production comes from the offshore areas where 30% and 70% represent coastal and offshore production respectively in recent years (Table 3).

Figure 1: % billfish landings over total large pelagic production.

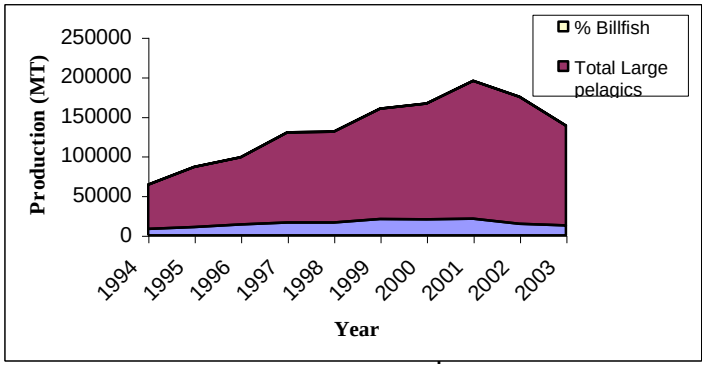


Table 2: Large pelagic fish landings according to major varieties from 1999 - 2003

	1999	%	2000	%	2001	%	2002	%	2003	%
Tunas	85535	61.3	89442	61.0	94956	54.7	79197	49.1	79999	62.8
Seerfish	1379	1.0	1243	0.9	1825	1.1	977	0.7	724	0.5
Billfish	20447	14.6	20000	13.6	20947	12.1	14347	8.9	12442	9.8
Sharks	23616	16.8	25005	17.1	13800	7.9	11106	6.9	12805	10
Skates & Rays	3764	2.7	2700	1.8	4721	2.8	2492	1.7	3114	2.4
Mammals	44	0.1	5	0.1	512	0.3	388	0.3	57	0.04
Other bony fish	4843	3.5	8126	5.5	37238	21.1	52049	32.4	18054	14.1

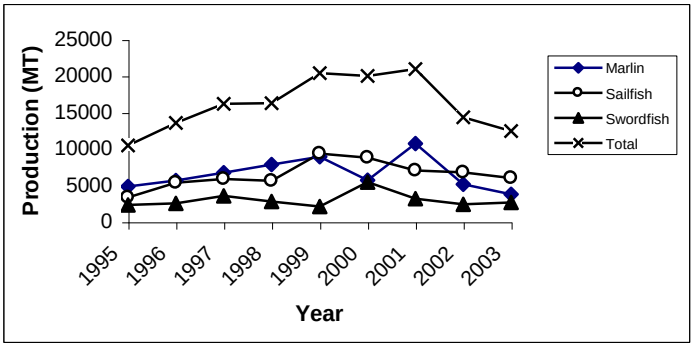
Table 3. The catch of billfish as a percentage to the total large pelagic catch in different years

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Coastal	31942	29674	32728	40932	33332	44768	85781	77502	11861
Offshore	44150	55354	80969	73566	106296	101757	88219	83055	114303
Total Large pelagic	76092	85028	113697	114498	139628	146526	174000	160557	126165
Billfish	10519	13602	16211	16294	20448	20002	20947	14347	12442
% Billfish	**13.82**	**15.99**	**14.25**	**14.23**	**14.64**	**13.65**	**12.03**	**8.93**	**9.86**

Species composition

Five species of billfishes have been identified in local commercial landings. This includes 3 species of marlins; black marlin (*Makaira indica*), blue marlin (*Makaira nigricans),* striped marlin *(Tetrapturus audax*), two non-marlin species; the sailfish *(Istiophorus platypterus)* and the swordfish *(Xiphias gladius).* In catch statistics billfishes comprised of 3 groups; marlins, sailfish and swordfish where 3 species of marlins are lumped in to a single category. According to the most recent estimates, the annual total catches of principle-market tuna species and billfish in the total large pelagic landings represents 50-60% and 9-10% respectively. The species composition by species and the total billfish landings realized by all types of crafts and gear combinations for the period of 1999 to 2003 is shown in the Figure 2. It shows an increasing trend up to 2001 and a decrease since then representing that of total large pelagic production. Among marlins, the most common species in the catches is the blue marlin in all areas. With the observations the blue and black marlin makes the bulk of the catch while striped marlins are caught in small quantities.

Figure 2: Trends in billfish composition (by weight)



Catch composition of billfishes has changed where marlins dominated the catch for nearly 50% up to 2001 and a sharp decline from there. As the total catch has increased with years, since 1997 sailfish has dominated in the catch composition and has shown dramatic increase maintaining their contribution making up to almost 50% in recent years. The catch composition of marlin, sailfish and swordfish were 35%, 48% and 17% respectively in the recent estimates of 2002 and 2003. According to a recent study in 2004, more and more sailfish is caught in single day fishing operations by FRP boats with other combinations of gears, which is not counted in to this, may probably result in higher contribution of sailfish in the total billfish landed. The % contribution by 3 groups to the total billfish production in past 5 years is given in the table 4.

Table 4: Percentage contribution of billfish groups

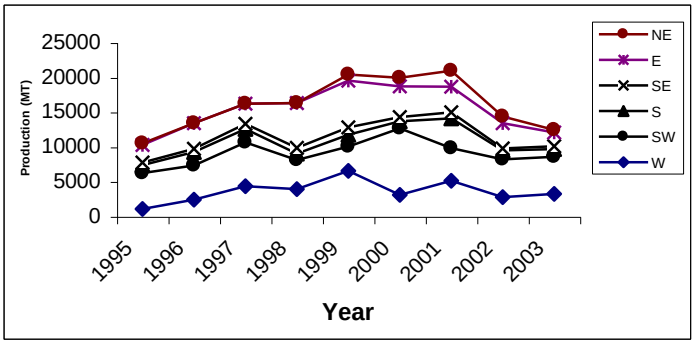
	1999%	**2000%**	**2001%**	**2002%**	**2003%**
Marlin	43.79	28.51	51.32	36.02	30.44
Sailfish	45.83	44.13	33.58	47.26	48.25
Swordfish	10.37	27.36	15.10	16.72	21.31

The estimated annual production of billfish by different area is shown in Table 5. The highest contribution of billfish to the total large pelagic production was reported from northeast followed by east, southeast, south, southwest and the least contribution from west coast.

Table 5: The estimated annual production of billfish by different areas

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
West (W)	1039.9	2391.8	4345.2	3909.1	6531	3084.8	5127.8	2753.5	3218.8
Southwest (SW)	5179.4	4913.5	6295.3	4174.9	3483.8	9584.5	4700.9	5420.9	5354.2
South (S)	1128.2	1926.7	1926	949.5	1740.9	994.5	4269.8	1300.8	1087
South East (SE)	387.2	488.9	728.1	829.2	1038.9	612.6	880.2	266.3	410
EAST (E)	2544.1	3654.9	2909.6	6434.4	6727.4	4424.7	3651.9	3645.7	1998.1
North East (NE)	220.8	0	0	0	867.9	1231.3	2331.7	970.6	362.4

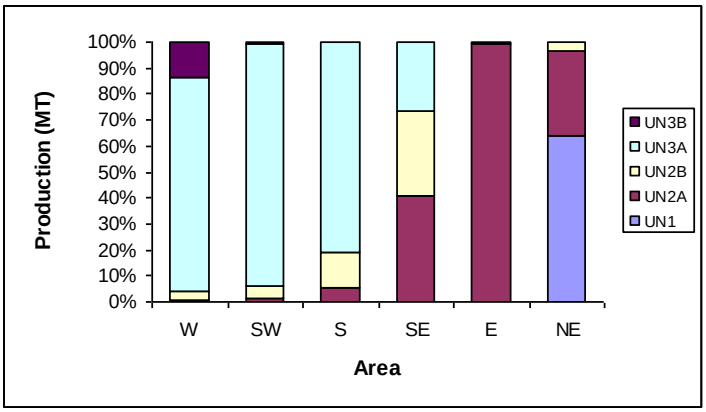
Figure 3: Trend of total production of billfish for different areas



The most common type of craft s engaged in large pelagic fishery for all the zones were the UN2A and UN2B. UN3A type was not present in east and northeast areas while the largest craft type

UN3B, are not present in Southeast, east and northeast areas. In northeast and east areas, most of the effort is by single operations by UN1, UN2A and UN2B types, where the large pelagic fishery mainly depends on the coastal fish resources. The production contributes high to the total where longlines represent a greater share and the gear is mostly used on seasonal basis. In southeast area, most contribution comes from UN2B, multi-day craft, with lesser contribution from UN3A. In south and southwest, most effort is from UN3A and from UN3B to a lesser extent. In west, UN2B, UN3A and UN3B contribute the total effort (Figure 4).

Figure 4: Total billfish production by craft type in different areas



Seasonal variation

Figure 5 & 6 show the annual variation in the catch of billfishes in year 2002 and 2003 where more sailfish is reported from May to September, which falls with the southwest monsoon. Yet an increasing trend of all groups was observed throughout the year towards the end of the year

Figure 5: Annual trends in billfish catches in 2002

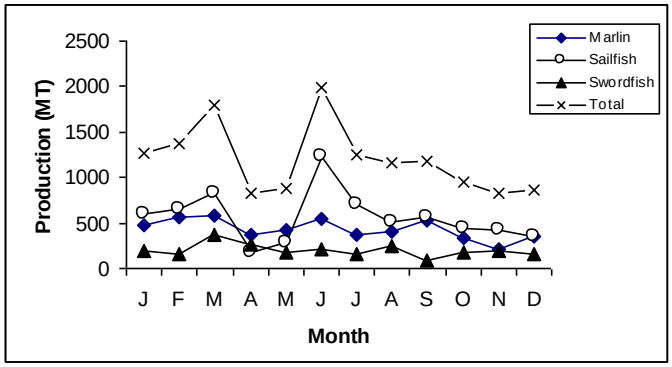
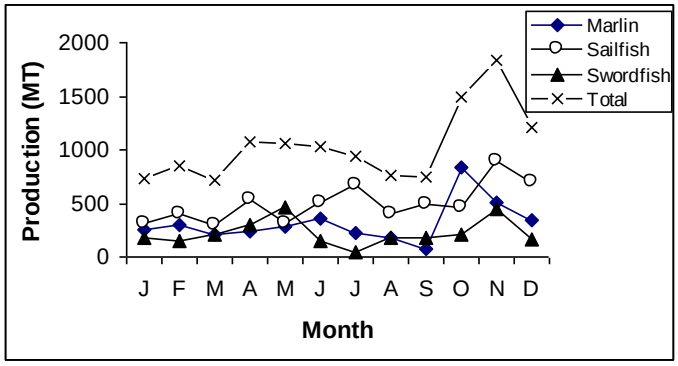


Figure 6: Annual trends in billfish catches in 2003



Size composition

Lengths recorded are very poor in statistics, especially for marlins and swordfishes as they are cut open at the sea. According to the recent observations the maximum length recorded for marlin is 246 cm of cut length. The size range of recorded sailfish varies from 17.5cm to 235cm FL and sword fish from 26 cm to 245cm FL. Due to there large size, marlins were most of the time cut open for the purpose of storage thus very less Length-frequency data is available.

Discussion

According to Dayaratne and Maldeniya (1996) in 1994, 44% of the catch of the large pelagic landings had been billfish where total large pelagic production had been 55,948 MT. But this % has gradually been decreased as the total large pelagic catch more and more dominated by tuna, mainly by 2 tuna species. The estimated billfish landings have shown an increasing trend and has reached 20947 MT in 2001 compared to the 10519 MT in 1995 although there has been a dramatic decline in the landings from 2001 to 2003. As other tuna species the catch of billfish has been at increasing trend could be due to several reasons such as, increased use of combination of gears, expansion of fishing range more towards offshore and deep-sea, under-reporting, increased quality of statistical records, improving market or reduced level of discards. The offshore fleet has expanded rapidly, with around 1400 multi-day boats staying out at sea for more than 10 days or more. This effort is within the entire EEZ and also with some exceptional cases where the vessels venture the international waters. However the species composition of billfish has changed dramatically over a short period. Incomplete data, improved statistical recordings, species mis-identification rather than a change in the fishing strategy may explain some of the changes. The change in catch composition where marlins dominated the billfish landings in early years of 90's and now the composition has changed so as the sailfish contribute nearly half of the total billfish landings with an increased contribution from swordfishes as well. This could be due to many reasons, over-exploitation of marlins, more abundance of sailfish and swordfish for gears used. They are abundant around Sri Lanka and India, and Sailfish shows a strong tendency to come closer to shore, thus are taken ashore more and more in recent time in combination gears especially by small-scale single day boats. Share of the principle

market tuna species has declined from 48% in 2001 to 37% in 2002 but has increased again to 59% in 2003 and 2004. There has been a significant increase of billfish landed in the first half of the year 2004 which makes about 11.55% of the total large pelagic landings. Although Sivasubramaniam (1965), Joseph and Amarasiri (1986), Maldeniya *et al*. (1987) and Foster (1987) reported about one species of Shortbill Spearfish (*Tetrapturus angustirostris*) to be caught in small quantities which shows occasional appearances, no records were reported in the present statistics. This could be due to mis-identification of the species in the field as billfish identification in the field is not an easy task.

High billfish catches were observed on east and northeast coasts of the island, for all 3 groups of billfishes. Maldeniya *et al* (1996), Joseph and Amarasiri (1986), Maldeniya et al (1987) and Foster (1987) also have recorded high catch rates in the same areas and also in southwest area. In east and northeast most of the catch was taken by gillnetting and also by trolling and pole and line which operates seasonally. In the total catch of the country as a whole, billfishes are caught in drift gillnetting which is the widely used gear in Sri Lanka and as they are believed to be easily vulnerable to entanglement as they inhabit surface waters. However as data of different gear types are not available in great detail, comparisons cannot be made for efficiency of the gear.

The present estimates are mainly based on the large pelagic data base records from local commercial catches. If the landings from the coastal single day operations in most areas and landings by tuna longliners of foreign companies permitted by the Government to fish beyond the EEZ of Sri Lanka were incorporated, the figure would be and is an underestimate. In spite of the substantial increase in information on billfish over the last decade, especially in the landings and catch/effort data in most countries, basic biological information on billfish such as on growth, maturation, catch at age and sex ratio by size is still insufficient for detailed studies. Although there has been dramatic increase in the catch recorded in the region, to what extent these changes increase represent, change in targeting or simply improved reporting in unknown (Campbell *et al.*, 1998). In Sri Lankan context, without targeted fishery, reason for higher catch rates is not known. Lack of annual catch and effort data of the contribution to the billfish landings from artisanal, small-scale fisheries sector which brings a considerable catch of sailfish as incidental catch, yet are not included in this production estimates poses a problem in production estimation. This also exclude the production in the Northern part of the country as regular sampling is not carried out by NARA samplers due to security reasons. Without good data about the fisheries it is not possible to evaluate the status of the stocks or possible interactions. In order to have better image of the fishery, stock status and to overcome problems, improvement of fishery-dependent statistics should coupled with the information on gear efficiency and stock availability of the gear. Still there is an uncertainty of the status of many billfish stocks represent a serious conservation problem. Maintenance of a logbook has been a success for tuna species in Sri Lanka in the past, which can be practiced for billfishes as well in order to improve better catch and effort data.

As mentioned by Campbell *et al.,* (1998), all species of billfishes have experienced an increase in catch in the Indian Ocean since the mid 1980's. In most instances this increase is due to the increase in the catches taken by Sri Lanka. Up to this year marlins have not been identified to

the species level to give relative proportions of different species in the commercial landings. They have been included in the data records as three different species very recently and assistance has been given to the samplers in identifying the species. No details about the positions and distribution is present, but can be obtained accurately by maintaining logbooks.

Conclusions and Recommendations

As considerable catch of billfish is recorded in east and northeast coasts, sport fishery can be initiated and developed in this area as tourism is a major foreign exchange earning in recent time in the eastern areas with the establishment of the peace agreement. As there is no target fishery, efficiency could be increased if a specific gear is introduced. The quality of fish landed is very poor as poor storage facilities inboard and poor facilities at landing sites and fishery harbours. In order to improve the quality of the data especially Length-Frequency data a mechanism such as log book could be introduced to the multi-day boats to get more reliable and complete data. High priority should be given to improve data recording procedures. The research on the life history parameters of the individual billfish species is also necessary. Without these data the stocks in the region will remain uncertain and will not be possible to identify the most appropriate management options for these stocks. Most scientists propose that, it is now high time to start focusing on the future of the billfish in the Indian Ocean. Proper management regimes should be identified and put in to place in the next few years so that the status of the billfish stocks in the Indian Ocean can be adequately monitored in the future, as more and more catch is brought in to shore with the time.

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Appendix 1

The vessel raising factor for large pelagic fishery - different craft types in each zone in 2003

Zone	UN1	UN2A	UN2B	UN3A	UN3B	Total
West	-	12	50	325	12	399
Southwest	-	15	28	301	12	356
South	-	32	225	350	10	617
Southeast	-	45	155	30	-	230
East	-	229	6	-	-	235
Northeast	90	35	3	-	-	128

The mechanized craft types operate in Sri Lanka, there size ranges and boat descriptions

Boat code	Boat description
UN1	5.5 – 7.2m FRP boats, outboard engine of 15-25HP - single day boats, fishing in coastal waters
UN2A	8.8 – 9.8m displacement hull, FRP or wooden, inboard engine of 40HP - No ice box, single day boats, fishing in coastal waters
UN2B	8.8 – 9.8m displacement hull, FRP or wooden, inboard engine of 40HP - With ice box, multi-day boats, fishing in offshore waters
UN3A	9.8 – 12.2 m displacement hull, FRP or wooden, inboard engine of 60HP - multi-day boats, fishing in offshore waters
UN3B	12.2 –15.2m displacement hull, FRP or wooden, inboard engine of 60+HP - with more facilities, multi-day boats, fishing in offshore waters
UN4	Reserved for vessel category 15.2-18.3m
UN5	Reserved for vessel category 18.3+m
TR5	Mechanized traditional oru – single day boat, fishing in coastal waters

Appendix 2

Map of principal landing centers and the fishing zones considered in this analysis.