

The French longliners historically mainly targets swordfish (*Xiphias gladius*) but also catches other species like tuna (Yellowfin, *Thunnus albacares*, Bigeye, *Thunnus obesus*, Albacore, *Thunnus alalunga*), dolphin fish (*Coryphaena hippurus*), other billfishes (Sailfish, *Istiophorus platypterus*, marlins, *Makaira mazara*...), sharks (*Carcharinidae*) or wahoos (*Acanthocybium solandri*). Even if in 2000, the percentage of swordfish caught by the French longliners was up to 50%, it falls down to 33% in 2006 and seems to continue decreasing in 2007 with 30.8% of the total catches (Figure 2). According to fishermen, this decrease is clearly the consequence of a change in the fishing strategy of the French longliners that want to increase the level of tuna catches.

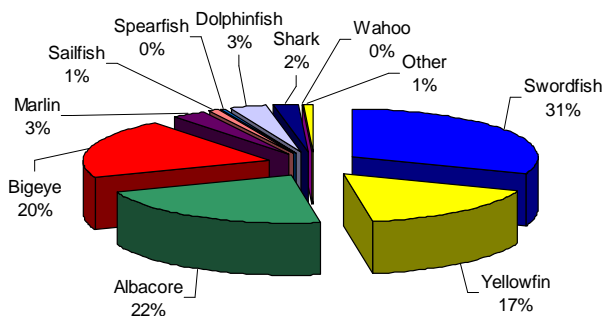


Figure 2: large pelagic species composition in longliners catches in 2007
(Sources: SIH IFREMER)

Because of the medium mean size of the French longliners, fishing locations are mainly located around La Réunion zone, from Mauritius to the East coast of Madagascar (Figure 3a, b) and most of the catches are realized in the EEZ of La Réunion and Madagascar/ Mauritius according to adequate fishing licences (Figure 4). With the arrival of larger fishing units (five 25 meters in 2007), the location was extended to the south and north of Madagascar and along the Mozambique Channel (Figure 3a, b).

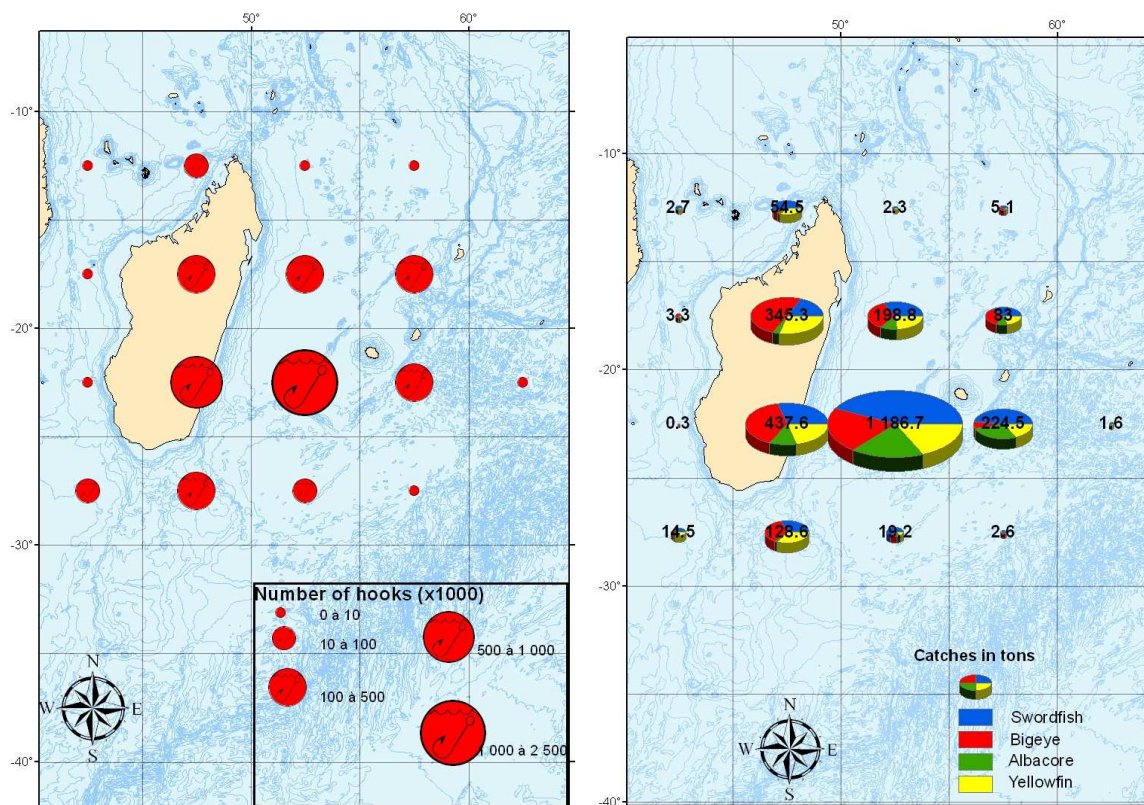


Figure 3: Effort and total catch in La Réunion longline fishery in 2007
(Sources: SIH IFREMER)

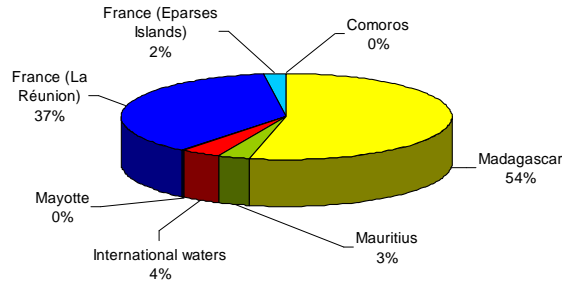


Figure 4: Location of total La Réunion longline fishery catches according to regional countries EEZ in 2007 (Sources: SIH IFREMER)

Evolution of effort, catches and CPUE

The effort developed by the Réunion longliners steadily increases until 1998 to reach more than 4 million hooks and then decreases to 3 millions in 2006 (Figure 5). We can note a huge increase to 4 million of hooks in 2007 as the consequence of the arrival of the 6 new fishing Units of 25 meters length. However, the increase of the effort was not followed by the same increase of the captures. CPUE remained relatively constant from 1996 to 2001 at an average rate of 0.69 Kg/hook (SD=0.04) of pelagic fishes and decreased to 0.52 Kg/hook in 2003 (Figure 6) mainly because of a decrease in the total catches. This decrease was followed by an important but short increase of the CPUE reaching 0.92 Kg/hook in 2005. In 2007, CPUE is at a level of 0.78 Kg/hook.

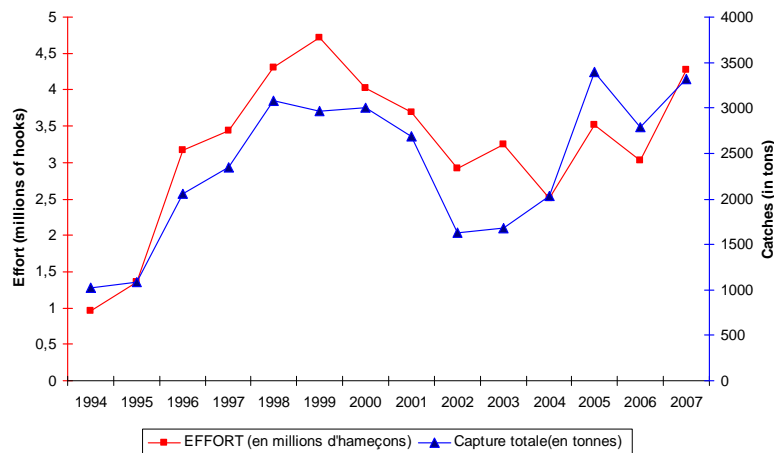


Figure 5: Evolution from 1994 to 2007 of the effort and total catches in La Réunion longline fishery (Sources: SIH IFREMER)

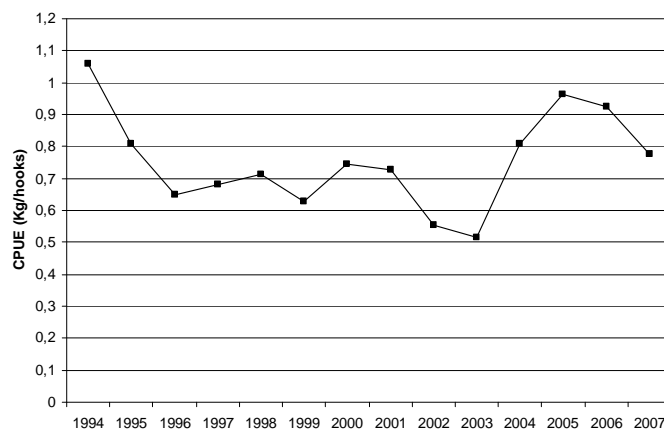


Figure 6: Evolution from 1994 to 2007 of the total CPUE in La Réunion longline fishery (Sources: SIH IFREMER)

Analysing catches and CPUE per targeted species, we clearly see that since 1994, the ratio between swordfish and tunas catches changed from $[2/3 - 1/3]$ to $[1/3 - 2/3]$ in 15 years (Figure 7a). Not taking into account some specific events (e.g. 2004, Figure 7b), we can note that swordfish CPUE globally decreased within the period whether tunas CPUE slowly increased, mainly the bigeye one (Figure 7b). According to fishermen, this is the consequence of changes in the fishing strategy (fishing zones: more bigeyes in the Est coast of Madagascar – depth – bates...), but clearly need to be confirmed with onboard observers and fishing parameters data because they are still fishing during the night, which is not congruent with the fact that they want to target tunas.

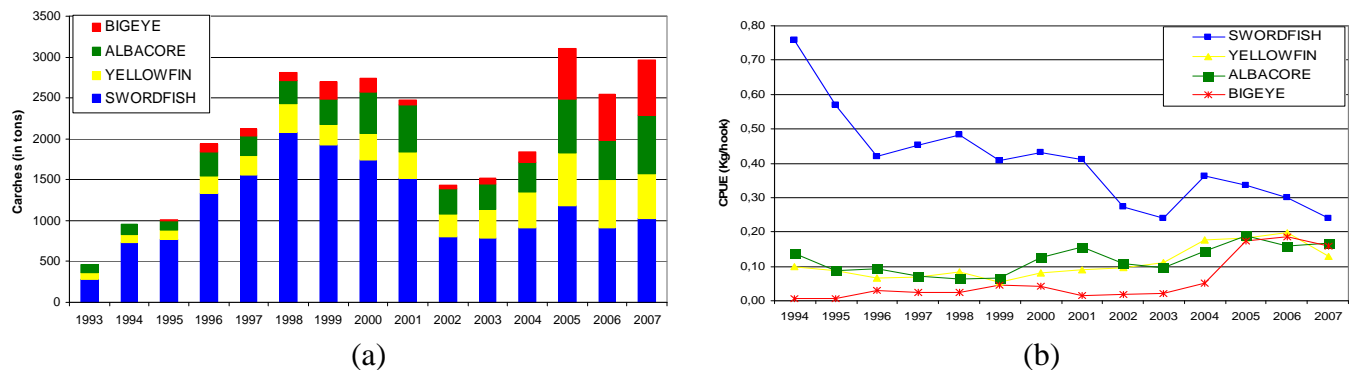


Figure 7: Evolution from 1994 to 2007 of the catches (a) and CPUE (b) of the main species caught by La Réunion longline fishery (Sources: SIH IFREMER)

FOCUS ON THE SWORDFISH (XIPHIAS GLADIUS)

Even if the rate of swordfish has decreased since the start of the fishery, with more than 30% of the total catches, La Réunion longliners are still targeting this species (Figure 7a). After a peak of catches in 1998 reaching 2000 tons of swordfishes, the total swordfish catches seems to be stabilized since 2002 at a level of 1000 tons (Figure 8). However, the CPUE for this species slowly fall down since 1994 from 0.75 Kg/hook to 0.24 kg/hook.

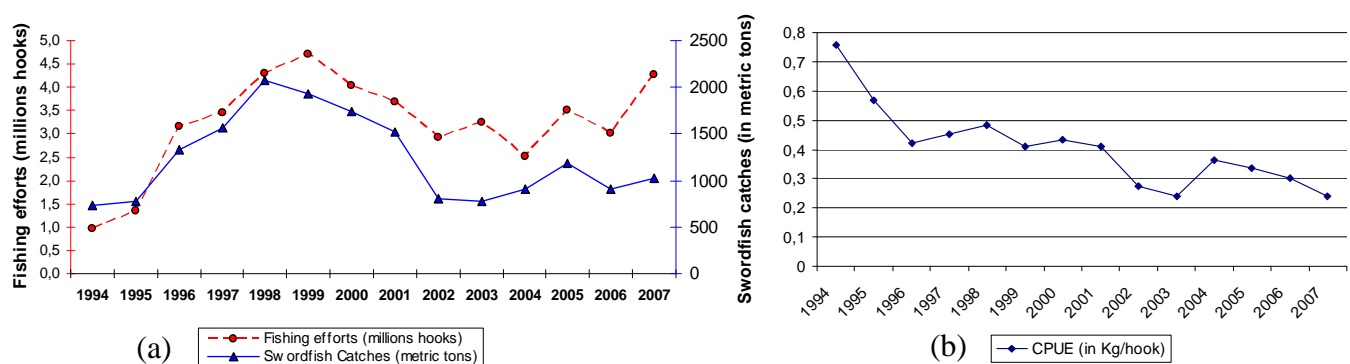


Figure 8: Evolution from 1994 to 2007 of the catches and effort (a) and CPUE (b) of swordfish caught by La Réunion longline fishery (Sources: SIH IFREMER)

Figure 9a and 9b show the location of catches and CPUE for this species in the South West Indian Ocean.

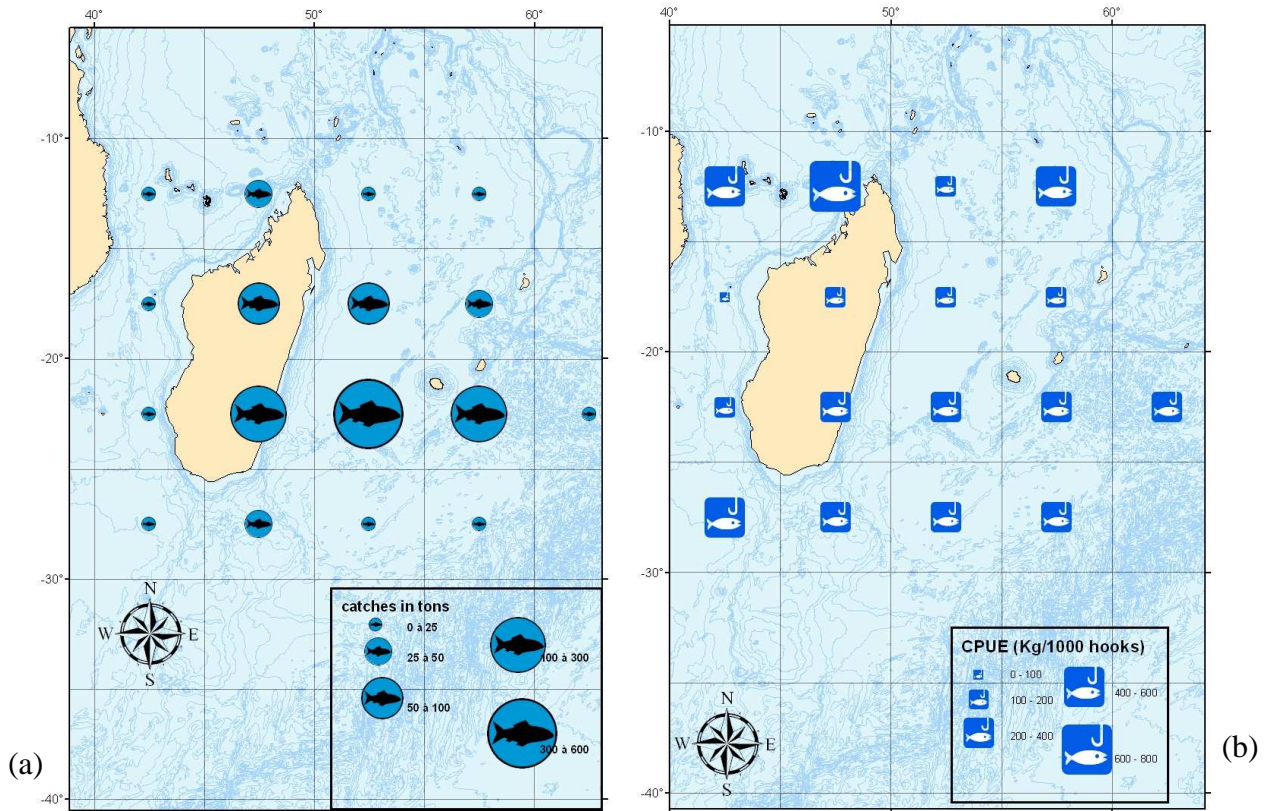


Figure 9: Catches (a) and CPUE (b) of swordfish caught in 2007 by La Réunion longline fishery (Sources: SIH IFREMER)

CPUE seems to be higher in the north and south of the Mozambique Channel (Figure 9b), but were calculated on the base of a small number of sets performed.

Since 1994, Ifremer has to follow for France/IOTC/UE the size of swordfish caught by French longliners fleet operating in the Indian Ocean. In 2007, 1423 swordfishes were measured (Lower Jaw Fork length – LJF) either directly onboard or during the landing. In 2007, the average LJF size of swordfish was 159.9 cm (SD = 28.40; Figure 10).

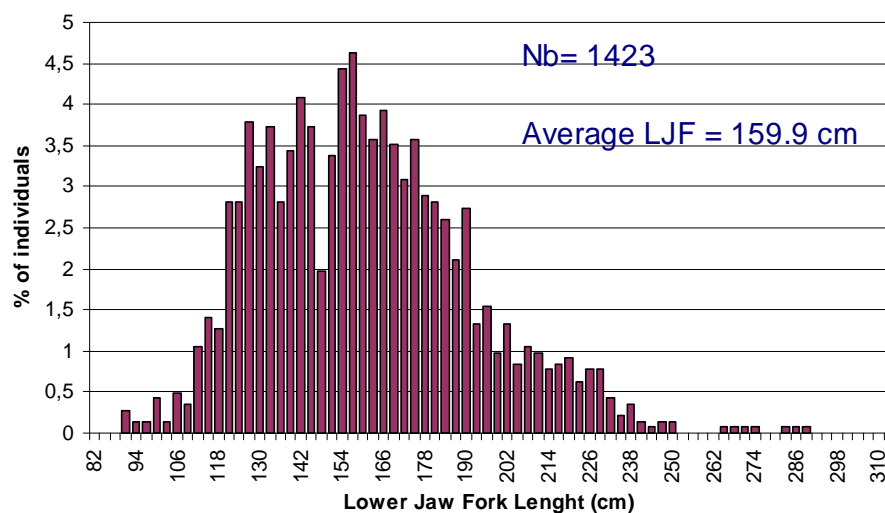


Figure 10: distribution of size (LJF length) of swordfish caught by La Reunion's longliners from in 2007 (Sources: SIH IFREMER)

Based on the LJF length collected since 1994, there is no significative change in the average size of this species caught by the French longliners operating in the south West Indian Ocean (Figure 11).

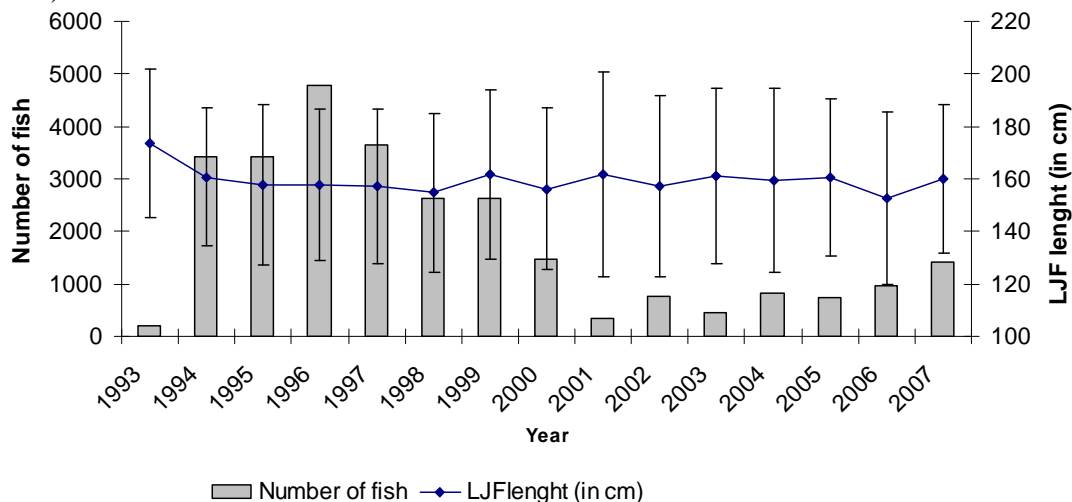


Figure 11: Evolution of the distribution of the mean size of swordfish caught by La Reunion's longliners from 1993 to 2007 (Sources: SIH IFREMER)

However, such kind of analysis need to be performed not in the whole fishing area, but within fishing area, meaning that the sampling size need to increase and be homogeneous per fishing zone (Figure 12). In fact the first average swordfish size analysis per zone (Figure 12) shows that there is a difference in the average size of caught fishes according to the fishing area.

If we focus on size of swordfishes (LJF length) caught in these different areas, we can note that average size of swordfishes caught in the north an the south of Madagascar are significantly smaller ($p < 0.001$) from those caught in the La Reunion area (Figure 12), but that the one caught in the North and South of Madagascar remains similar ($p > 0.05$). However, this result need to be taken with caution as the repartition of our sampling is not homogeneous through time and there may have an important temporal effect on the mean size observed per zone.

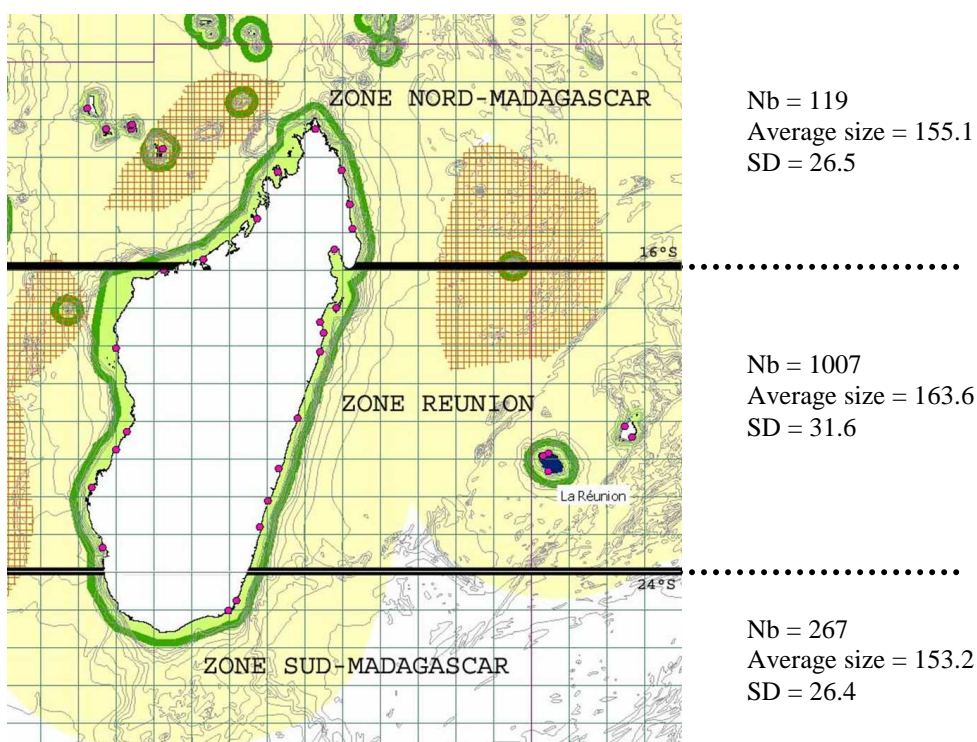


Figure 12: Average size (LJF length) of swordfish caught by La Réunion longline fishery according to the area sampled (Sources: SIH IFREMER)

FOCUS ON OTHER BILLFISHES (MARLINS, SAILFISH, SPEARFISH)

In La Reunion island, others billfishes are caught by the longline fishery and by the coastal fishery

The longline fishery

The other billfishes caught by the French longline fishery are the sailfish – *Istiophorus platypterus*, the shortbill spearfish – *Tetrapturus angustirostris*, the blue marlin – *Makaira mazara*, the black marlin – *Makaira indica* and the striped marlin – *Tetrapturus audax*. Unfortunately, we are not able at this stage to provide data per species of marlins.

In 2007, this fleet caught 106.5 tons of marlins (3.2% of the total catches), 27.7 tons of sailfish (0.8%) and 9.6 tons of spearfish (0.3%; Figure 13a).

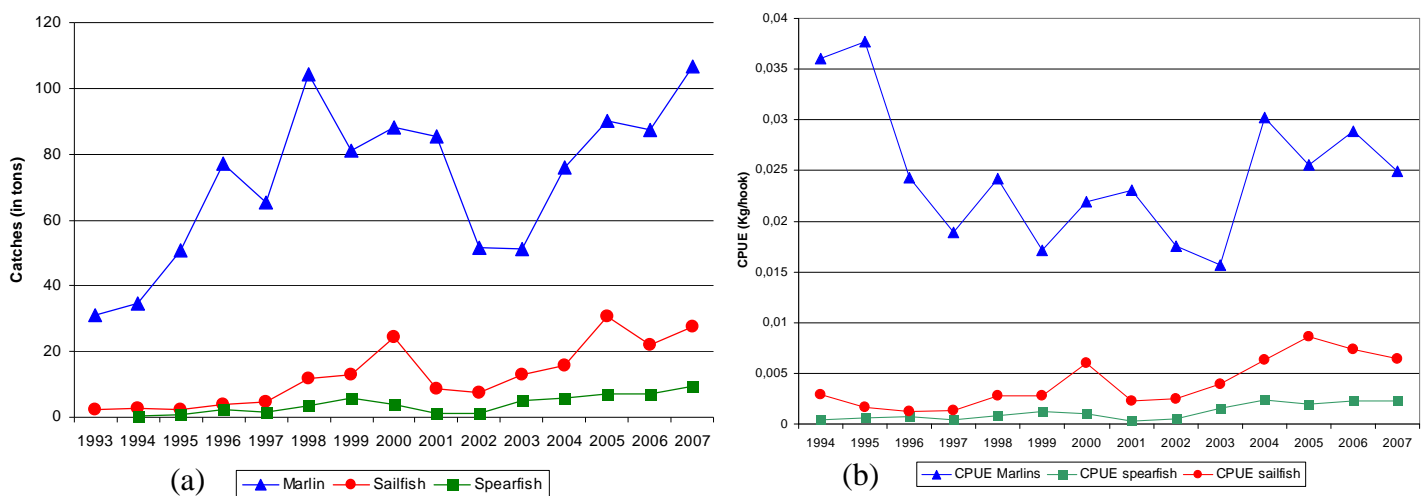


Figure 13: Evolution of the catches (a) and CPUE (b) for other billfishes (marlins, sailfishes and shortbill spearfishes) caught by La Reunion's longliners from 1993 to 2007 (Sources: SIH IFREMER)

The coastal fishery

La Reunion coastal fleet is currently composed of 203 boats in activity in 2007 (205 in 2006). Almost all of them use hand-line and troll-line gears. The coastal fishery that fishes large pelagic fishes can be separated in 2 fleets: the one targeting only large pelagic fishes (29 boats in 2007) and the other one targeting benthic fishes and large pelagic fishes (168 boats in 2007). The last one used to fish billfishes when the boats go to benthic fishes sites using troll-line gear and estimation on real effort on large pelagic fishes remain extremely difficult to estimate.

Data collection is implemented via datasheet declaration to managers. Until 2006, these data sheet were not an obligation, but since then, it remains obligatory. The number of datasheet declarations for this fishery fluctuates and the main problem is that the quality of the data is unknown. Contrary to the longline fishery, the real data of landing are not available.

In order to obtain reliable estimation of the catches of the La Reunion coastal fishery, we followed up the landing of this coastal fishery since 2006 by sampling in the different harbours of the island. As boats do a one day fishing trip, a one boat harbour sampling represents an effort of a one day at sea for this boat.

Coastal fishery targeting large pelagic fishes

Even if the sampling effort represents respectively only 3.4 - 3.5% and 2.8 – 3.0% of the total landing, it is composed of 154 landing samples in 2006 and 110 in 2007 (Table 1). We used the ‘*interviews theory*’ to estimate the mean number of at sea days and a parametrical approach to assess total catches and standard deviation.

	2006				2007			
number of boat in activity	205				203			
number of boat targeting large pelagic	32				29			
number of boat sampled	26							
number of landing sampled	154				110			
total number of landing estimated	4344 à 4511 (3.4 à 3.5 % sampled)				3709 à 3879 (2.8 à 3 % sampled)			
Species	catch sampled (kg)	catch estimated (kg) min	catch estimated (kg) max	mean catch estimated (kg)	catch sampled (kg)	catch estimated (kg) min	catch estimated (kg) max	mean catch estimated (kg)
Marlins	1008	9520	49191	28990	72	72	7420	2483
Sailfish	10	10	857	287	25	25	2576	862
Spearfish	0				27	27	2280	945
TOTAL catches	5248	73803	248338	150894	2136	38763	118060	73670

Table 1: La Réunion coastal fishery targeting large pelagic fishes sampled at landing (effort used here: one landing = one day at sea) (Sources: SIH IFREMER)

Coastal fishery targeting large pelagic and benthic fishes

Even if the sampling effort represents respectively only 1.6% and 0.6% of the total landing, it is composed of 391 landing samples in 2006 and 127 in 2007 (Table 2). We used the ‘*interviews theory*’ to estimate the mean number of at sea days and a parametrical approach to assess total catches and standard deviation.

	2006				2007			
number of boat in activity	205				203			
number of boat targeting large pelagic and benthic	159				168			
number of boat sampled	109							
number of landing sampled	391				127			
total number of landing estimated	23726 à 24166 (1.6% sampled)				22397 à 23027 (0.6% sampled)			
Species	catch sampled (kg)	catch estimated (kg) min	catch estimated (kg) max	mean catch estimated (kg)	catch sampled (kg)	catch estimated (kg) min	catch estimated (kg) max	mean catch estimated (kg)
Marlins	0				146	146	62799	26110
Swordfish	48	48	8734	2940	0			
TOTAL catches	7188	214142	698101	440099	2015	110864	645338	360431

Table 2: La Réunion coastal fishery targeting large pelagic and benthic fishes sampled at landing (effort used here: one landing = one day at sea) (Sources: SIH IFREMER)

Comparison between years and fleets cannot be performed because of the sampling rate and the estimation method. However in 2006, 67% of the catches are composed of tunas and we can have a first estimation based on landing sampling of the total catches of billfishes of this coastal fishery with an average of 28 tons of marlins, less than 1 tons of sailfish and spearfish and quite never swordfish.

Little is known regarding sport-fishing but their catches are included in the statistic presented here. Since 2006, there are 12 boats that practice sport fishing for tourist and that sell the fishes caught.

Regarding the model used based on landing interview (and the low sampling rate), we compared for 2006 the estimation performed using data collected by datasheet declaration and landing interview (Table 3) in order to evaluate the validity of the method. We can note that the order of magnitude remains the same for the total catches. The interview method data shows a clear advantage of being exact when collected while datasheet declaration remains sometime obscure.

	Datasheet declaration (kg)	Estimation of catches (kg) based on datasheet declaration	Estimation of catches (kg) based on landing sampling
billfishes	31 457	72 762	118 156
tunas	245 640	355 743	261 425
other large pelagic	171 731	236 299	223 505
total	448 828	664 804	603 087

Table 3: Comparison for 2006 data between estimation of catches (kg) based on datasheet declaration and landing sampling. Small longliners catches are included in this comparison
(Sources: SIH IFREMER)