

A GENERAL OVERVIEW ON THE ACTIVITY OF THE SPANISH SURFACE LONGLINE FLEET TARGETING SWORDFISH (*Xiphias gladius*) IN THE INDIAN OCEAN FOR THE PERIOD 1993-1999.

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ABSTRACT.

This paper presents general information obtained on the Spanish surface longline fleet targeting swordfish in the Indian Ocean from the beginning of its activity in 1993 to 1999. For the years 1998 and 1999 this information is also offered disintegrated by 5x5 degrees square format and by month.

INTRODUCTION.

The Spanish surface longline fleet targeting the swordfish in the Indian Ocean (FAO Area 51) began its activity in September of 1993. A total of 5 ships under the Spanish flag began prospecting the fishery of this resource in the international waters of the Indian Ocean and the operation lasted until August, 1994. Only one of these boats continued in the activity on a partial basis in 1995 (for approximately 1 month) and in 1996 (for approximately 2 months). In 1997 two vessels fished in this zone of the Indian Ocean for about 6 months. In 1998 a total of 8 vessels directed their fishing effort at the swordfish in the same area FAO 51 for a period lasting approximately 9 months. From November 1999 to February 2000 others 2 experimental surveys were developed in the Area FAO 51 in southern areas mostly, while others 7 vessels were fishing in 1999 all over the year.

MATERIAL AND METHODS.

The basic data for the scientific monitoring of the Spanish fleet's activity started in 1993 were provided by 5 scientific observers on board the vessels that conducted the fishery prospecting surveys between 1993 and 1994. The scientific observers compiled basic, biological information and took down size data (LJFL: law jaw-fork length) of all the specimens of swordfish taken on board.

It was later considered appropriate to take additional measures that would enable us to obtain basic scientific information on the fleet fishing outside the ICCAT framework. For this purpose we set up a system to collect information based on catch data through the individualized monitoring of the activity of each vessel, nominal effort and size, compiled by means of the specific fishing log book system filled out voluntarily by the fleet, in addition to landing and transfer data provided by the Information and Sampling Network of the Spanish Institute of Oceanography (RIM). The data on catch, fishing effort and set position as well as the individual weights of each swordfish are recorded in these log-books voluntarily and then processed.

The nominal effort is expressed in thousands of hooks and the overall annual CPUE was determined as the sum of the catches from each year divided by the sum of the nominal effort of the pertinent year. In 1998 and 1999, the scientific monitoring started in 1993 was stepped up specifically based on the individual vessel follow-up. The 1998 and 1999 data were elaborated in a 5x5 square format/month, according to the same method used in the Atlantic Ocean (Mejuto et al., 1997; 1999; Mejuto et al., in press), following the methodology recommended by the ICCAT (Miyake, 1990).

Additionally, the scientist observers and skippers have contributed to our Tagging Program, taking advantage of the live individual caught and tagging individuals of swordfish, billfish and sharks since these experimental surveys.

RESULTS.

A total of 5 surface longline vessels sailing under the Spanish flag participated in the fishery prospecting surveys carried out between September, 1993 and August, 1994 (3 of the vessels began prospecting in 1993 and the other 2 started this activity in 1994), in a zone comprising 15°N and 38° S and between 35°-60° E longitude, which pertains to FAO area 51. The fishing zone of the Spanish vessels in subsequent years was approximately the same, although it did not generally include the Northern hemisphere. The two experimental surveys developed from November 1999 to February 2000, have prospected new areas of the Indian ocean, southern of 5°S and eastern of 60°E to 75°E (Fig. 1). These vessels ranged from 150 to 345 GRT, 30 - 45 metres in length and with a power of 755 HP as average. All species caught are dressed on board.

Table 1 presents a summary of the number of Spanish surface longline vessels per year which have generally fished temporarily in FAO Area 51 of the Indian Ocean from 1993 until 1999, the annual catch levels in number and round weight (kg) (Fig. 2), nominal effort exerted (in thousands of hooks), number of fishes sampled, sizes and/or individual weight, estimation of mean round weight and sampling coverage in percentage. The mean swordfish catch for this period was around 699 Tm/year, with a mean effort of 1760 thousand hooks per year. The mean number of swordfish sampled was 4938 fishes/year. The mean sampling coverage of catch sizes was 65 % for this period.

YEAR	SHIPS	CATCH#	CATCH (Kg)	Hook*1000	N.sampled	Av.weight	% sampl.
1993	3	5457	206814	350	4440	37.9	81.4
1994	5	18648	693948	1535	14819	37.2	79.5
1995	1	306	18482	30	306	60.4	100
1996	1	466	29226	72	466	62.7	100
1997	2	no inf.	507802	no inf.	no inf.	no inf.	no inf.
1998	8	31591	1424629	2765	5502	45.1	17.42
1999	9	42075	2012982	5807	4094	47.8	9.73

Table1. Number of vessels, catch in number of individuals, catch in round weight, nominal effort (thousands of hooks), number of individuals sampled, mean weight and sample ratio for the 1993-99 period.

The data compiled to date (Table 2) have enabled us to conduct a preliminary analysis of the overall nominal CPUE per year in number of swordfish individuals and in kg of round weight (Fig. 3). The yields obtained over the course of the 1993-1999 period fluctuate between 346 and 616 kg of round weight per one thousand hooks with a mean yield of 487.7 kg/1000 hooks and their 90% confidence intervals range from 376.7 to 598.6 (no processed information is available on the 1997 effort).

YEAR	CPUE#	CPUEw
1993	15.59	591
1994	12.15	452
1995	10.20	616
1996	6.47	406
1997	no inf.	no inf.
1998	11.43	515
1999	7.25	346

Table 2. Yield in number of individuals and kg of round weight of the swordfish from 1993 to 1999.

The size range sampled from the fishery prospecting period (1993-94) included from 50 cm to 340 cm LJFL. The size distribution for this period (Fig. 4) would appear to imply a bi-modal distribution owing to the difference in the sizes of the specimens caught in the different prospecting zones. This difference may be related to the different mean surface temperature in each zone surveyed, which would cause a drop in the size of the specimens caught as the SST increases.

In 1998 and 1999 the sizes ranged between 75 cm and 280 cm LJFL (Fig. 5 and Fig. 6). The 1998 and 1999 data on catch, effort, overall CPUEs and catch per size class are shown in table 3 and table 4, and they have been processed in a 5x5 degree/month format (Table 5 and Table 6).

MONTH	03	04	05	06	07	08	09	10	11	12	TOTAL
HOOKS*1000	97.18	118.14	274.85	122.59	998.11	206.92	199.17	140.67	538.93	68.12	2764.68
LAND Kg(RW)	34195	45573	107456	32834	506798	129498	141351	118587	272338	35998	1424628
LAND # fish	751	946	2056	622	11986	2679	3024	2257	6543	727	31591
# SAMPLED	391	502	1069	322	1103	517	416	782	148	252	5502
Aver. Weight	45.5	48.2	52.3	52.8	42.3	48.3	46.7	52.5	41.6	49.5	45.1
CPUEn	7.73	8.01	7.48	5.07	12.01	12.95	15.18	16.05	12.14	10.67	11.43
CPUEw	351.9	385.8	391.0	267.8	507.8	625.8	709.7	843.0	505.3	528.4	515.3
% SAMPLED	52	53	52	52	9	19	14	35	2	35	17
LJFL	03	04	05	06	07	08	09	10	11	12	TOTAL
T050	0	0	0	0	0	0	0	0	0	0	0
T055	0	0	0	0	0	0	0	0	0	0	0
T060	0	0	0	0	0	0	0	0	0	0	0
T065	0	0	0	0	0	0	0	0	0	0	0
T070	0	0	0	0	0	0	0	0	0	0	0
T075	0	2	0	0	0	0	0	0	0	0	2
T080	0	0	2	0	10	0	0	0	0	0	12
T085	4	10	4	0	87	12	15	0	43	0	175
T090	10	4	2	0	220	50	53	0	106	0	445
T095	25	8	16	0	446	123	131	128	270	77	1224
T100	19	25	22	0	347	65	80	0	202	0	760
T105	27	31	35	4	438	73	122	300	309	95	1434
T110	35	25	41	4	403	67	99	105	259	14	1052
T115	48	33	77	14	598	96	130	12	351	6	1365
T120	45	74	68	12	783	168	159	0	372	0	1681
T125	50	51	72	8	889	169	184	0	489	0	1912
T130	45	48	166	60	690	134	148	122	365	52	1830
T135	33	63	122	65	567	125	130	60	297	37	1499
T140	57	68	149	43	883	167	201	130	488	37	2223
T145	31	45	101	38	568	110	126	87	312	35	1453
T150	35	57	102	33	734	141	171	134	395	31	1833
T155	33	26	98	41	504	98	122	76	280	17	1295
T160	29	45	122	49	446	94	96	118	231	25	1255
T165	22	45	140	51	299	73	78	167	143	23	1041
T170	31	57	118	31	574	125	160	141	285	35	1557
T175	20	33	117	37	338	118	87	153	166	29	1098
T180	43	27	87	27	624	175	196	95	359	46	1679
T185	21	47	107	21	379	99	116	76	200	41	1107
T190	22	33	66	20	203	68	78	77	100	46	713
T195	23	25	64	17	409	96	136	52	229	14	1065
T200	14	14	84	25	148	53	72	58	70	14	552
T205	12	23	22	15	174	70	46	35	97	15	509
T210	2	12	20	4	27	39	29	23	17	17	190
T215	2	4	12	0	49	22	13	31	27	6	166
T220	8	8	12	2	87	22	27	17	47	6	236
T225	0	8	4	0	12	8	6	12	6	4	60
T230	0	0	6	0	2	0	6	14	0	4	32
T235	2	0	0	0	4	2	2	17	0	0	27
T240	2	0	4	0	4	4	2	6	0	0	22
T245	0	2	0	2	2	2	2	2	0	0	12
T250	2	0	0	0	35	10	7	6	21	0	81
T255	0	0	0	0	0	0	0	2	0	0	2
T260	0	0	0	0	0	0	0	0	4	0	4
T265	0	0	0	0	0	0	0	0	4	0	4
T270	4	0	0	0	2	0	0	0	0	0	6
T275	0	0	0	0	0	0	0	0	0	0	0
T280	0	0	0	0	0	0	0	2	0	0	2
T285	0	0	0	0	0	0	0	0	0	0	0
T290	0	0	0	0	0	0	0	0	0	0	0
T295	0	0	0	0	0	0	0	0	0	0	0
T300	0	0	0	0	0	0	0	0	0	0	0
T305	0	0	0	0	0	0	0	0	0	0	0
T310	0	0	0	0	0	0	0	0	0	0	0
T315	0	0	0	0	0	0	0	0	0	0	0
T320	0	0	0	0	0	0	0	0	0	0	0
T325	0	0	0	0	0	0	0	0	0	0	0
T330	0	0	0	0	0	0	0	0	0	0	0
T335	0	0	0	0	0	0	0	0	0	0	0
T340	0	0	0	0	0	0	0	0	0	0	0
T345	0	0	0	0	0	0	0	0	0	0	0
T350	0	0	0	0	0	0	0	0	0	0	0
TOTAL	756	953	2062	623	11985	2678	3030	2258	6544	726	31615

Table 3. Monthly summary of the activity of the Spanish longline fleet (EU) in the Indian Ocean in 1998.

MONTH	03	04	05	06	07	08	10	11	12	TOTAL
HOOKS*1000	14.92	1201.27	506.55	345.00	376.80	1435.13	362.15	934.33	631.03	5807.18
LAND Kg(RW)	5213	218702	158629	141817	123518	468740	130180	366784	399399	2012982
LAND # fish	80	4918	2688	2499	2181	8520	3981	9552	7656	42075
# SAMPLED	70	147	131	520	106	0	1176	825	1119	4094
Aver.Weight	65.2	44.5	59.0	56.7	56.6	55.0	32.7	38.4	52.2	47.8
CPUEn	5.36	4.09	5.31	7.24	5.79	5.94	10.99	10.22	12.13	7.25
CPUEw	349.3	182.1	313.2	411.1	327.8	326.6	359.5	392.6	632.9	346.6
% SAMPLED	88	3	5	21	5	0	30	9	15	10
LJFL	03	04	05	06	07	08	10	11	12	TOTAL
T050	0	0	0	0	0	0	0	0	0	0
T055	0	0	0	0	0	0	0	0	0	0
T060	0	0	0	0	0	0	0	0	0	0
T065	0	0	0	0	0	0	0	0	0	0
T070	0	0	0	0	0	0	3	0	0	3
T075	0	0	0	0	0	0	10	36	0	46
T080	0	0	0	0	0	0	30	39	0	69
T085	0	0	0	0	0	0	146	409	8	563
T090	0	0	0	0	0	0	166	340	8	514
T095	0	0	0	0	0	0	210	324	31	565
T100	0	0	0	0	0	0	322	632	33	987
T105	0	0	0	0	0	0	196	304	79	579
T110	0	0	0	0	0	0	119	242	116	477
T115	0	0	0	1	0	0	197	450	143	791
T120	3	470	230	237	251	1002	225	619	161	3198
T125	2	171	89	75	34	125	261	559	241	1557
T130	8	299	150	156	225	877	287	694	235	2931
T135	2	107	57	51	31	125	274	472	323	1442
T140	8	364	180	176	221	877	274	386	490	2976
T145	1	321	155	149	31	125	228	556	398	1964
T150	9	449	223	230	96	376	164	460	549	2556
T155	0	64	36	35	31	125	156	333	440	1220
T160	3	577	312	284	159	626	143	507	456	3067
T165	2	150	82	70	156	626	69	303	492	1950
T170	10	278	167	157	129	501	109	336	455	2142
T175	0	150	82	72	0	0	75	211	490	1080
T180	9	406	217	213	159	626	73	190	423	2316
T185	0	128	80	64	35	125	78	357	402	1269
T190	6	299	184	164	295	1128	30	121	273	2500
T195	2	107	68	51	0	0	37	158	330	753
T200	3	235	147	121	222	877	34	238	241	2118
T205	1	64	47	30	31	125	12	89	263	662
T210	3	150	93	83	40	125	23	66	163	746
T215	1	21	21	10	0	0	10	75	145	283
T220	0	43	34	32	1	0	6	15	73	204
T225	0	21	16	10	0	0	3	18	65	133
T230	1	21	10	11	0	0	3	3	31	80
T235	0	0	0	1	0	0	0	3	10	14
T240	0	0	0	3	0	0	3	3	31	40
T245	0	0	0	1	0	0	0	9	39	49
T250	1	21	10	9	0	0	3	3	2	49
T255	0	0	0	0	31	125	0	0	0	156
T260	0	0	0	0	0	0	0	3	0	3
T265	0	0	0	0	0	0	0	0	8	8
T270	0	0	0	0	0	0	0	0	0	0
T275	0	0	0	0	0	0	0	0	0	0
T280	1	0	0	0	0	0	0	0	0	1
T285	0	0	0	0	0	0	0	0	0	0
T290	0	0	0	0	0	0	0	0	0	0
T295	0	0	0	0	0	0	0	0	0	0
T300	0	0	0	0	0	0	0	0	0	0
T305	0	0	0	0	0	0	0	0	0	0
T310	0	0	0	0	0	0	0	0	0	0
T315	0	0	0	0	0	0	0	0	0	0
T320	0	0	0	0	0	0	0	0	0	0
T325	0	0	0	0	0	0	0	0	0	0
T330	0	0	0	0	0	0	0	0	0	0
T335	0	0	0	0	0	0	0	0	0	0
T340	0	0	0	0	0	0	0	0	0	0
T345	0	0	0	0	0	0	0	0	0	0
T350	0	0	0	0	0	0	0	0	0	0
TOTAL	76	4916	2690	2496	2178	8516	3979	9563	7647	42061

Table 4. Monthly summary of the activity of the Spanish longline fleet (EU) in the Indian Ocean in 1999.

The nominal overall CPUE was 11.43 and 7.25 fishes or 515.3 and 346.6 kg per thousand hooks in number and round weight in 1998 and in 1999 respectively. The mean weight for all of 1998 was 45.1 kg and for 1999 was 47.8 kg round weight and with a total effort of 2.76 and 5.80 million hooks in 1998 and 1999, respectively. The greatest yields (CPUEs) were obtained in the months from September to December (567.3 as a mean) (Fig. 7 and Fig. 8).

The total number of fishes (all species) tagged was 295 where 122 were swordfish but any swordfish has been recaptured yet. However, some recaptures of others species have been reported.

The by-catch species associated with the swordfish catch for the above period are shown in table 7.

ACANTHOCYBIUM SP.
ALEPISAURUS FEROX
ALOPIAS PELAGICUS
ALOPIAS SUPERCILIOSUS
BRAMA BRAMA
CARCHARHINUS FALCIFORMIS
CARCHARHINUS LONGIMANUS
CARCHARHINUS PLUMBEUS
CORIPHAENA HIPURUS
DASIATYS VIOLACEA
GALEOCERDO CUVIER
GEMPILUS SERPENS
ISTIOPHORUS PLATYPTERUS
ISURUS OXYRINCHUS
ISURUS PAUCUS
KATSUWOMUS PELAMIS
LAMNA NASUS
LEPIDOCIBIUM FLAVOBRUNNEUM
MAKAIRA INDICA
MAKAIRA MAZARA
MOBULA MOBULA
MOLA MOLA
PRIONACE GLAUCA
PSEUDOCARCHARIAS KAMOHARAI
RUBETUS PRETIOSUS
SPHYRAENA BARRACUDA
SPHYRNA LEWINI
SPHYRNA ZYGAENA
TETRAPTURUS ALBIDUS
TETRAPTURUS AUDAX
TETRAPTURUS PLUEGERIS
THUNNUS ALALUNGA
THUNNUS ALBACARES
THUNNUS OBESUS

Table 7. List of by-catch species caught accidentally by the Spanish surface longline fishery targeting the swordfish in the Indian Ocean.

FUTURE planning.

-It is going to continue the Information and Sampling Network of the Spanish Institute of Oceanography (RIM) to obtain information about catches, effort and size distribution by 5x5 degrees squares overcoming the difficulties to contact with skippers and to get on time the log book filled out voluntarily by the fleet as well as the continuous change of landings ports.

-We will try to recover basic data (task II) previously to 1998.

-It will be analysed the sex-ratio data by size and its relationship with reproduction behaviour.

-It will be continued the opportunistic tagging stimulating the tagging by commercial fleet and scientific observers on board.

-We have the intention to increase the developing of surveys with scientific observers on board to get biological information, by-catch, samples, oceanographic parameters...if the funds from the Project are enough.

-It will be taken tissues samples for genetic analyses (studies about stock structure).

ACKNOWLEDGMENTS.

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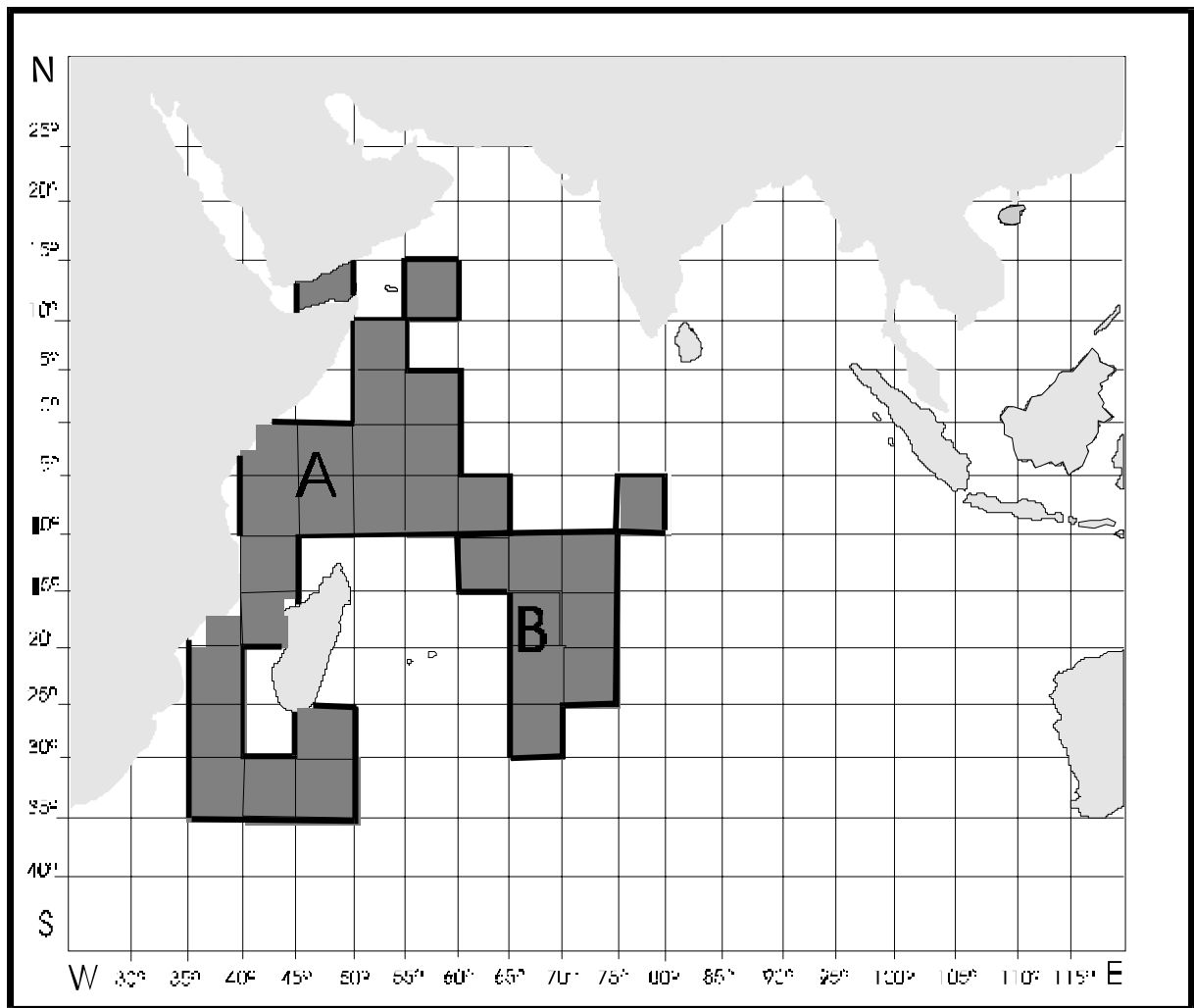


Fig. 1. Areas covered by the Spanish longline boats during the prospecting survey developed in years 1993-1994 (A) and in year 1999 (B).

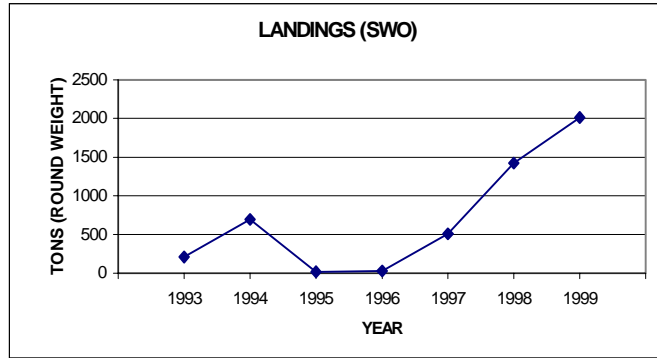


Fig. 2. Landings (tons of round weight) of swordfish caught by the surface longline Spanish fleet in the Indian Ocean, during the period 1993-99.

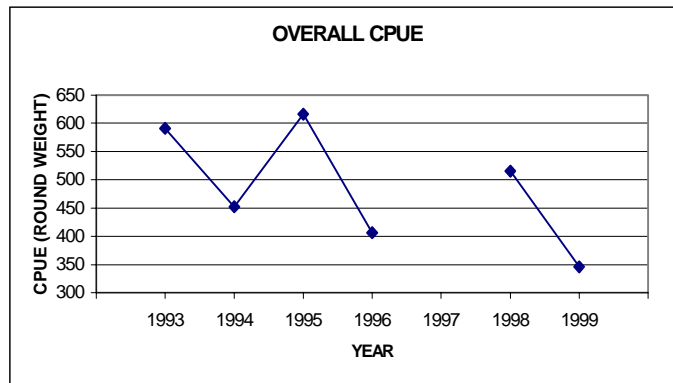


Fig. 3. Overall nominal CPUE per year (kg round weight) caught by the Spanish fleet in the Indian Ocean, during the period 1993-99. Data of 1997 is not available.

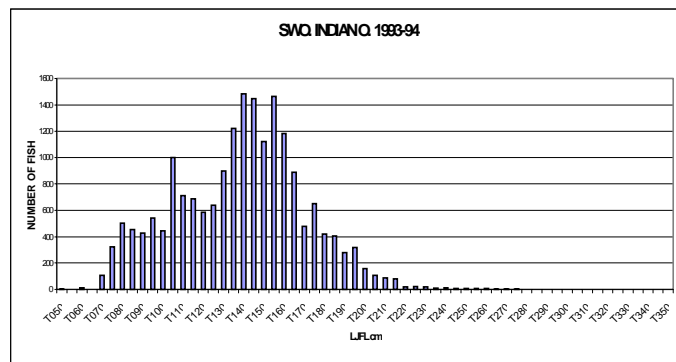


Fig. 4. Length distribution of swordfish caught during the fish prospecting survey during the period 1993-94.

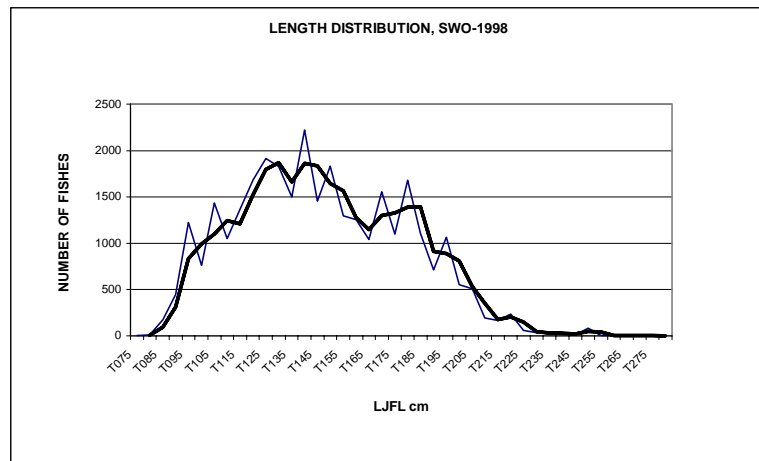
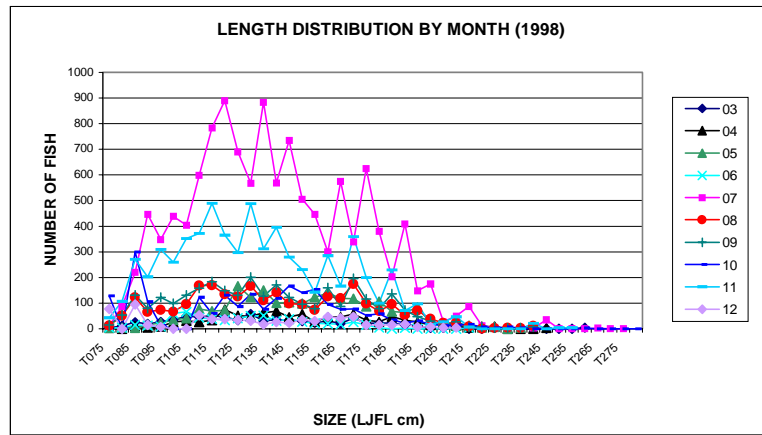


Fig. 5. Size distribution of the swordfish caught by the Spanish surface longline, during 1998, by month and annual.

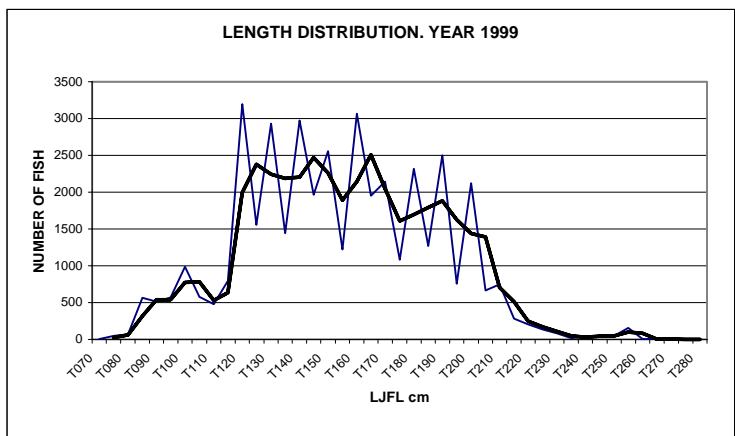
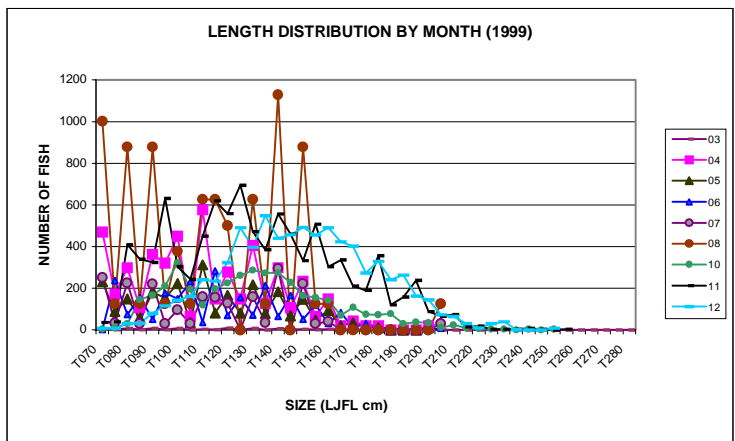


Fig. 6. Size distribution of the swordfish caught by the Spanish surface longline, during 1999, by month and annual.

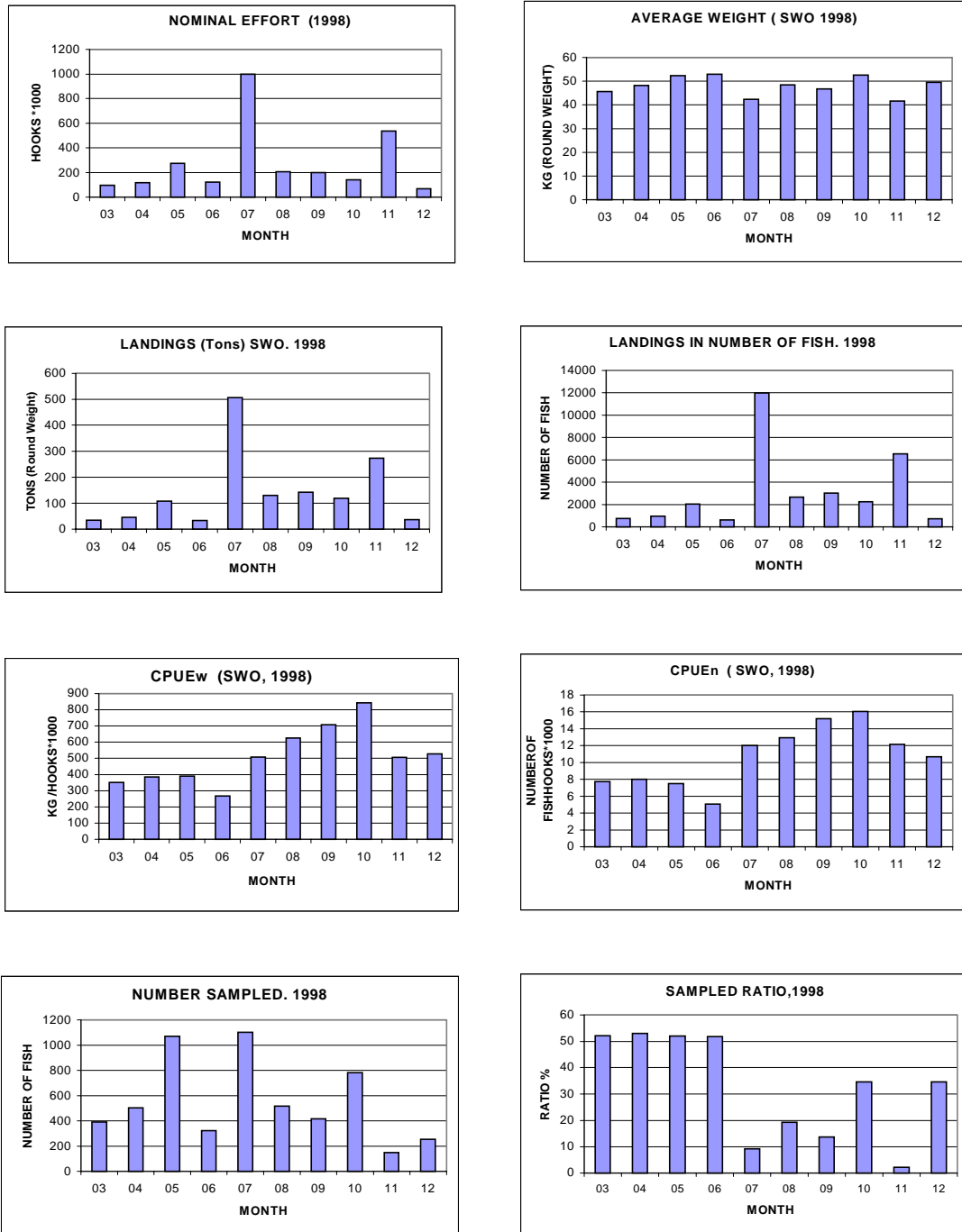


Fig. 7. Nominal effort (in thousands of hooks), mean round weight of swordfish (kg), landings in tons ,landings in number of fish, CPUE in weight, CPUE in number of fish, number of fish sampled and coverage ratio obtained by the Spanish surface longline fleet in the Indian Ocean in 1998.

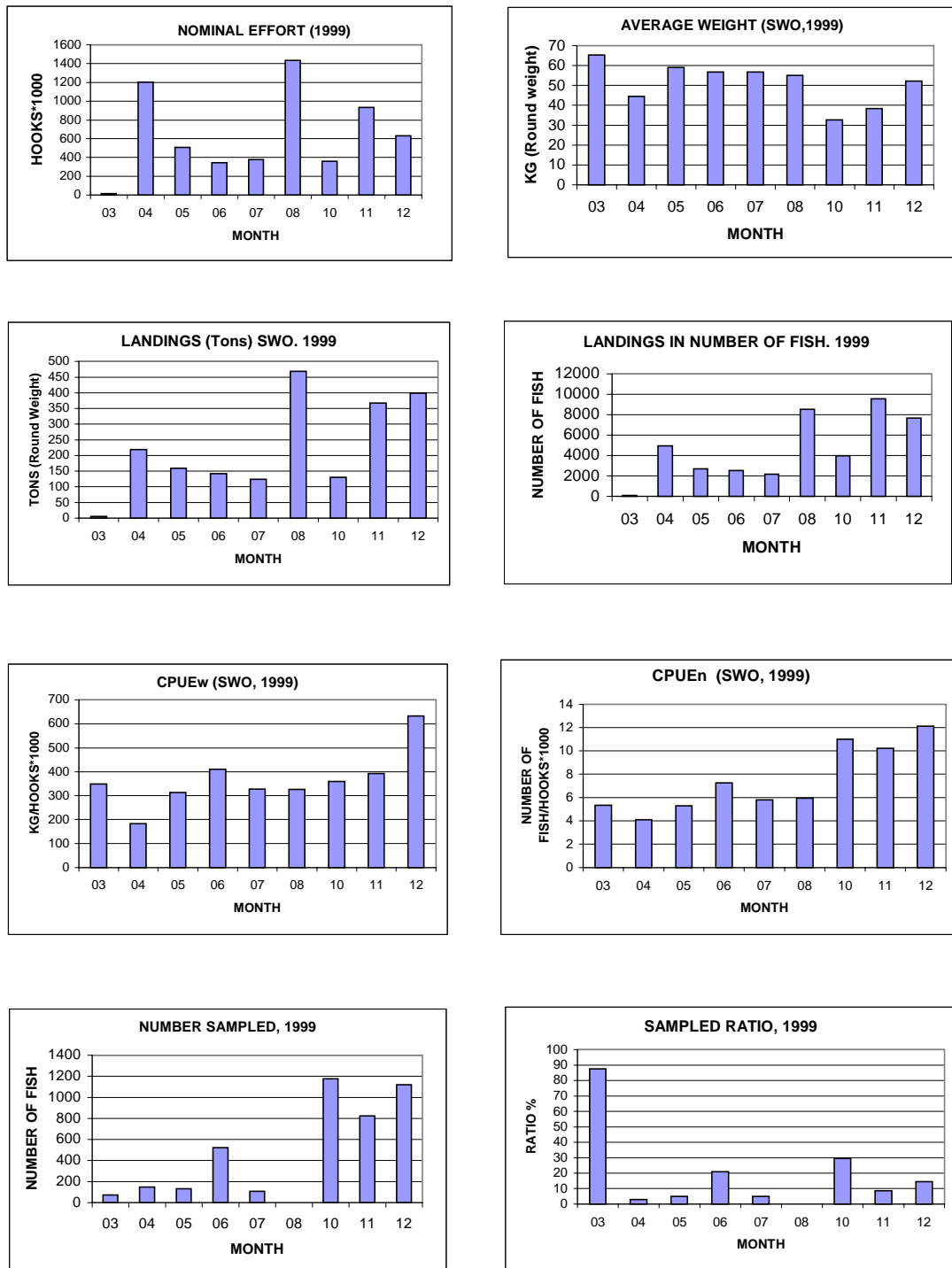


Fig. 8. Nominal effort (in thousands of hooks), mean round weight of swordfish (kg), landings in tons, landings in number of fish, CPUE in weight, CPUE in number of fish, number of fish sampled and coverage ratio obtained by the Spanish surface longline fleet in the Indian Ocean in 1999.