UPDATED FISHERY STATISTICS FOR BIGEYE, SKIPJACK AND ALBACORE TUNAS FROM MADEIRA ARCHIPELAGO

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SUMMARY

Tunas constitute an important seasonal fishery in the region of Madeira. Bigeye and skipjack are usually the most abundant species in the area, with albacore reaching record landings in 2014. This document updates the tuna statistics of Madeira archipelago between 1999 and 2015, including the total catch by species, the baitboat fleet composition and the catch size frequencies for the main tuna species (BET, SKJ and ALB). Fishing grounds used in recent years (2010-2015) are also presented.

RÉSUMÉ

La pêche thonière est une pêcherie saisonnière importante dans la région de Madère. Le thon obèse et le listao sont généralement les espèces les plus abondantes dans la région, et les débarquements de germon ont atteint un niveau jamais observé auparavant en 2014. Le présent document fournit une actualisation des statistiques thonières de l'archipel de Madère entre 1999 et 2015, y compris la capture totale par espèce, la composition de la flottille de canneurs et les fréquences de taille au moment de la capture des principales espèces de thonidés (BET, SKJ et ALB). Les zones de pêche fréquentées ces dernières années (2010-2015) sont également présentées.

RESUMEN

Los túnidos constituyen una importante pesquería estacional en la región de Madeira. El patudo y rabil suelen ser la especie más abundante en la zona, y el atún blanco alcanzó un récord de desembarques en 2014. En este documento se proporciona una actualización de las estadísticas de túnidos del archipiélago de Madeira entre 1999 y 2015, incluida la captura total por especies, la composición de la flota de cebo vivo y las frecuencias de tallas de la captura para las principales especies de túnidos (BET, SKJ y ALB). También se presentan los caladeros utilizados en años recientes (2010-2015).

KEYWORDS

Fishery statistics, Size frequency,
Fishing grounds, Madeira, Bigeye tuna, Skipjack, Albacore

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1. Introduction

Tunas are an important seasonal fisheries resource in Madeira, often comprising around half of total landings in recent years (2010-2015). The value of sales at auction reached about 43.4% of total trade in the same period. The most abundant species are usually bigeye tuna (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*) (Gouveia *et al.*, 2001). Albacore (*Thunnus alalunga*) is also fished in variable amounts, while other species such as bluefin (*Thunnus thynnus*) and yellowfin (*Thunnus albacares*) are poorly represented in the region. The main fishing method used in the region is the pole and line, with live bait (Gouveia et al., 2001). In recent years, after detection of the school, the fishing boats are then used as fish aggregating devices (locally called "mancha").

Catches of the different tuna species are dependent on their seasonal abundance in this region. Tunas are highly migratory pelagic fishes, whose seasonal geographic distribution may be conditioned by both environmental and biological variables (Gouveia *et al*, 2001). For example, sea surface temperature and currents, as well as climate patterns such as the North Atlantic Oscillation, may be partly responsible for the variability in tuna abundance (Amorim et al., unpublished results; Gouveia and Mejuto 2003). Prey abundance and the location of ocean fronts, which are used by tunas as foraging grounds, can also condition the distribution of these pelagic predators (Schick and Lutcavage 2009; Woodson and Litvin 2015).

In this study, we present updated statistics on tuna catches in Madeira archipelago for the three main tuna species, with particular emphasis on the unusually high landings of albacore in 2014.

2. Data

The fisheries data used in this analysis come from the activity of the bait boat fleet operating around the archipelago fishing grounds, comprising tuna vessels registered in Azores and Madeira islands. Data on tuna landings were collected in the main fishing ports for the period between 1999 and 2015. The catch data of the three most representative species in the fishery - bigeye tuna (BET), skipjack (SKJ) and albacore (ALB) - were considered in these analyses.

Size composition of fish is based on statistical sampling program of specimens landed daily in the main fishing ports of the island (2010-2015). In this period a total of 23.581 bigeye tuna individuals, 12.753 skipjack and 6.506 albacore were sampled.

Information on the tuna fleet composition (GT and number of vessels) was extracted from the national fleet register database for 2010-2015 period.

The spacial locations of the tuna fishing grounds were considered globally for the years 2010-2015, obtained from the fishing logbooks and processed using QGIS 2.2 software.

Environmental data (sea surface temperatures) were extracted from the meteorological records of Observatório Meteorológico do Funchal, for the period 1960 to 2015.

3. Results

Landings of the main tuna species in Madeira exhibit fluctuations, but have remained relatively stable overall (around an average of 2,400 t), showing a slight increasing tendency since 1999 (**Table 1, Figure 1**). Albacore landings are the most variable, with peak landings of 2,263 t in 2014. The previous highest landing of this species was obtained in 2002, with 1,479 t.

The regional tuna fishing fleet composition, classified by gross tonnage, is presented in **Table 2**. In recent years, tuna fishing in the region has concentrated in the areas around Madeira and Porto Santo islands. In addition, important fleet displacements of the Madeiran and Azorean fleets are observed each year between the two Portuguese archipelagos (**Figure 2**). The relative weight of each fleet in the landings of the main tuna species in Madeira fishing ports is presented in **Figure 3**, where dominance in the amount of catches made by the Azorean fleet can be observed, reflecting its higher capacity.

The three main tuna species present a marked seasonal pattern in the region (**Figure 4**). For the period under analysis, bigeye was mainly caught in the spring months, whereas skipjack usually presented a peak in late summer and autumn. Despite high inter-annual variability, albacore landings followed the same seasonal pattern as bigeye in the last two years, with unusually high landings observed in June 2014 (1,303 ton) and in May 2015 (523 ton).

Length composition of the three main tuna species was estimated for the total landings for the years 2010-2015 (**Tables 3a, 3b, 3c**). The annual size distribution of Bigeye tuna varies considerably between years, probably due to the availability and abundance of the species to the annual catch and success of the fishery, as was verified in previous studies (Gouveia et al, 2001). However, this species shows a more restricted range of lengths in 2012, but otherwise no particular trend is observed in the length composition in the considered period (**Figure 5a**). Skipjack length composition seems to have a normal distribution, with no major differences between years, ranging between 40 and 65 cm FL (**Figure 5b**). For albacore, the length composition seems to have converged on a more normal distribution since 2013, varying between 70 and 90 cm FL; this may reflect the higher landings observed in this period (**Figure 5c**).

Environmental data presented in form of annual average of sea surface temperature anomalies (SSTa) was based on the period January 1960 – December 2015, from daily temperature registers of sea surface temperature (**Figure 6**). Despite the observed variability, there is a clear warming trend since 1995. In recent years, a positive SST anomaly of +0.9ºC was observed in 2012.

4. Conclusions

In recent years, tuna catches in Madeira archipelago have remained relatively stable. However, in 2014, exceptionally high landings of albacore were registered. A thorough analysis of environmental variables is under way, but a preliminary observation suggests that 2014 was unremarkable in terms of environmental conditions such as SST, SSH, ocean currents and chlorophyll *a*. As such, no clear explanation for the peak in albacore landings is immediately apparent, but it is possible that a combination of ecological and biological factors may be responsible. Both local environmental features and large-scale climate patterns such as the North Atlantic Oscillation (Báez *et al.* 2011) may affect albacore abundance and age-class strength, which is reflected in regional landings.

The warming trend observed in sea surface temperature anomalies is consistent with previous results (Gouveia *et al.* 2001) and is likely to reflect global climate changes, which may also influence tuna distribution and migratory patterns (Arrizabalaga *et al.* 2015), as well as availability to different fishing methods.

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Table 1. Landings of the main tuna species in Madeira, in tones, for period 1999-2015.

YEAR	BET	SKJ	ALB	OTH	TOTAL
1999	1107	345	78	44	1575
2000	384	262	14	32	692
2001	276	495	765	38	1574
2002	759	556	1479	25	2819
2003	883	587	333	17	1820
2004	1227	1595	104	23	2949
2005	977	1094	63	31	2164
2006	2082	1713	3	24	3822
2007	2321	504	25	16	2866
2008	1400	912	111	9	2431
2009	2405	104	9	7	2525
2010	1118	686	40	16	1860
2011	1020	299	13	36	1369
2012	1576	1537	21	22	3157
2013	1241	210	151	10	1612
2014	1667	962	2264	12	4905
2015	1773	117	864	7	2761

Table 2. Fishing tuna fleet composition by gross tonnage, 2010-2015.

		Madeiran Fleet		***Azorean Fleet***	
Year	*GT*	*Nr. Boats*	*Landings (t)*	*Nr. Boats*	*Landings (t)*
2010	<50	68	303	1	22
	[50-150]	5	89	10	876
	>150	3	462	3	93
2011	<50	62	410	1	22
	[50-150]	5	241	9	343
	>150	3	336	1	16
2012	<50	49	1043	2	59
	[50-150]	4	588	10	776
	>150	3	637	2	53
2013	<50	53	538	1	33
	[50-150]	4	205	13	514
	>150	3	278	3	43
2014	<50	46	630	4	149
	[50-150]	4	512	17	2628
	>150	3	652	3	333
2015	<50	60	364	3	67
	[50-150]	5	348	16	1490
	>150	3	246	3	225

Table 3a. Size composition of bigeye tuna landed in Madeira, 2010-2015.

FL(5-5cm)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
40	225	0	0	0	0	703
45	1985	26	43	24	0	634
50	3387	291	808	361	1026	2364
55	4900	1133	1822	758	2339	8089
60	5923	1920	3128	422	2524	11577
65	4180	1930	3091	443	1675	6167
70	8124	1931	6164	3313	2831	6156
75	8346	2124	12634	4264	4217	7085
80	3931	1561	22252	3764	4509	7531
85	1404	1591	13578	1467	2731	4748
90	2567	2003	11235	914	3543	4154
95	2337	2328	7352	1410	5456	5221
100	2125	2404	5648	2302	7855	6283
105	2388	2875	2531	2118	6181	3945
110	3133	3813	2334	2912	6319	4855
115	2429	2784	1227	2513	2878	3485
120	2086	2214	1211	1559	2921	3667
125	1495	1277	1017	840	2888	3188
130	1195	974	1654	833	2880	2691
135	503	674	625	619	1978	1344
140	519	564	346	891	1043	948
145	260	433	165	1131	506	387
150	214	555	77	1954	462	203
155	369	442	51	609	112	60
160	188	422	1	1037	71	79
165	314	325	1	605	100	156
170	282	370	7	606	43	160
175	47	68	5	302	41	2
180	49	26	38	94	13	56
185	1	0	36	63	0	26
190	1	10	0	0	52	0
195	0	0	0	0	56	0
200	0	0	0	0	0	0
205	0	0	0	0	0	0
210	0	0	0	0	0	0
215	0	0	0	0	0	0
220	0	0	0	0	0	0
Total Nr.	64.909	37.066	99.081	38.131	67.251	95.963
Total Landing (t)	1.105	1.019	1.576	1.241	1.667	1.752
Average weight (Kg)	17	28	16	33	25	18

Table 3b. Size composition of skipjack landed in Madeira, 2010-2015.

FL(2-2cm)	2010	2011	2012	2013	2014	2015
30	0	0	0	0	0	0
32	27	5	61	0	78	0
34	27	5	95	1	151	164
36	106	20	570	3	788	189
38	1451	39	1159	7	1702	728
40	9922	575	4581	28	5848	1815
42	18058	5369	14059	85	11692	8050
44	25441	11399	26832	302	14840	11525
46	39772	10215	49285	1980	33067	10659
48	38138	22189	84008	4235	48989	7235
50	27596	14294	80567	7148	47329	6519
52	24471	15253	75455	8814	39646	3257
54	18853	8877	75010	11176	33791	2096
56	13911	6030	54106	8798	27044	1385
58	8470	2917	32122	5181	19045	509
60	8321	1893	18060	3722	13825	160
62	4760	1995	7707	2263	10323	264
64	5299	1495	4151	1721	5666	32
66	2415	623	564	701	5173	85
68	2823	1308	551	814	1032	16
70	1146	1186	167	350	745	16
72	369	381	217	463	73	0
74	0	61	0	350	187	16
76	0	0	0	0	156	0
78	0	0	0	88	0	0
80	0	0	0	0	0	0
82	0	0	0	0	0	0
84	0	0	0	0	0	0
86	0	61	0	0	0	0
Total Nr.	251.376	106.187	529.324	58.231	321.190	54.720
Total Landings (t)	685	299	1537	209	962	117
Average Weight (Kg)	3	3	3	4	3	2

Table 3c. Size composition of albacore tuna landed in Madeira, 2010-2015.

FL(5-5cm)	2010	2011	2012	2013	2014	2015
40	0	0	0	0	0	0
45	0	0	0	0	0	0
50	0	0	41	6	426	45
55	10	5	62	97	778	409
60	132	79	103	15	2206	772
65	42	16	21	3	2407	2150
70	90	10	23	307	16585	14435
75	347	5	235	2042	60970	27752
80	682	101	403	5087	86509	21673
85	541	108	168	2370	26515	6985
90	135	59	47	532	4165	2096
95	109	50	49	350	890	702
100	157	78	84	451	303	735
105	138	67	70	156	741	666
110	192	95	136	137	68	171
115	37	22	24	17	2	217
120	6	7	0	0	1	183
125	6	0	0	0	0	92
130	0	0	0	0	0	0
135	0	0	0	0	0	0
140	0	0	0	0	0	1
145	0	0	0	0	0	0
Total Nr.	2.622	703	1.467	11.572	202.566	79.083
Total Landings (t)	40	13	21	151	2.264	864
Average Weight (Kg)	15	18	14	13	11	11

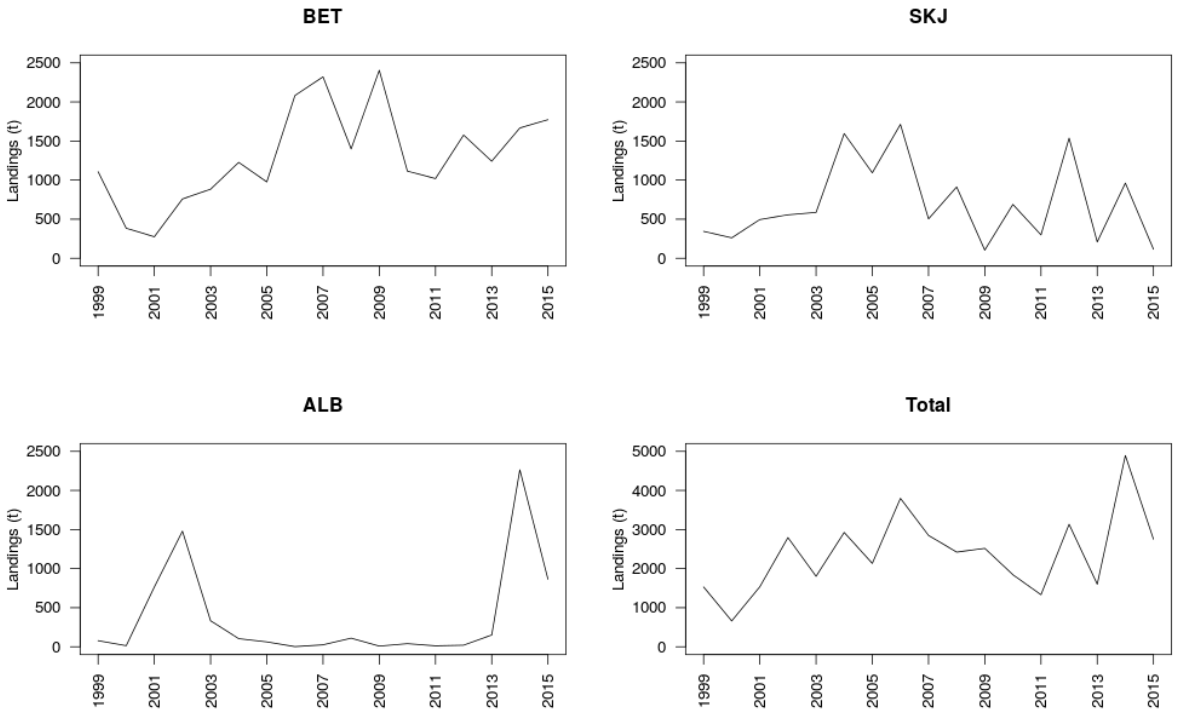

Figure 1. Landings of bigeye, skipjack, albacore, and the three tuna species in the Madeira EEZ, 1999-2015.

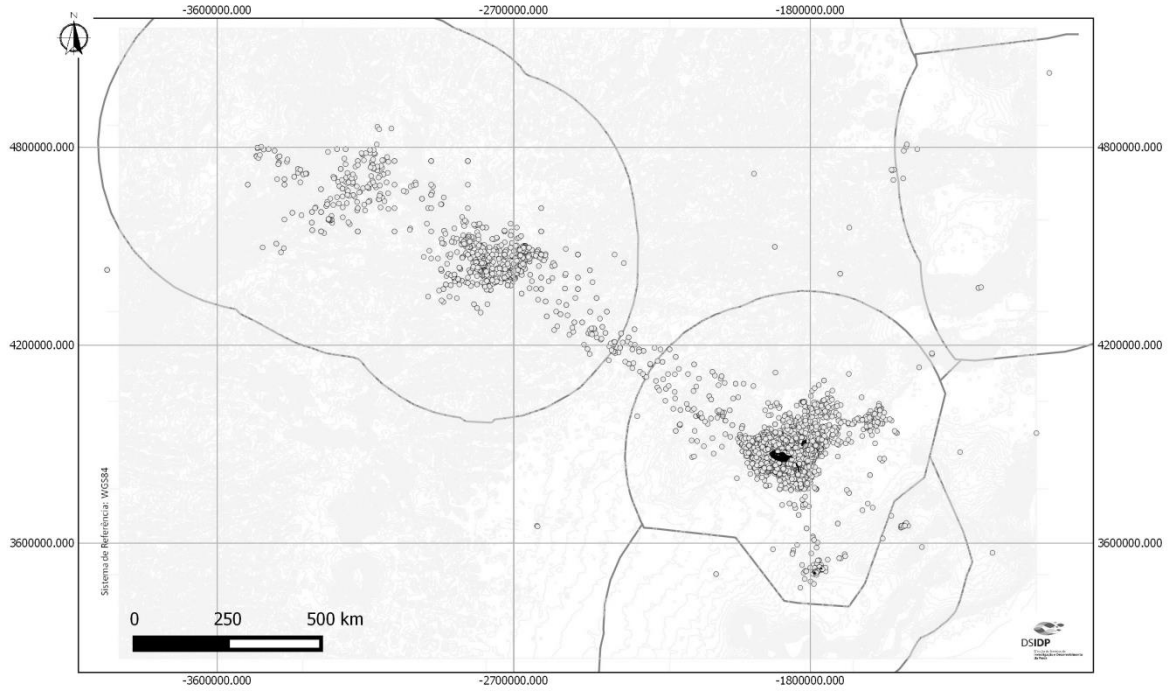

Figure 2. Tuna fishing grounds around Madeira and Azores islands used by the local fleet in the period 2010-2015.

Data source: Fishing logbooks.

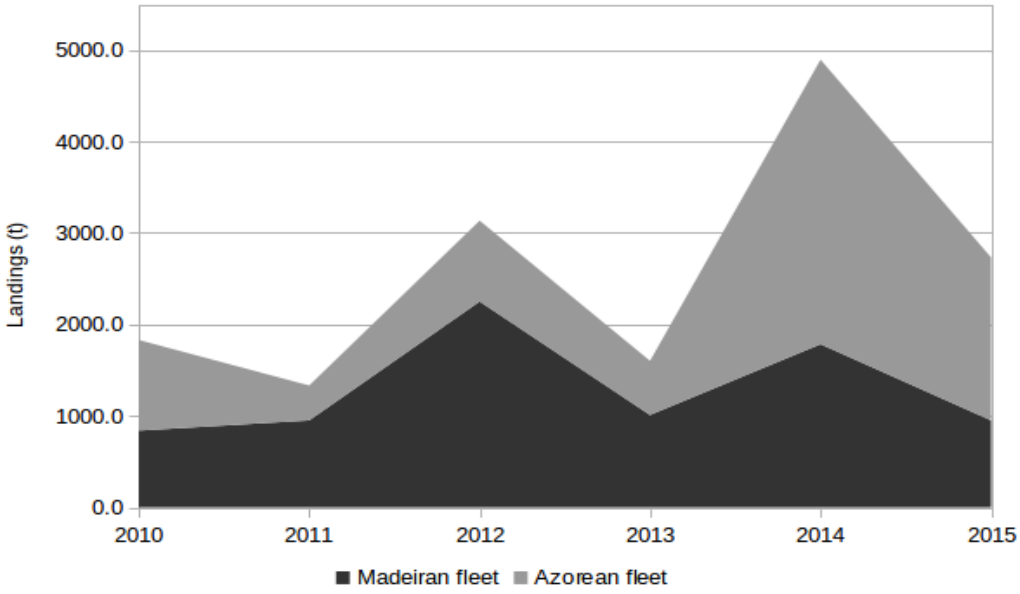

Figure 3. Landings of the major tuna species in Madeira, by fleet, 2010-2015.

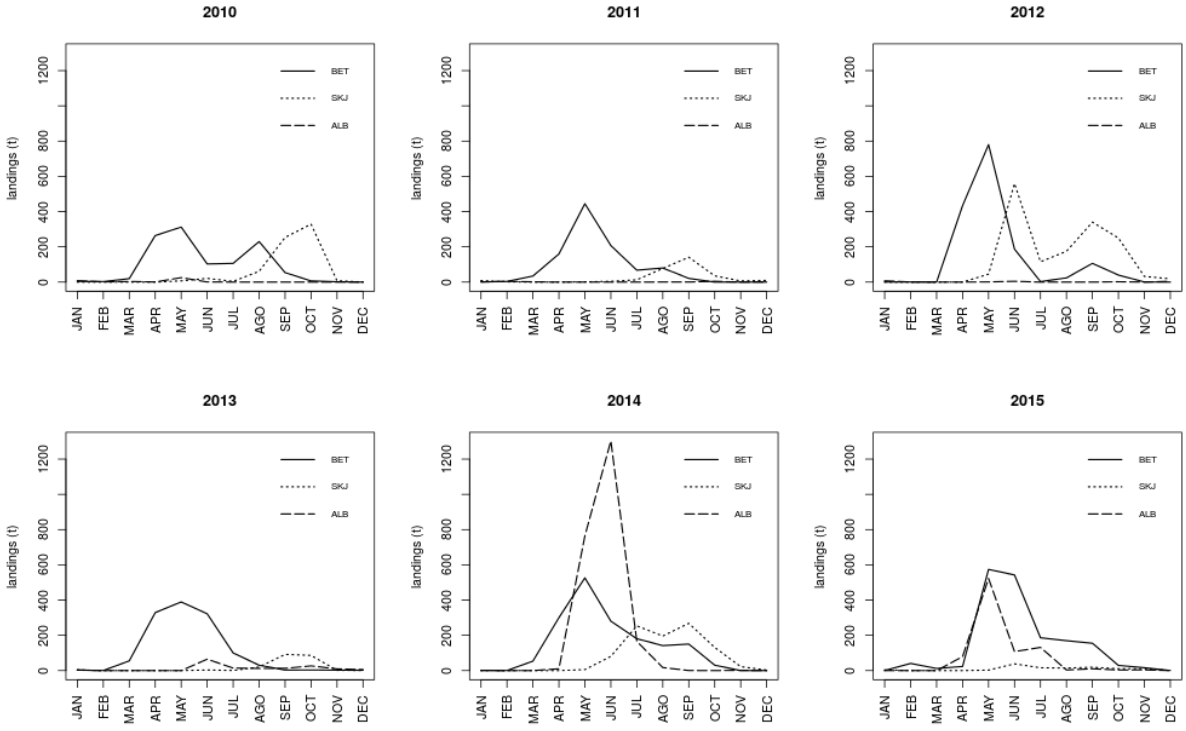

Figure 4. Landings seasonality for the main tuna species (BET, SKJ, ALB) in Madeira, 2010-2015.

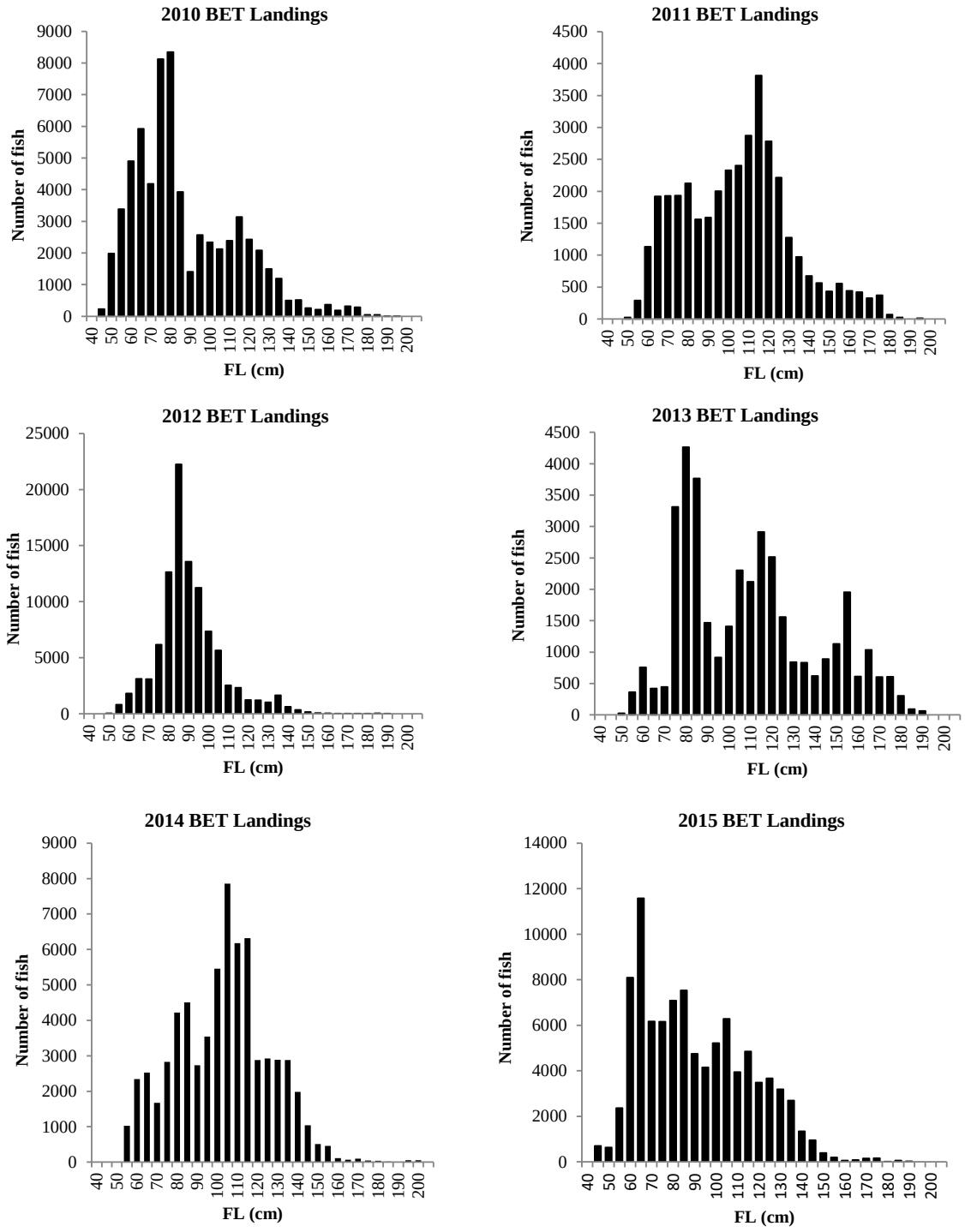

Figure 5a. Estimated length composition of bigeye tuna landed in Madeira, 2010-2015.

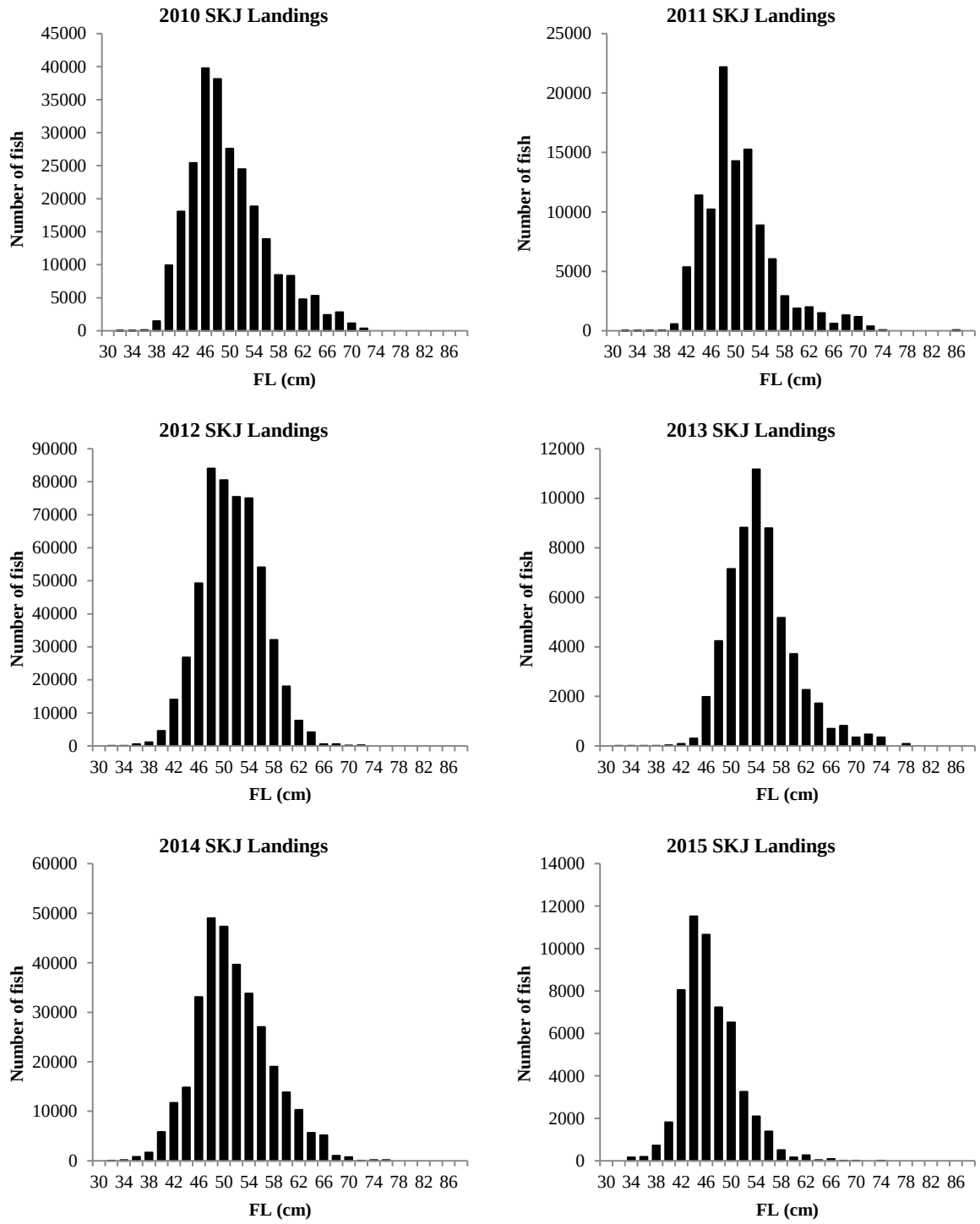

Figure 5b. Estimated length composition of skipjack landed in Madeira, 2010-2015.

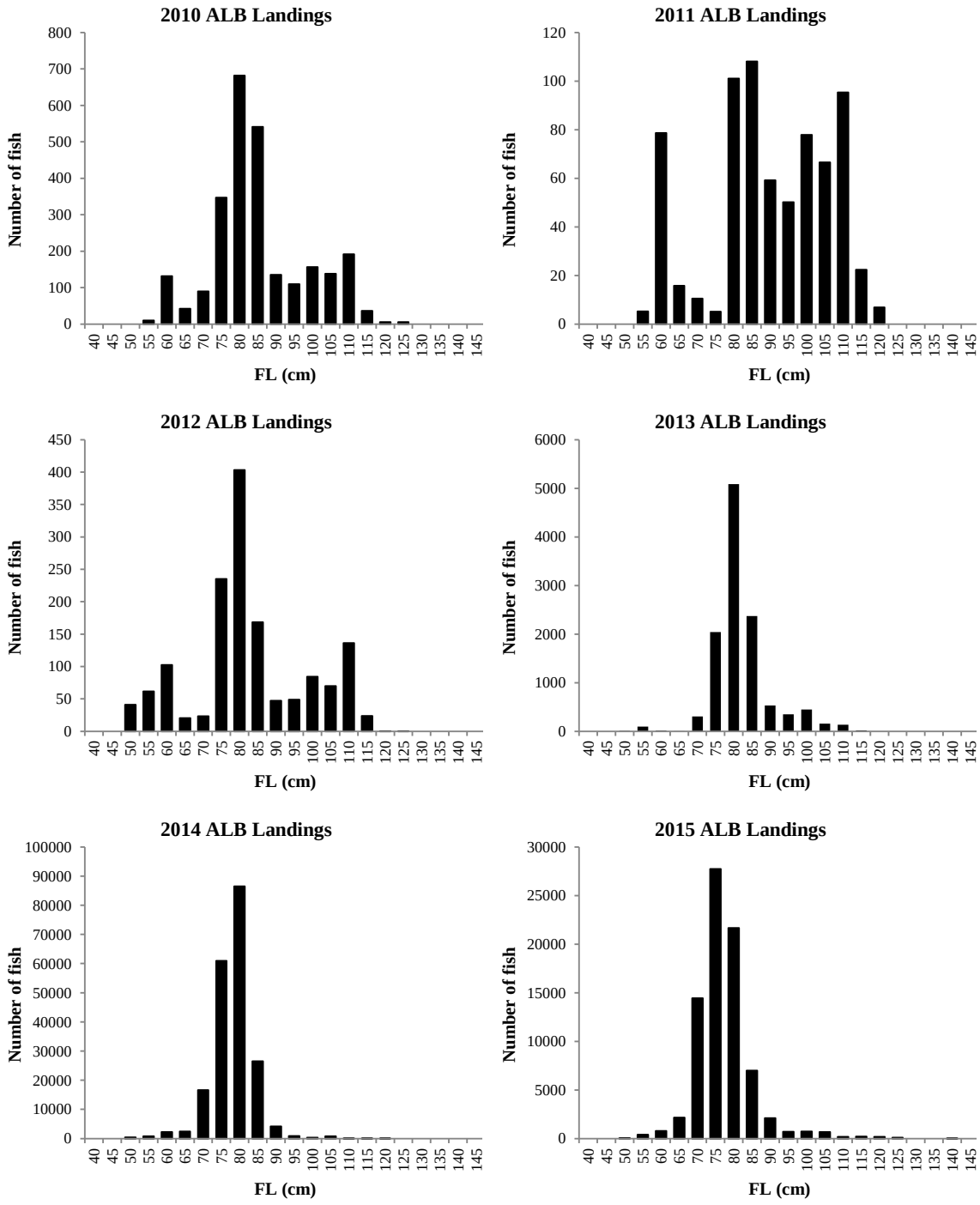

Figure 5c. Estimated length composition of albacore landed in Madeira, 2010-2015.

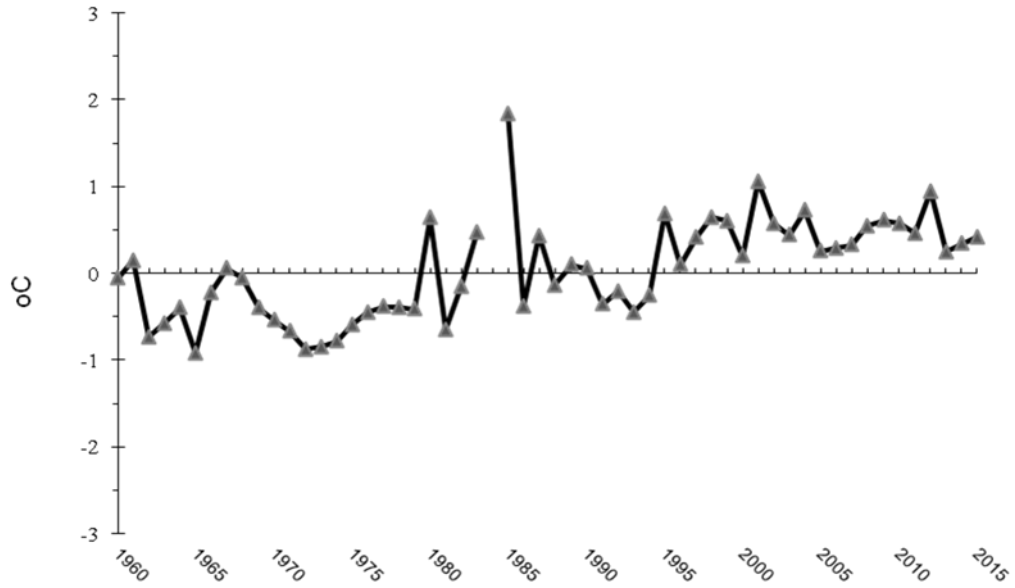

Figure 6. Annual average Sea Surface Temperature anomalies (degrees Celsius), Madeira, 1960-2015.
Data source: Meteorological records of Observatório Meteorológico do Funchal.
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