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Commercial catch sampling programme for highly migratory fish species in 2009–10, 2010–11, and 2011–12

New Zealand Fisheries Assessment Report 2014/10

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EXECUTIVE SUMMARY

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Historically, most biological data concerning Highly Migratory Species (HMS) were collected by observers at sea in the tuna longline fishery. Whilst observer coverage of the larger vessels of the charter fleet is high, this fleet participates almost exclusively in the southern bluefin tuna longline fishery operating off the west coast of the South Island. The southern bluefin longline fishery that operates off the east coast of the North Island, and the bigeye tuna fishery are mainly fished by smaller domestic vessels, and this fleet is not adequately observed. These more northerly fisheries also account for almost all of the associated bycatch of Pacific bluefin tuna, yellowfin tuna and swordfish.

The four Licensed Fish Receivers (LFRs) that participate in this programme are all based in the top half of the North Island and service the domestic longline fleet. They are, in most years, among the top five LFRs for the species of interest and in the three years, 2009–10 to 2011–12, handled almost the entire catch of bigeye tuna, and more than 80% of the annual catch of swordfish and yellowfin. They accounted for less of the catch of Pacific bluefin (but still more than 70% annually) and about half of the southern bluefin catch. The shortfall for southern bluefin tuna is accounted for by the charter fleet, and by some domestic vessels that fished off the west coast of the South Island and landed to South Island processors.

Swordfish and tunas caught by tuna longline vessels are processed at sea, preventing the measurement of length or determination of sex in port samples, but individual processed weights of a high proportion of the catch is kept by those fish processors that export, in a relatively whole state, these large and valuable fish. Processed weights can be converted to lengths to determine catch length composition for most species in the main processed states. This project therefore effectively augments the observer length frequency data with length estimates based on individual processed weights of fish landed by the domestic fleet.

Data for 13 173 individual fish were obtained in 2009–10; including 7600 swordfish, 2546 bigeye tuna, 2875 southern bluefin tuna, 73 Pacific bluefin tuna and 82 yellowfin tuna. Overall, 73% of reported catch (in number of fish, for the domestic longline fleet) of the five species of interest was sampled.

In 2010–11, data for 19 676 fish were obtained including 12 453 swordfish, 2801 bigeye tuna, 4245 southern bluefin tuna, 138 Pacific bluefin tuna and 39 yellowfin tuna. Overall, 85% of the reported catch **(**in number of fish for the domestic longline fleet**)** of the five species of interest was sampled.

In 2011–12, data for 18 788 fish were obtained including 10 475 swordfish, 2532 bigeye tuna, 5659 southern bluefin tuna, 101 Pacific bluefin tuna and 21 yellowfin tuna. Overall, 76% of the reported catch **(**in number of fish for the domestic longline fleet**)** of the five species of interest, by number of fish, was sampled.

The spatial and seasonal representativeness of the domestic longline fishery was examined and found to be adequate in each year.The increase in numbers of fish sampled is a result of increases in the TACC for southern bluefin tuna in 2009–10 and in 2011–12, and increases in the market share processed by the

participating processors. Improved coverage of the catch processed by each shed has been achieved as processors transition to electronic data capture and collation.

Objectives:

This study was contracted as MFish project TUN2009/02 with the specific objectives:

1. To continue the shore-based catch sampling programme for swordfish, southern bluefin tuna, bigeye tuna, Pacific bluefin tuna, and yellowfin for the 2009/10 fishing year.

2. To continue the shore-based catch sampling programme for swordfish, southern bluefin tuna, bigeye tuna, Pacific bluefin tuna, and yellowfin for the 2010/11 fishing year.

3. To continue the shore-based catch sampling programme for swordfish, southern bluefin tuna, bigeye tuna, Pacific bluefin tuna, and yellowfin for the 2011/12 fishing year.

Note: This project represents a continuation of work undertaken in TUN2005/02, TUN2006/01, and TUN2007/02. This project does not summarise the data for input into stock assessments; separate projects will be set up when necessary. While these projects are awarded by fishing year the data for swordfish, bigeye, Pacific bluefin and yellowfin lengths must also be collated by calendar year for inclusion in the annual data submission to WCPFC.

1. INTRODUCTION

Historically, most biological data concerning Highly Migratory Species (HMS) were collected by observers at sea in the tuna longline fishery. Whilst observer coverage of the larger vessels of the charter fleet is high, this fleet participates almost exclusively in the southern bluefin tuna longline fishery operating off the west coast of the South Island. The southern bluefin longline fishery that operates off the east coast of the North Island, and the bigeye tuna fishery are mainly fished by smaller domestic vessels, and this fleet is not adequately observed. These more northerly fisheries also account for almost all of the associated bycatch of Pacific bluefin tuna, yellowfin tuna and swordfish.

Swordfish and tunas caught by tuna longline vessels are processed at sea, preventing the measurement of length or determination of sex in port samples, but individual processed weights of a high proportion of the catch is kept by those fish processors that export, in a relatively whole state, these large and valuable fish. Processed weights can be converted to lengths to determine catch length composition for most species in the main processed states. This project therefore effectively augments the observer length frequency data with length estimates based on individual processed weights of fish landed by the domestic fleet.

A high coverage of the National domestic (EEZ) catch of the species of interest will permit scaling up of sampled LFs with adequate confidence i.e. without the need for bootstrapped confidence limits. To ensure that LFs are representative of the seasonal and spatial distribution of the fishery at least 60% coverage of the catch is required. Previous projects have suggested that this level of coverage is possible by sampling just four of the most important fish processors. Successful capture of these data requires the goodwill and cooperation of these processors, which in turn depends on minimum disruption to their procedures.

2. METHODS

There are several aspects to this project, the most important of which is obtaining records of individual processed fish weights from the main LFRs involved in the export, in a relatively whole state, of swordfish and large tunas. Fish for which individual weights are not available include those consumed locally or exported as chunks and loins, and also B grade fish which have shark damage accounting for up to 30% of the body weight.

Four processing sheds involved in this project provide consignment notes and export summaries either in electronic or handwritten format and go to some considerable effort to collate these data. As a minimum they provide vessel name and/or registration, date of processing, species, processed weight and processed state. One processor also includes port of landing, and two of the processors include the grade of fish or a note to indicate shark damage. The data are received 3- monthly in some cases and annually in one case.

The Ministry for Primary Industries database “warehou” is queried to obtain spatial and temporal information for the effort associated with the landings. Although individual fish are not identifiable in catch effort records, the resolution is adequate for stratification of catch to month and 5°×5° latitude/longitude squares (for southern bluefin tuna), and by all the NZ EEZ and year-quarter for other species as required for reporting to WCPFC and CCSBT. The sampled processed weights are linked to landings information and submitted to NIWA for inclusion in the secondary database ‘market’. The sampled processed weights are converted to length frequencies for this report and compared with length compositions from other sources where available.

During the study period, one participant moved to electronic capture and provision of these data with a noticeable improvement in the agreement with LFRR totals, and another participant is also transitioning to an electronic system which should hopefully make the task less arduous in future for the staff who collate these data. Most of the data provided to this programme however, is in the form of handwritten and faxed consignment notes.

3. RESULTS

3.1. Coverage of EEZ catch

Catches of Southern bluefin tuna increased by about 50% over the period in response to increases in the Total Allowable Commercial Catch (TACC) from 420 t to an average of 570 t in the 2009–10 and 2010–11 fishing years, and to 787 t in the 2011–12 fishing season. Catches of swordfish also increased proportionately while bigeye and Pacific bluefin catches varied from year to year but showed no trend, and catches of yellowfin continued to decline.

The domestic tuna longline fleet landed almost all (over 99.6% by weight) of the bigeye, swordfish, Pacific bluefin, and yellowfin tuna caught in the EEZ in each of the three years, and 57–77 % of the southern bluefin tuna caught annually (Table 1). The balance of the southern bluefin was caught by charter vessels which operated entirely off the west coast of the South Island during these years.

Observer coverage of the domestic catch was less than 10% in each year, and that was mostly from a large vessel that fishes in company with the charter fleet. The four North Island sheds that participate in this programme, however, largely maintained their market share, processing most of the catch (greenweight) of bigeye tuna (more than 96%), swordfish and yellowfin tunas (more than 80%), and Pacific bluefin (more than 70% in each year), they also processed more than 40% of the annual bluefin tuna caught in the EEZ (Table 1).

Table 1: Greenweight (t) of in-zone catch reported by permit holders on Monthly Harvest Returns (MHR), by fishers on Catch Landing Returns (CLR), and for domestic vessels only (kept catch associated with tuna longline), by the four participating processors on Licensed Fish Receiver Returns (LFRR, which do not differentiate between in-zone and high seas catch), and provided by them to this programme (sampled). Also shown is the landed greenweight reported by the domestic fleet (CLR) as a percentage of in-zone greenweight (CLR), and by the participating sheds (LFRR) as a percentage of in-zone MHR totals, in the 2009–10, 2010–11 and 2011–12 fishing years. Greenweight is back-calculated from processed weight in all cases.

	Greenweight(t)					% of in-zone greenweight	
	In-zone	In-zone	Domestic	Participating sheds		Domestic	Partic. sheds
2009–10	MHR	CLR	CLR	LFRR	Sampled	CLR/CLR	LFRR/MHR
BIG	161.2	158.1	158.1	155.3	137.5	100.0	96.4
STN	499.5	480.0	272.0	214.5	190.7	56.7	42.9
SWO	536.6	522.6	521.6	494.5	375.3	99.8	92.2
TOR	13.6	11.2	11.2	11.3	9.8	100.0	83.1
YFN	6.2	5.6	5.6	5.3	4.1	100.0	86.0
2010–11							
BIG	181.3	180.9	180.9	176.3	174.4	100.0	97.2
STN	547.4	535.2	385.5	268.3	267.6	72.0	49.0
SWO	729.6	714.2	711.7	667.8	630.5	99.6	91.5
TOR	27.4	24.4	24.4	19.9	18.7	100.0	72.4
YFN	2.8	2.4	2.4	2.4	2.0	100.0	88.3
2011–12							
BIG	157.2	157.1	156.4	151.0	148.3	99.6	96.0
STN	775.1	773.0	592.1	320.3	329.9	76.6	41.3
SWO	688.2	668.1	661.3	560.0	544.3	99.0	81.4
TOR	13.7	13.7	13.7	10.7	10.2	100.0	78.1
YFN	2.2	1.5	1.5	1.9	1.1	100.0	84.2

3.2. Main processors of domestic catch

A characterisation of Licensed Fish Receivers (LFRs) shows that the four processors currently contributing to this programme were among the top five for the species of interest in 2009–10 and 2010–11, and among the top eight in 2011–12. (Table 2). The LFRs accounting for most of the balance of southern bluefin are South Island operators, and therefore of less interest to this programme.

Other important LFRs also process large volumes of out of zone purse seine catch (which is not differentiated on the LFRR form), notably of bigeye and yellowfin,. The processors that participated in this programme provided individual processed weights for most of the catch they processed, and all of it was identified as having been landed by domestic longline vessels.

Table 2: Landings to the participating processors, as a percentage of national annual MHR totals (greenweight) by species for the 2009–10, 2010–11 and 2011–12 fishing years.

2009–10	BIG	STN	SWO	TOR	YFN
Processor A	46	12	36	45	24
Processor B	23	18	28	15	35
Processor C	16	9	20	20	21
Processor D	11	4	7	4	6
2010–11	BIG	STN	SWO	TOR	YFN
Processor B	41	16	35	28	40
Processor A	32	21	31	30	30
Processor C	14	10	18	8	8
Processor D	11	2	8	7	10
2011–12	BIG	STN	SWO	TOR	YFN
Processor B	39	24	39	32	11
Processor A	35	13	28	33	37
Processor C	11	3	7	4	12
Processor D	11	2	7	9	25

3.3. Recovery rates from selected processing sheds

Table 3 summarises the fish sampled as a percentage of their greenweight totals reported on LFRRs for each processor. There is some shortfall that varies among species but is greatest for swordfish and yellowfin tunas. The shortfall comprises fish used for domestic consumption, or exported as loins, chunks or otherwise not whole, but two of the processors are also able to identify B grade exported fish which are shark damaged so that those fish can be excluded. Both confirm that fish for which individual processed weights are not available include skinny, badly bitten, or otherwise poor condition fish that are filleted for the local market and are not in any way selected by size. They also observe that damage mainly affects broadbill (swordfish) and rarely tunas. The shortfall may also in part be due to the manual nature of the search done through the daily consignments notes for relevant data. In 2010–11, Processor B transitioned to an electronic data capture system which has noticeably improved their agreement with LFRR totals. There has also been a marked improvement in the agreement with LFRR totals from Processor A, which may simply be due to a new fax machine that copies consignment notes with fewer overlaps and hidden pages.

Processors C and D are not able to identify shark damaged fish so that they can be eliminated from analysis, and the total greenweight sampled by these companies has historically comprised 100% of LFRR totals. They both confirm that their data will include some bitten fish.

In 2011–12 some unusual oversampling of TOR and STN by Processor C prompted further investigation of all available data sources. The over-sampled TOR comprised 13 fish that were most likely BIG mistakenly included with TOR on the report sheet submitted. The vessel attributed with catching the 13 fish in July 2012, in fact only caught one TOR, while the greenweight of BIG sampled in the same period was less than the LFRR total weight by a similar weight (about 400 kg). The over-sampling of STN appears to be a mistake in the LFRR totals submitted by the company, which seemed to exclude the catches processed in May 2012. The number of STN measured in each month tallies closely with the catch reported by the vessels to which they were attributed. The company has been approached for clarification.

Table 3: Fish sampled in this study as a percentage (greenweight) of the annual totals reported on LFRRs by the participating processors for the 2009–10, 2010–11 and 2011–12 fishing years. The balance includes B grade and shark damaged fish and fish exported in chunks or loins.

2009–10	BIG	STN	SWO	TOR	YFN
Processor B	87	103	77	83	79
Processor A	80	77	51	78	57
Processor C	100	100	100	100	100
Processor D	98	72	97	100	100
2010–11	BIG	STN	SWO	TOR	YFN
Processor B	105	101	92	97	88
Processor A	91	99	92	99	64
Processor C	100	100	100	100	100
Processor D	101	102	101	49	100
2011–12	BIG	STN	SWO	TOR	YFN
Processor B	97	101	91	79	63
Processor A	100	100	100	100	100
Processor C	98	134	102	179	100
Processor D	98	100	100	100	21

3.4. Coverage of domestic catch in numbers of fish

Data for 13 173 individual fish were obtained in 2009–10; including 7600 swordfish, 2546 bigeye tuna, 2875 southern bluefin tuna, 73 Pacific bluefin tuna and 82 yellowfin tuna (Table 4). The coverage of the domestic catch this represents was greatest for Pacific bluefin (92%) and least for southern bluefin (62%). Overall, 73% of reported catch (by the domestic longline fleet) of the five species of interest, by number of fish, was sampled. This is an increase on the previous two years; 11 470 fish were sampled in 2008–09, and 8250 fish in 2008–08, according to Kendrick & Hanley (2010).

In 2010–11, data for 19 676 fish were obtained including 12 453 swordfish, 2801 bigeye tuna, 4245 southern bluefin tuna, 138 Pacific bluefin tuna and 39 yellowfin tuna (Table 4). This was an increase on the previous year in numbers for all species except for yellowfin tuna, and in also in terms of coverage of the domestic catch for bigeye tuna (90%), southern bluefin tuna (77%), swordfish (88%), and yellowfin tuna (93%), and a slight decrease in coverage of the catch of Pacific bluefin (76%). Overall, 85% of the reported catch **(**by the domestic longline fleet**)** of the five species of interest, by number of fish, was sampled.

In 2011–12, data for 18 788 fish were obtained including 10 475 swordfish, 2532 bigeye tuna, 5659 southern bluefin tuna, 101 Pacific bluefin tuna and 21 yellowfin tuna (Table 4). This was an increase on the previous year in numbers for southern bluefin tuna, and in in terms of coverage of the domestic catch for bigeye tuna (91%), and Pacific bluefin tuna (87%), and a decrease in coverage of the catch of southern bluefin tuna(60%), swordfish (84%), and yellowfin tuna (62%). Overall, 76% of the reported catch (by the domestic longline fleet) of the five species of interest, by number of fish, was sampled.

Table 4: Number of fish sampled for 2009–10, 2010–11, and 2011–12 fishing years (based on date of landing) compared to the number of fish estimated on TLCER forms by domestic vessels.

2009–10 Species	Number fish caught (TCELR)	Number fish sampled	% coverage
Bigeye tuna	2 858	2 546	89.1
Southern bluefin tuna	4 596	2 875	62.5
Swordfish	10 338	7 600	73.5
Pacific bluefin tuna	79	73	92.4
Yellowfin tuna	111	82	73.9
Total	17 982	13 173	73.3
2010–11			
Bigeye tuna	3 122	2 801	89.7
Southern bluefin tuna	5 486	4 245	77.4
Swordfish	14 130	12 453	88.1
Pacific bluefin tuna	182	138	75.8
Yellowfin tuna	42	39	92.9
Total	22 962	19 676	85.7
2011–12			
Bigeye tuna	2 787	2 532	90.9
Southern bluefin tuna	9 358	5 659	60.5
Swordfish	12 377	10 475	84.6
Pacific bluefin tuna	116	101	87.1
Yellowfin tuna	34	21	61.8
Total	24 672	18 788	76.2

The shortfall in coverage of the domestic catch of southern bluefin can be attributed to an increasing proportion of domestic effort in 2011–12 expended in the south western fishery (Figure 1) with some vessels landing their catch to South Island LFRs. The high observer coverage (of charter vessels) in the south western fishery is considered adequate to describe the southern bluefin catch from this south western fishery.

Much of the increase over the three years is attributable to TACC increases for southern bluefin tuna and expanded coverage of the domestic catch of southern bluefin tunas and of swordfish by Processor B.

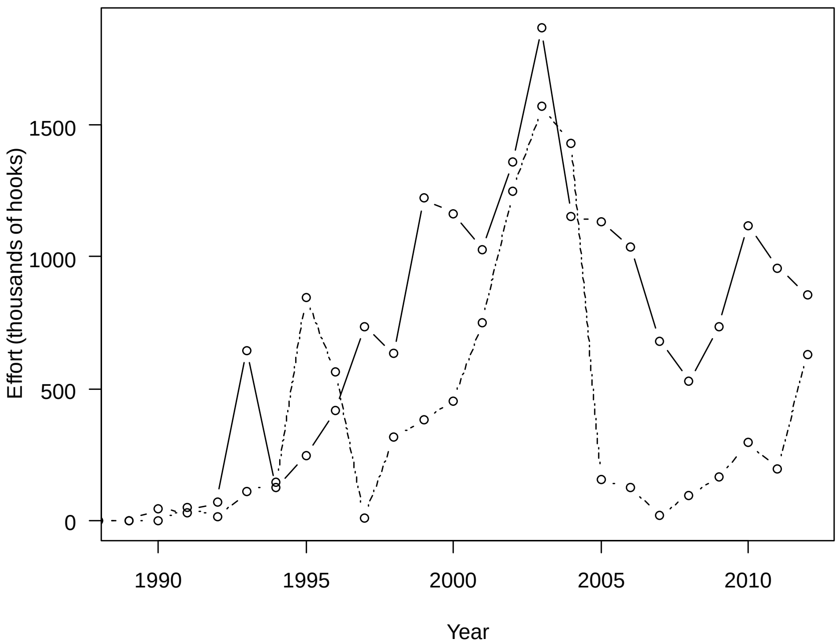


Figure 1: Target effort (hooks from sets that either targeted or caught southern bluefin tuna – thousands of hooks) by the domestic fleet for CCSBT Region 5 (solid line – east coast North Island) and Region 6 (dashed line – west coast South Island). Reproduced from CCSBT (2013).

3.5. Representativeness of sampling

The seasonal distribution of sampling in each fishing year is described in Table 5 in numbers of fish, and percentage coverage of the (numbers of) fish caught by the domestic fleet and reported on Tuna Longline Catch Effort Returns (TLCERS). The number of fish caught is summarised on the basis of the date associated with the estimated catches on the catch effort form whereas the number of fish sampled is based on the date on the load sheet or consignment note and is the date they were subsequently exported by the processor. This has resulted in some misleading statistics in this table especially when the number of fish involved is small. Possibly a better way of demonstrating seasonal coverage of sampling is with cumulative frequency plots as in Figure 2. This graphic calculates each monthly catch and sample as a proportion of the respective annual totals and shows seasonal coverage to have been adequate in each year for each species.

Figure 2 also shows that there have been shifts in the behaviour of the fleet in response to the availability of STN catch allowance. For example, in 2009–10, when the STN allowance was not reached, the fleet did not return to catching bigeye in the last few months of the fishing year as they usually do. In 2011–12 there was a marked shift to an earlier start to fishing for STN.

Table 5: Seasonal coverage of sampling in numbers of fish, and as a percent of numbers of fish reported caught on TLCERs (not including charter vessels) in 2009–10, 2010–11, and 2011–12 fishing years.

2009–10	Number of fish sampled					% sampled				
Month	BIG	STN	SWO	TOR	YFN	BIG	STN	SWO	TOR	YFN
Oct	198	15	40	1	3	67	83	60	25	38
Nov	423	11	57		4	73	157	55	0	80
Dec	354	2	244	2	4	108	67	91		67
Jan	255	3	316	3	12	106	43	55	100	86
Feb	189	3	881	1	13	68	150	69	100	163
Mar	570		1953	11	32	107		83	110	56
Apr	340	55	1496	8	14	93	51	72	80	127
May	81	304	1158	15		95	51	63	68	
Jun	36	293	618	11		103	24	76	100	
Jul	25	1648	454	8		66	81	83	100	
Aug	58	492	308	10		112	88	83	125	
Sep	17	46	75	3		53	77	96	300	0

2010–11	Number of fish sampled					% sampled				
Month	BIG	STN	SWO	TOR	YFN	BIG	STN	SWO	TOR	YFN
Oct	53	36	67	0	3	73	212	81		60
Nov	164	11	50	3	5	67	58	45	100	83
Dec	269	17	370	4	3	112	170	88	100	300
Jan	170	6	645	4	1	88	86	54	133	25
Feb	367	5	1807	5	12	71	100	95	71	109
Mar	600	1	2132	6	11	92	33	103	100	92
Apr	255	62	2136	7		93	66	91	50	
May	106	421	1813	27		102	47	74	82	
Jun	100	2213	1076	39	2	357	80	104	59	
Jul	79	852	975	3	0	50	75	78	30	
Aug	285	525	1054	26	1	82	114	109	90	50
Sep	353	96	328	14	1	120	125	105	200	100

2011–12	Number of fish sampled					% sampled				
Month	BIG	STN	SWO	TOR	YFN	BIG	STN	SWO	TOR	YFN
Oct	123	37	133	6		97	109	102	120	
Nov	111	9	144	2		83	90	84	200	
Dec	145	5	307	8	4	101	125	95	200	57
Jan	138	2	763	1	2	75	200	75	100	67
Feb	424	9	1589		9	110	24	87		90
Mar	319	322	1980	6	4	86	48	71	55	44
Apr	122	940	1278	1	2	116	47	92	6	200
May	104	981	1146	10		99	46	91	111	
Jun	83	1372	757	11		48	66	75	44	
Jul	457	1373	1405	29		103	74	97	171	
Aug	342	534	767	17		71	119	90	81	
Sep	164	75	206	10		122	103	139	167	

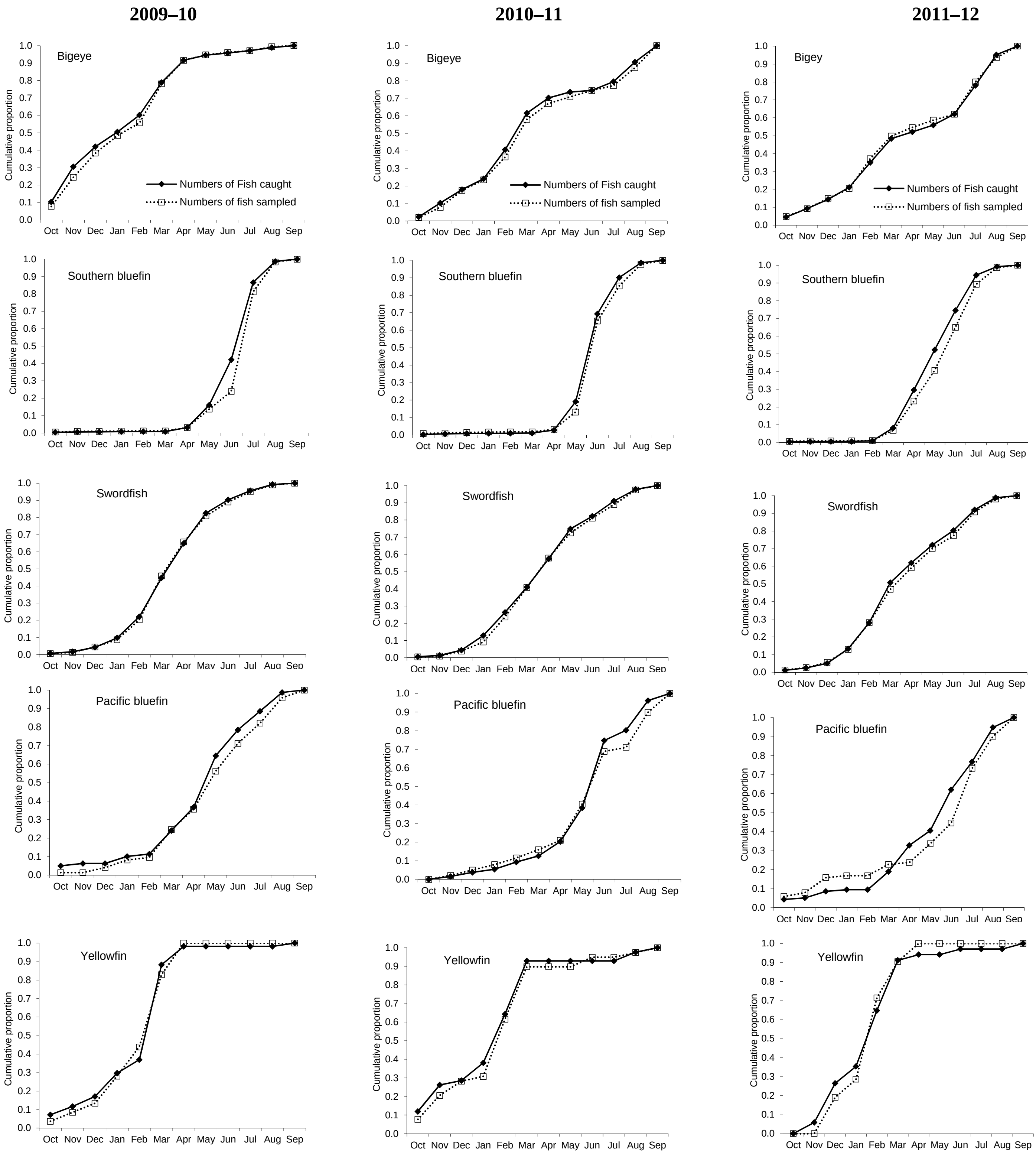


Figure 2: Cumulative frequency plots showing the seasonal distribution of sampling compared with that of reported catches (domestic fleet TLCERs) for each species in each fishing year.

Tables 6 to 8 show the distribution and coverage of sampling by species and stratum (year, quarter) compared with the number of fish reported by the domestic fleet on TLCERs, landed greenweight, and MHR totals.

Catch and effort data for vessels landing species of interest has been obtained in extracts from the Ministry for Primary Industries (MPI) database "warehou", and the spatial distribution of surface longline sets by the sampled vessels is compared to that for the whole fleet (excluding charter vessels) in Figure 3. The geographical distributions are similar and the spatial representativeness appears to be adequate, although with some undersampling of catch from off Hawkes Bay. The spatial distribution of sets by vessels sampled for this study has not been linked to individual sampled landings however, and while this figure shows that participating vessels account for most of the domestic effort off the west coast of the South Island, some of that catch may have been landed to South Island LFRs and thus not sampled.

Table 6: Distribution of fish sampled by stratum in numbers, and as a percent of estimated numbers of fish reported on TLCERS (not including charter vessels), blanks = no catch.

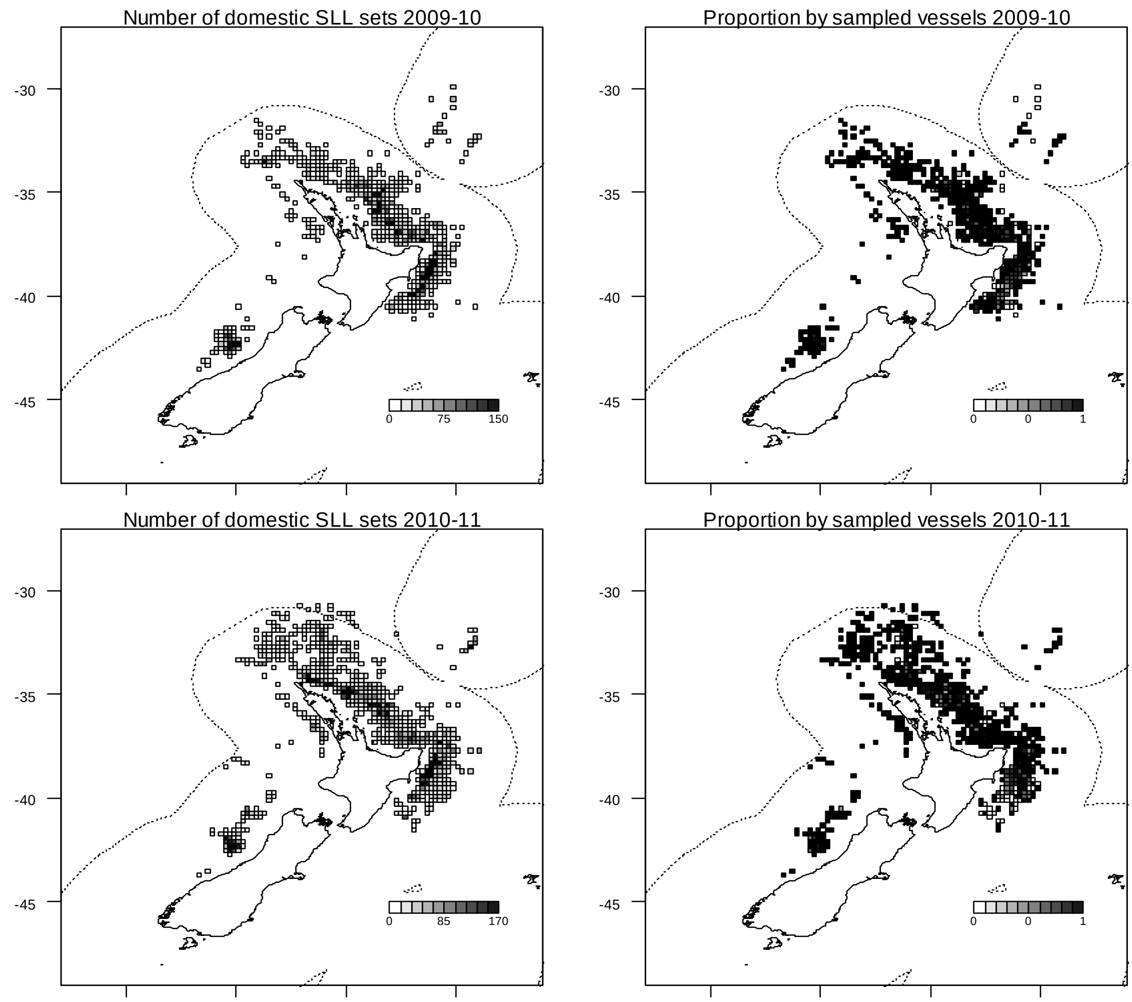
Strata		Number of fish sampled					% sampled				
Year	Quarter	BIG	STN	SWO	TOR	YFN	BIG	STN	SWO	TOR	YFN
2009	4	975	28	341	3	11	81	100	78	60	58
2010	1	1014	6	3150	15	57	96	67	75	107	72
2010	2	457	652	3272	34	14	94	34	69	79	127
2010	3	100	2186	837	21	0	82	82	84	124	
2010	4	486	64	487	7	11	87	139	79	100	92
2011	1	1137	12	4584	15	24	84	80	89	94	89
2011	2	461	2696	5025	73	2	114	72	86	65	0
2011	3	717	1473	2357	43	2	90	88	93	93	67
2011	4	379	51	584	16	4	94	106	93	160	44
2012	1	881	333	4332	7	15	93	47	77	58	68
2012	2	309	3293	3181	22	2	81	53	87	44	100
2012	3	963	1982	2378	56	0	91	83	97	127	

Table 7: Greenweight of fish sampled, by stratum, and as a percent of landed greenweight reported on CLRs (not including charter vessels). Blanks = no catch.

Strata		Greenweight of fish sampled (t)					% sampled				
Year	Quarter	BIG	STN	SWO	TOR	YFN	BIG	STN	SWO	TOR	YFN
2009	4	44.9	1.7	20.3	0.2	0.5	83.6	101.9	88.6	40.8	63.8
2010	1	57.7	0.2	147.3	3.9	2.8	90.3	113.3	76.2	98.1	72.0
2010	2	28.2	41.5	153.7	3.0	0.8	85.3	13.8	63.8	75.1	81.2
2010	3	6.8	147.3	54.0	2.7	0.0	89.6	82.8	82.6	100.6	
2010	4	24.5	3.8	24.7	0.8	0.5	97.4	143.2	100.8	100.3	74.8
2011	1	79.4	0.7	213.7	3.0	1.3	95.5	83.5	92.8	96.9	79.5
2011	2	30.2	171.1	261.8	7.5	0.1	104.1	40.2	82.8	61.7	
2011	3	40.3	92.0	130.3	7.4	0.1	92.4	86.5	91.0	88.6	100.3
2011	4	16.6	2.7	32.7	1.3	0.2	96.3	103.1	98.6	105.4	54.0
2012	1	60.6	15.0	222.6	1.2	0.8	94.9	64.0	83.9	66.9	85.8
2012	2	18.7	193.6	161.9	2.2	0.1	92.2	32.5	70.4	61.2	100.0
2012	3	52.4	118.7	127.1	5.4	0.0	94.1	78.7	91.1	77.2	

Table 8: Greenweight of fish sampled, by stratum, and as a percent of landed greenweight reported on MHRs. (not including charter vessels). Blanks = no catch.

Strata		Greenweight of fish sampled (t)					% sampled				
Year	Quarter	BIG	STN	SWO	TOR	YFN	BIG	STN	SWO	TOR	YFN
2009	4	44.9	1.7	20.3	0.2	0.5	82.9	97.6	82.8	31.8	66.1
2010	1	57.7	0.2	147.3	3.9	2.8	88.5	60.8	74.7	89.4	67.8
2010	2	28.2	41.5	153.7	3.0	0.8	82.5	13.8	63.9	58.5	101.1
2010	3	6.8	147.3	54.0	2.7	0.0	86.9	74.8	72.7	78.8	
2010	4	24.5	3.8	24.7	0.8	0.5	98.2	125.9	102.9	100.3	104.4
2011	1	79.4	0.7	213.7	3.0	1.3	95.6	53.7	91.6	92.6	70.4
2011	2	30.2	171.1	261.8	7.5	0.1	105.7	39.3	81.1	55.1	85.1
2011	3	40.3	92.0	130.3	7.4	0.1	90.1	85.6	87.0	75.1	35.2
2011	4	16.6	2.7	32.7	1.3	0.2	95.0	101.4	97.8	105.4	54.0
2012	1	60.6	15.0	222.6	1.2	0.8	94.8	58.4	82.7	60.5	90.2
2012	2	18.7	193.6	161.9	2.2	0.1	94.0	32.4	67.5	56.5	23.2
2012	3	52.4	118.7	127.1	5.4	0.0	93.7	79.3	87.1	83.0	



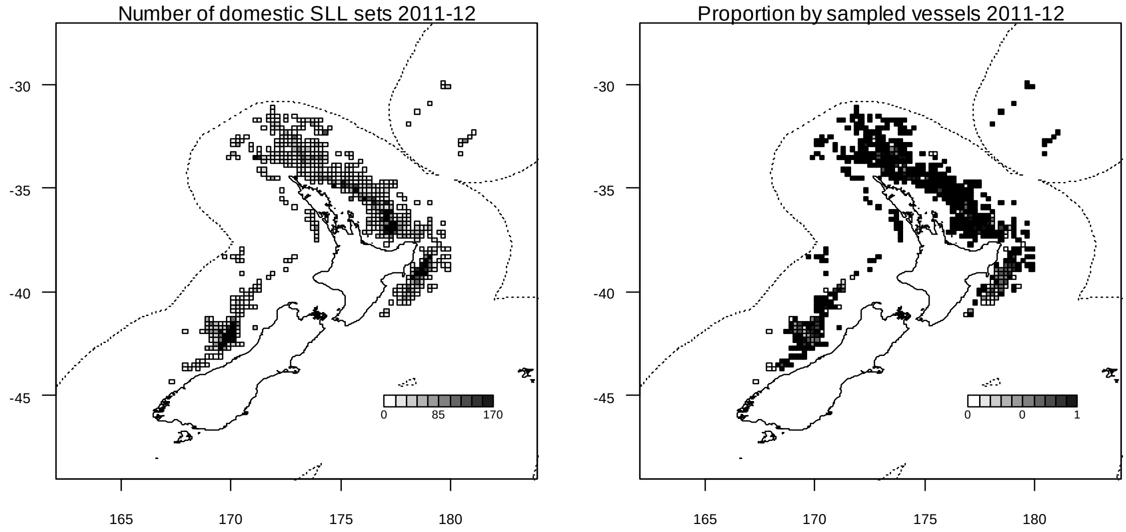


Figure 3: Spatial distribution of domestic surface longline sets (start position to 0.2 degree resolution) and proportion attributed to vessels that were sampled for this programme in 2009–10, 2010–11, and 2011–12.

3.6. Conversion of processed weights to fork lengths

Table 9 summarises the sampled fish by processed state and includes the conversion factors used to back-calculate greenweight. It also highlights the sampled fish for which it is currently possible to estimate lengths using relationships established from observer data.

Regression equations (Table 10) are available for calculating fork length (FL) from weight for the main processed states of all species except Pacific bluefin tuna (Francis et al. 2006). No regression is available for the GGO state (tail on) for southern bluefin tuna, because tuna longline observers on charter vessels in the southern fishery only reported 3.4% of fish in this state. Yet the commercial landing returns reported more than 36% SI (GGO) and the fish sampled in the 2007–08 fishing year from North Island processors included almost 50% landed in this state (Table 9).

Two key LFRs stated that all southern bluefin are landed with the tail removed, but one important LFR reported that they are landed with the tail on and the caudal fin lobes trimmed. In this latter state, the processed weight would differ little from SI weight, so a regression of FL versus SI/GGO weight would provide a good approximation for estimating FL from weights provided electronically (Davies & Griggs 2006). For this report, both processing states have been used and the same regression applied to convert processed weight to Fork Length.

Greenweight distributions in each fishing year are provided by species in Figures 4 – 8 in 5 kg bins, alongside length distributions (in 5 cm bins) for those bigeye tuna, southern bluefin tuna, swordfish and yellowfin tuna that were landed in a processed state for which we have weight-length relationships. The time series are extended with distributions for 2007–08 and 2008–09 (reproduced from Kendrick & Hanley 2010) included for comparison.

In Figures 9 and 10, the length distributions estimated for southern bluefin and for swordfish are reproduced, and are compared with length distributions obtained by the observer programme. The agreement in each year is reasonable for both species, suggesting that both fleets are exploiting the same underlying population, and also giving confidence in the utility of the back calculation of length from processed weight. There are some interesting differences, for example the truncation in the distribution of smaller swordfish and southern Bluefin tunas seen by observers in 2011–12, when compared with the sampled catch which is largely by domestic vessels from the north eastern fishery.

The distributions of observed southern Bluefin catch are further compared with lengths reported to the CCSBT catch documentation scheme separately for the charter and domestic fleets. This is outside of the scope of this project but of interest in evaluating historical series of observer data. The distributions resemble each other closely for the charter fleet (Figure 11), but observer data are not representative of the domestic catch in the three years examined, in particular of the smaller fish (Figure 12).

Table 9: Distribution of sampled fish (numbers of fish) by processed state code, including conversion factors used to back calculate greenweight. B grade fish (damaged) and parts of fish (loins, fillets etc.) are not included. GGU is probably used in error. Grey cells indicate fish for which processed weight: fork length conversions are available from observer data.

	Processed state					
Species	GGO	GGT	GRE	GUT	HGF	HGU
Conversion factor	1.1	1.15	1	1.1	1.25	1.5
2009–10						
Bigeye tuna	878	1665				3
Southern bluefin tuna	661	2207	3			1
swordfish	1			1	7 598	
Pacific bluefin tuna	28	45				
Yellowfin tuna	26	56				
	Processed state					
2010–11	GGO	GGT	GRE	GUT	HGF	HGU
Bigeye tuna	238	2 563				
Southern bluefin tuna	588	3 657				
swordfish		2	7		12 439	
Pacific bluefin tuna	9	129				
Yellowfin tuna	4	34	1			
	Processed state					
2011–12	GGO	GGT	GRE	GUT	HGF	HGU
Bigeye tuna	297	2 234				1
Southern bluefin tuna	956	4702				1
swordfish			7	2	10 466	
Pacific bluefin tuna	13	88				
Yellowfin tuna	2	19				

Table 10: Regression formulae and constants used to convert processed weight to forklength (Francis et al. 2006; Davies & Griggs 2006).

($\log_{10}$ FL = *a* + *b* $\log_{10}$ PW).

Both sexes	State	a	b
BIG	GGT	1.654	0.292
BIG	GGO	1.573	0.341
STN	GGT	1.63	0.312
YFN	GGT	1.631	0.328
YFN	GGO	1.611	0.33
FL=a*PW^b			
SWO	HGF	55.622	0.2895

3.7. Greenweight and fork length distributions

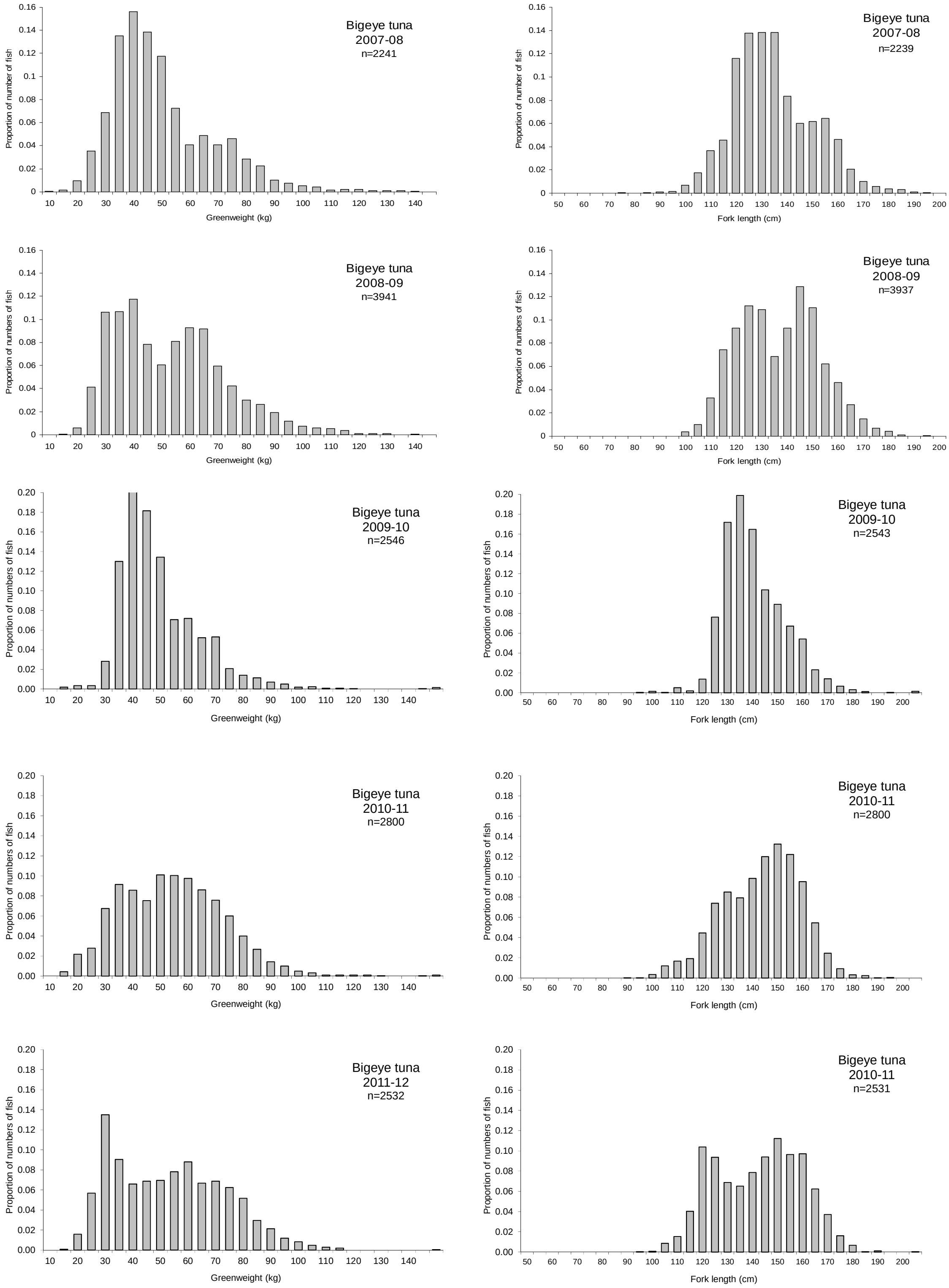


Figure 4: Greenweight distribution (left) and length frequency (right) histograms of market sampled bigeye tuna landed as processed state GGT or GGO in 2007–08 and 2008–09 (reproduced from Kendrick & Hanley 2010), and 2009–10, 2010–11, and in 2011–12 (this study).

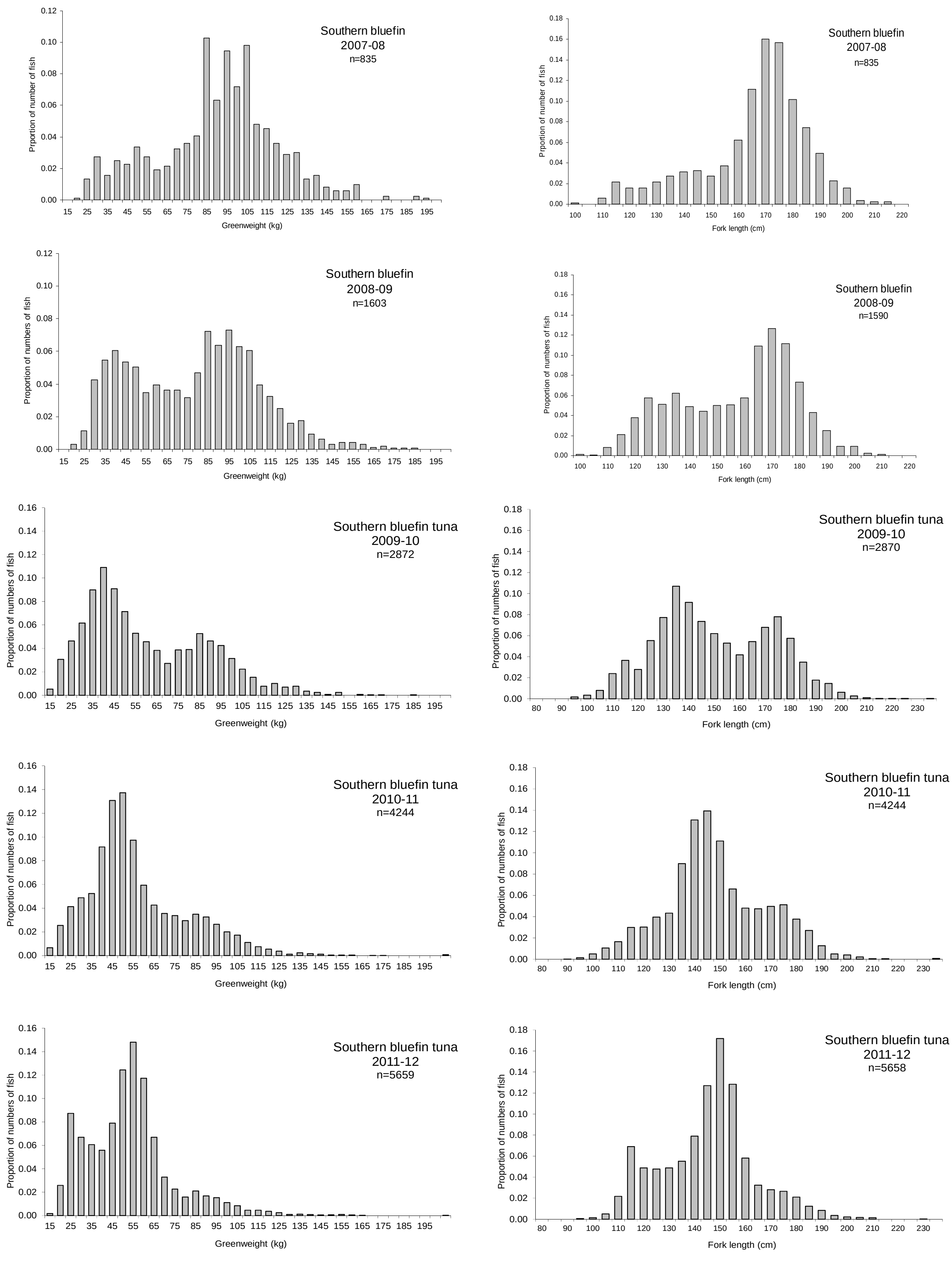


Figure 5: Greenweight distribution (left) and length frequency (right) histograms of market sampled southern bluefin tuna landed as processed state GGT or GGO, in 2007-08, and 2008-09 (reproduced from Kendrick & Hanley 2010), and 2009–10, 2010–11, and 2011–12 (this study).

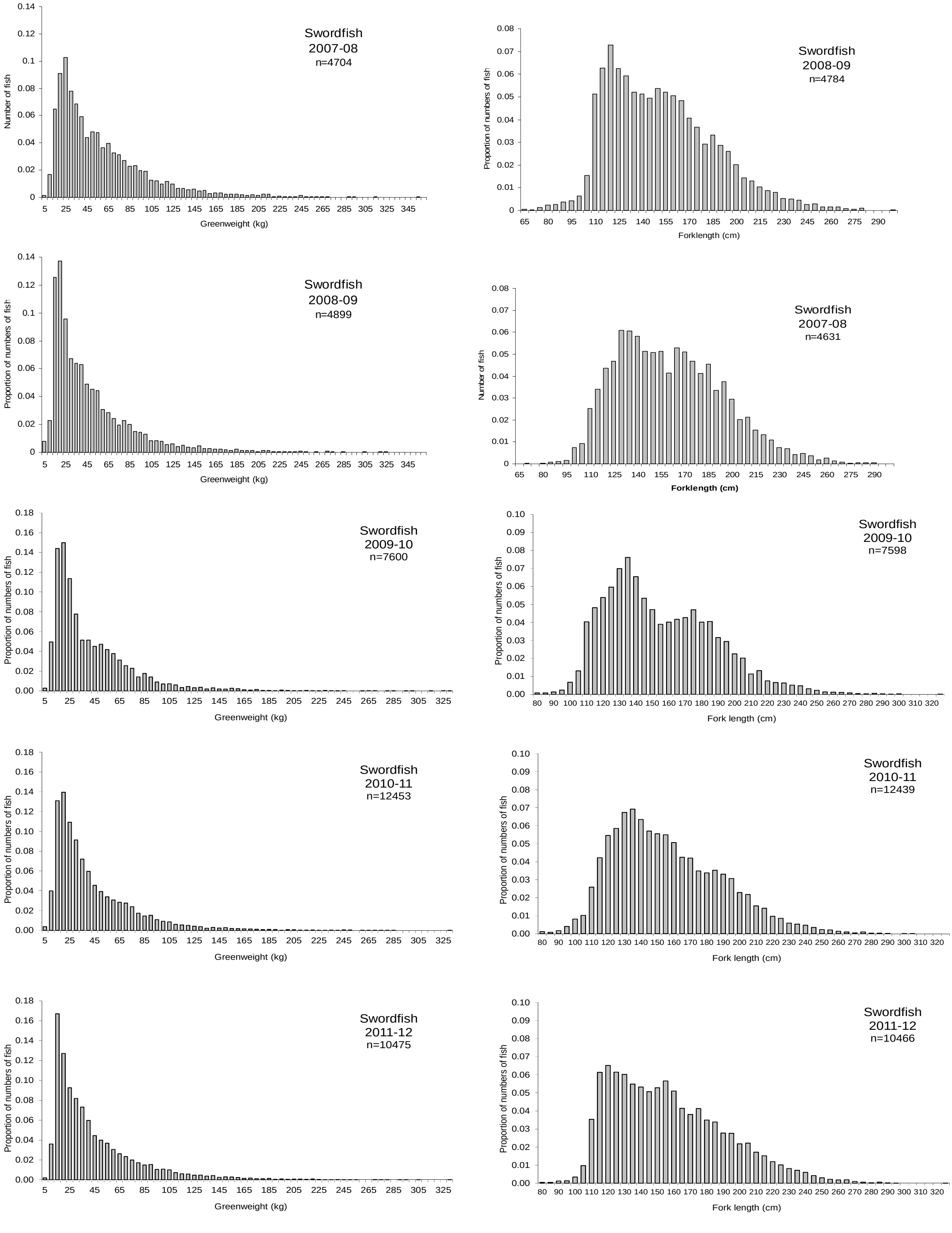


Figure 6: Greenweight distribution (left) and length frequency (right) histograms of market sampled swordfish landed as processed state HGF in 2007–08 and 2008–09 (reproduced from Kendrick & Hanley 2010), and 2009–10, 2010–11, and 2011–12 (this study).

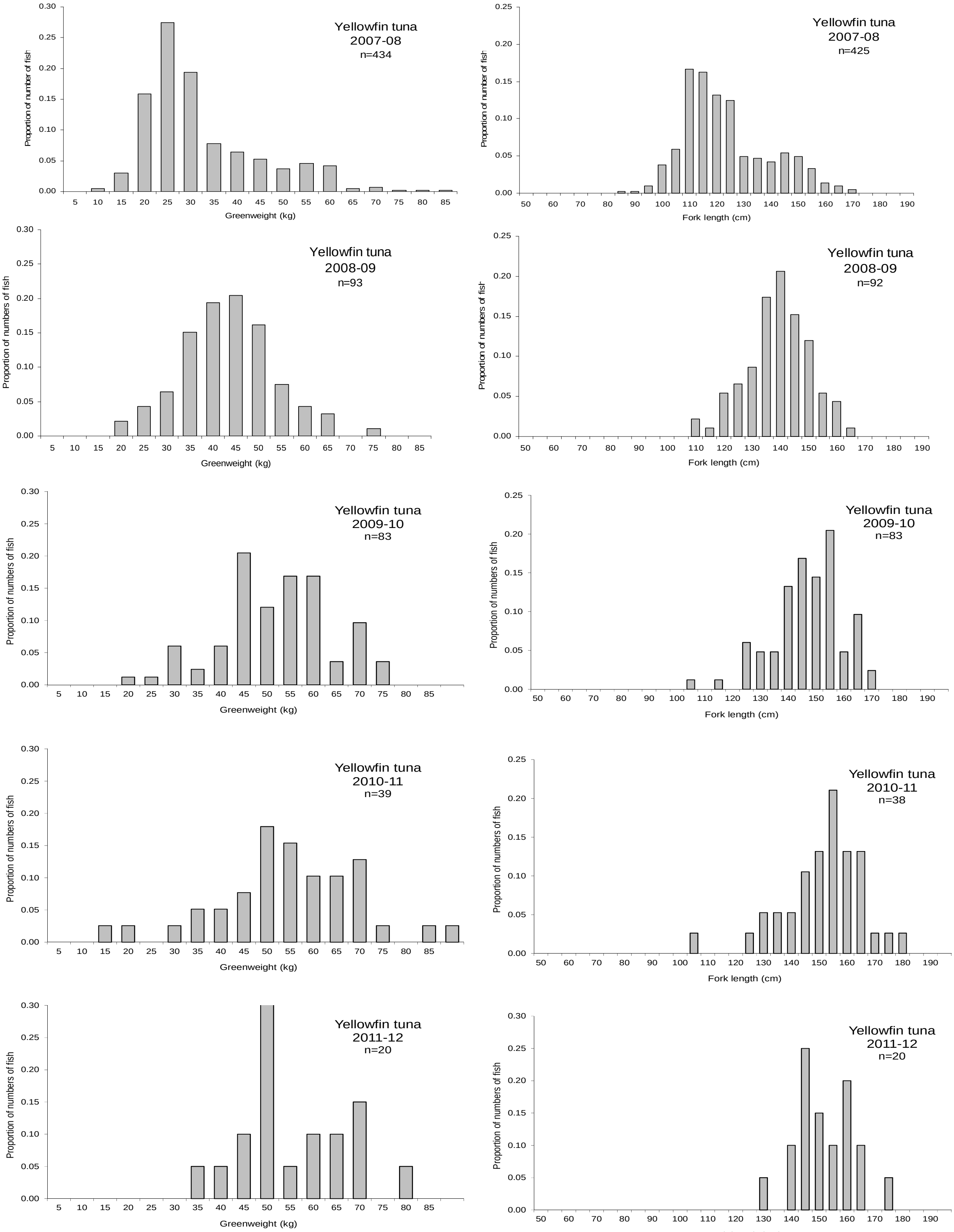


Figure 7: Greenweight distribution (left) and length frequency (right) histograms of market sampled yellowfin tuna landed as processed state GGT or GGO in 2007–08 and 2008–09 (reproduced from Kendrick & Hanley 2010), and 2009–10, 2010–11, and 2011–12 (this study).

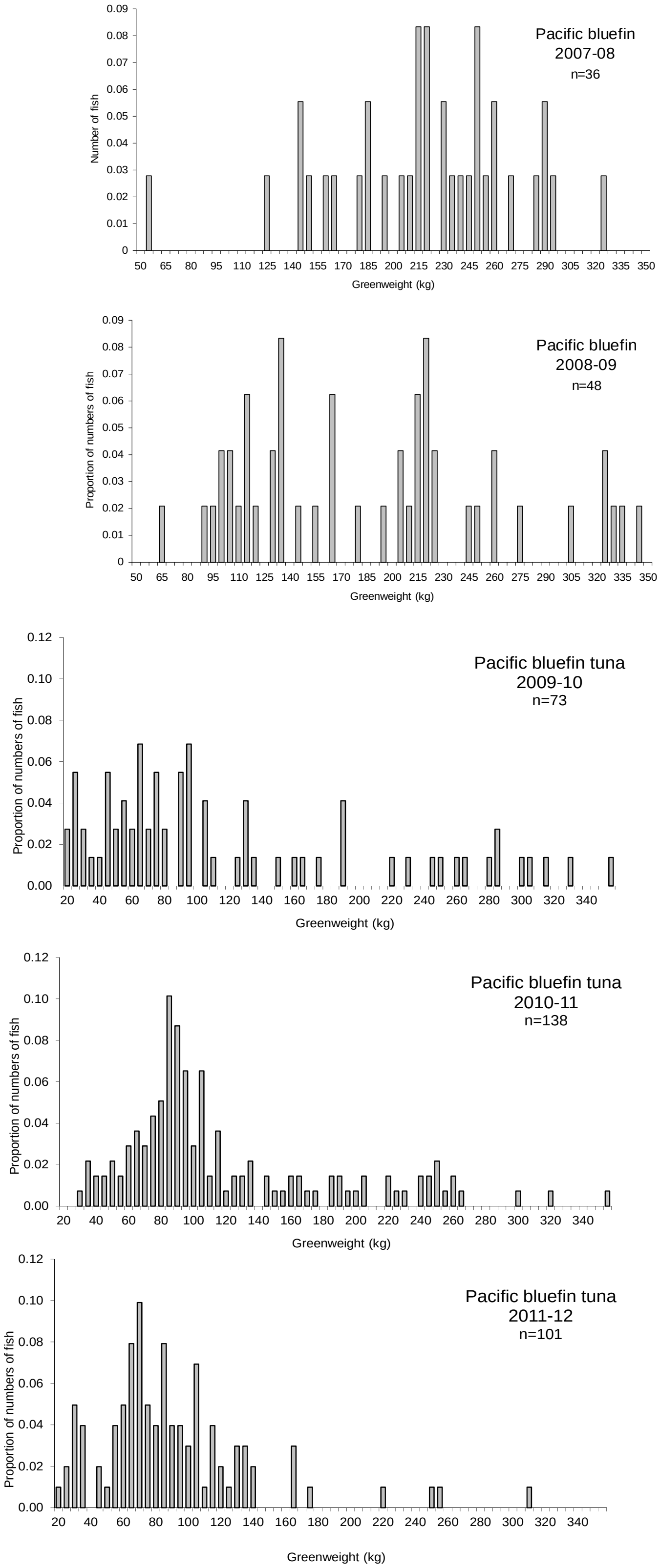


Figure 8: Greenweight distribution (left) of market sampled Pacific bluefin tuna in 2007–08, 2008–09 (reproduced from Kendrick & Hanley 2010), and 2009–10, 2010–11, and 2011–12 (this study).

Comparisons with observer length frequencies

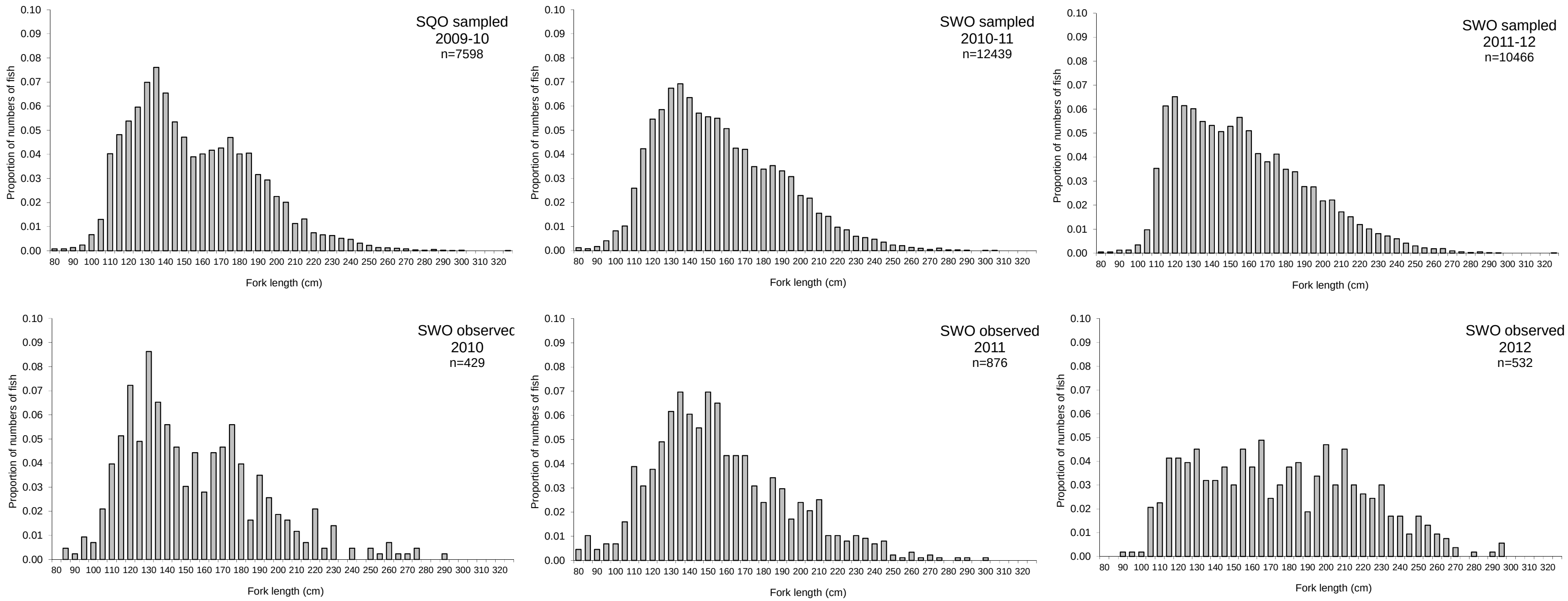


Figure 9: Comparison of length frequencies (5 cm bins) for swordfish; converted from processed weights (this study) [upper], and measured by observers [lower]. Observer data are as provided to WCPFC (i.e. by calendar year), but for swordfish, should be compatible with fishing year summaries, most catch being taken between January and September of each year. All vessels and locations combined.

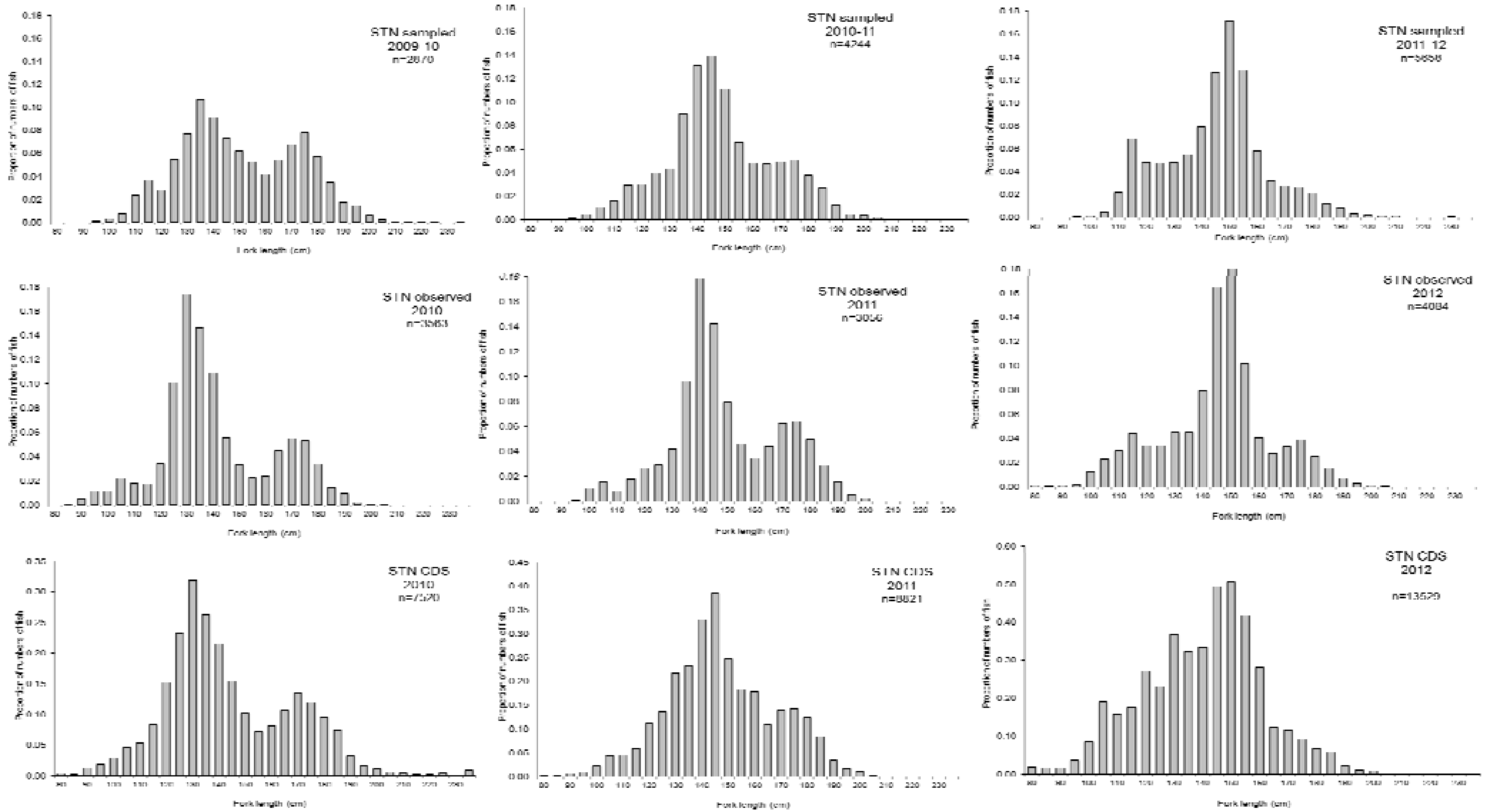


Figure 10: Comparison of length frequencies (5 cm bins) for southern bluefin tuna; converted from processed weights (this study) [top], measured by observers [middle], reported by fishers to the CCSBT catch documentation scheme (CDS, lower), all vessels and locations combined. The observer and CDS data are as provided to CCSBT (ie. by calendar year), which for southern bluefin should be compatible with fishing year summaries, most catch being taken between March and August of each year.

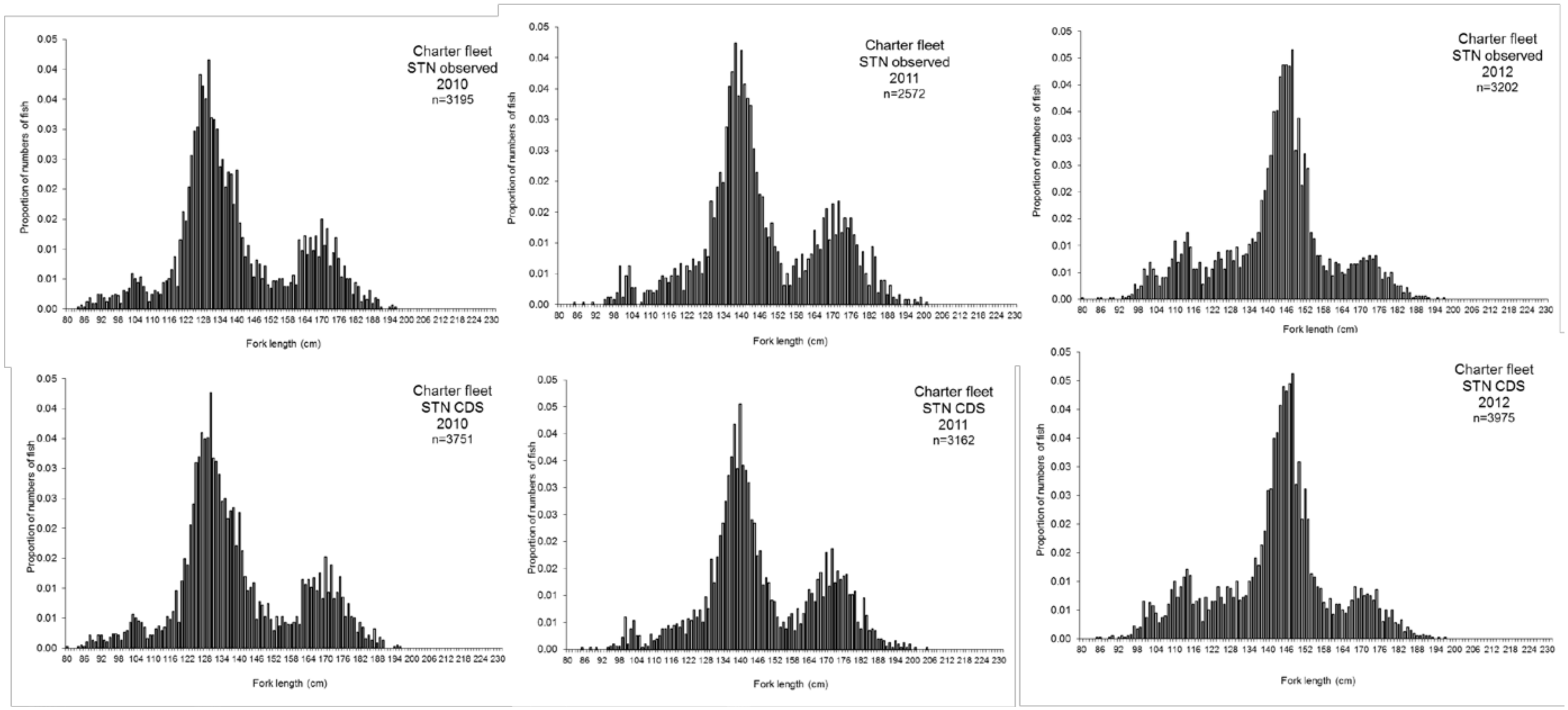


Figure 11: Comparison of length frequencies (1 cm bins) for southern bluefin tuna from the charter fleet; measured by observers [top], reported by fishers to the CCSBT catch documentation scheme (CDS, lower), in 1 cm bins by calendar year.

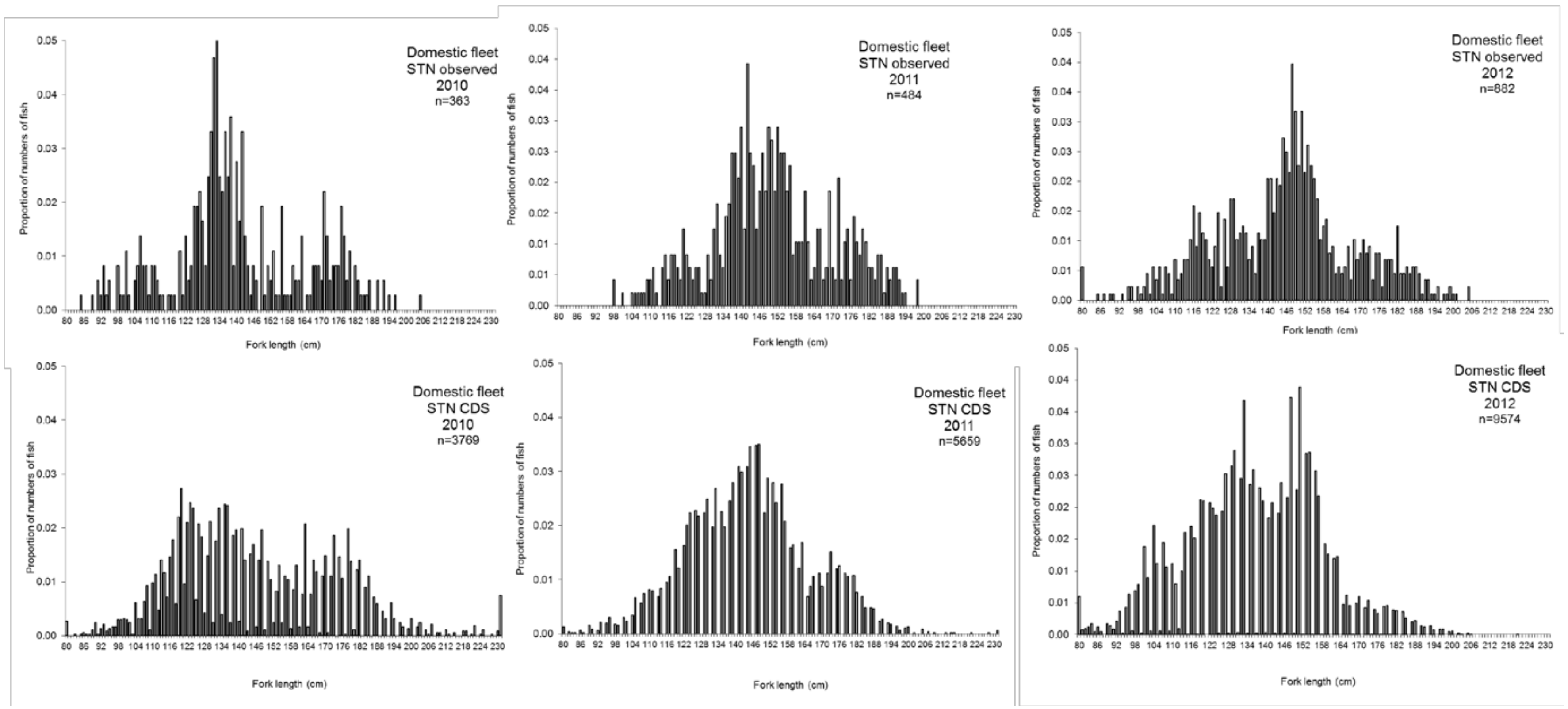


Figure 12: Comparison of length frequencies for southern bluefin tuna from the domestic fleet; measured by observers [top], reported by fishers to the CCSBT catch documentation scheme (CDS, lower), by calendar year.

4. CONCLUSIONS

The programme is effective in collecting processed weights for most of the swordfish and large tunas caught in northern fisheries by domestic longliners. Large increases in the numbers of southern bluefin and swordfish caught in the three years of this study have been easily accommodated and processors are moving towards electronic capture and provision of individual fish data.

The percentage of fish sampled is adequate to avoid the need for scaling for the key species. Seasonal sampling of catch and spatial coverage of effort appears to be reasonably representative of the domestic fleet. The shortfall for southern bluefin tuna is largely accounted for by fish landed to South Island processors and presumably caught in the west coast South Island fishery. That fishery is dominated by larger charter vessels and is considered to be adequately sampled by observers. The shortfall in other species of interest is due in part to the sale of poor condition and shark damaged fish (primarily swordfish but also Pacific bluefin tunas) on the domestic market, for which wholeweights are not collected or are excluded at data entry, with the balance being landed across several processors, but with little consistency from year to year.

The converted length frequencies closely resemble observer length frequencies for swordfish and southern bluefin in terms of nodes but also suggest differences in some years in the size of fish being caught by the charter fleet in the south western southern bluefin fishery compared with what is caught by the domestic fleet in more northern waters. Historical series of observer data for the domestic fleet may underrepresent the smaller fish caught by that fleet.

Individual southern bluefin lengths are now captured by the Catch Documentation System (CDS) set up by CCSBT and perhaps no longer need to be included in this programme.

5. ACKNOWLEDGEMENTS

This study was funded as project HMS2009-02 by the Ministry for Primary Industries. Many thanks to the participating fish processing companies and in particular to the staff who compiled and provided the data.

6. DATA MANAGEMENT

Data will be formatted for inclusion in the secondary research database ‘market’ and provided to the data manager at projects end.

7. REFERENCES

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