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Assessment of Independent Fishery Data collected from the PNG Purse Seine Fishery between 2008 and 2011

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Summary

Independent fishery data collected through a port sampling program between April and November in 2008 to 2011 show that skipjack recorded between 68% and 79% and Yellowfin comprised 19% to 27% of total species composition in numbers of fish. Bigeye was notably more in numbers in 2008 and 2009 and decreased in proportion in 2010 and 2011. Size distributions showed that larger skipjack were sampled in 2011 compared to previous years. Yellowfin illustrated varying distributions over sampling periods. Bigeye size distributions were similar in 2008 and 2011.

Introduction

The purse seine fishery operating in Papua New Guinea (PNG) waters is one of the largest in the WCPO, representing approximately 20% of recent purse seine catches from the entire WCPO (Nicol et, al, 2009). In recent years purse seine catches in PNG have reached and exceeded 400 000 mt. The fishery consists of both domestic and foreign access vessels. The domestic sector is made up PNG flag vessels and PNG chartered vessels supporting processing facilities on shore in PNG. Foreign vessels under access arrangements fish in PNG EEZ waters and outside of PNG.

Purse Seiners and Carriers unload or transship catch taken from archipelagic waters, within EEZ and high seas at various ports. These ports are Lae, Madang, Rabaul and Wewak. Three of the ports (Lae, Madang and Wewak) are home to processing facilities where catch is landed to be processed. With the primary aim of monitoring species composition and size distribution of the main tunas and non target species caught by purse seine gear, a port sampling program has been established and operating intermittently over the past 4 years at the main fishing ports. This paper presents a compilation of data collected from port sampling between 2008 and 2011 and is an assessment of size distribution and species composition for April to November across the 4 years that sampling has been carried out.

Sampling Method and Developments in Data collection

A stratified sampling technique was used in which each fish hold or well was sampled from the top, middle and bottom sections. Species were identified and fork length measurements were taken for each individual fish contained within a single net that was either unloaded or transshipped. Each net was estimated to weigh one metric tone and a selected number of nets were sampled that would equate to 20% of the weight of catch in each well. Sampling took place between April to November in all years except in 2010. In 2010 sampling only took place in May, and August to November.

Prior to 2008, port sampling was also conducted in 1999 and 2005. At the time species and length data were the primary fields recorded, also recorded were, well location, the approximate weight of fish contained within the well and the layer (top, middle or bottom). Since 2010 other data fields were also collected where possible including set type, set location, observer trip number and trip start and end dates.

Data collected in 2008 was entered into a separate database and only extracted as frequencies at various lengths, therefore average length and other variables were not obtained. Data collected in 2009 to 2011 were entered into a new database that has been developed to suit the entry of additional data fields recently being included into the sampling protocol. Data was extracted and processed using MS Excell to evaluate species composition and size distribution. Set type, set location and other more recent data fields were not used in this paper since these were not consistent across all years.

Results

Species Composition

From 2008 to 2011, a total of 4,453073 tuna and non target species were sampled, between April and November each year.

In 2008, 1,012481 individual fish were sampled. Skipjack made up 77% (778496), Yellowfin 20% (205 255), Bigeye 2% (18352) and non target species 1% (10,378).

In 2009 the total number sampled increased to 1,341187. Skipjack comprised 68% (912371), Yellowfin 27% (358917), Bigeye 3% (23145) and non target species 3% (46754). Compared to the previous year there was a decline in proportion of skipjack, and increase in proportion of yellowfin and non target species.

During 2010, 849878 fish were sampled; Skipjack 79% (675108), Yellowfin 19% (157241), Bigeye 1% (6653) and non target species were also 1% (10876).

The most recent sampling in 2011 recorded a total of 1,249527 tuna and non target species together. Skipjack again dominated with 72% (904355), Yellowfin comprised 23% (290 518), Bigeye 1% (7814) and non target species 4% (46840).

Size (Length) Distribution

Skipjack

The mean length for skipjack was 43.5 cm in 2009, 45.03 cm in 2010 and 45.62 cm in 2011. The mode was 40 cm in 2008, and 46 cm in 2009, 40 cm in 2010 and 50 cm in 2011. The size range has consistently been between 10 cm and 100 cm for all years (Table 1).

In 2008 size distribution of skipjack shows more of and even spread of size frequencies from 31 cm to 56 cm. In the 2009 results, there was an obvious reduction in sizes greater than 46 cm. The 2010 size distribution shows a slight similarity in overall pattern of the distribution to 2008 however noting the appearance of smaller sizes between 19 and 22 cm and reduction of larger sizes greater than 46 cm. The 2011 size distribution showed an increase in larger size skipjack compared to previous years (Fig 2).

Yellowfin

The mean length for Yellowfin was 59.66 cm in 2009, 66.2 cm in 2010 and 52.17 cm in 2011. The mode in 2009 was 60 cm, in 2010 the mode was 40 cm and 50 cm in 2011. Size ranges were 10 cm to 201 cm in 2008, 22 cm to 142 cm in 2009, 20 cm to 210 cm in 2010 and 15 cm to 190 cm in 2011 (Fig 3).

The size distribution for Yellowfin in 2008, shows three distinct peaks (modes) in size frequencies in the early juvenile period between 25 cm and 75 cm and another peak with larger juvenile sizes at about 90 cm to 105 cm. In the following year 2009, a different size distribution pattern was observed to show less variation across sizes and did not show the larger yellowfin sizes greater than 110 cm. The size frequency observed for 2010 showed two distinct peaks in the earlier juvenile stage than size frequencies gradually decreased into the larger juvenile sizes. The 2011 size distribution was similar to the pattern observed for 2009.

Bigeye

Bigeye size distribution showed that mean lengths were 59.66 cm in 2009, 62.94 cm in 2010 and 48.43 cm in 2011. The modes were 56 cm in 2008, 60 cm in 2009, 56 cm in 2010 and 40 cm in 2011.

The size distribution for Bigeye fluctuated from year to year but notably 2008 and 2010 size distributions were very similar. The size ranges for 2009 and 2010 were smaller than size ranges observed for 2008 and 2011.

Discussion

The species composition results from 2008 to 2011 are relatively within the ranges of species composition expected for the main tuna species affected by purse seine gear. Similar proportions were mentioned in Williams and Lawson (2005) and have generally been the trend over recent years.

Size distributions also show variability for each species however notably, higher frequencies of larger skipjack where observed in 2011 and size distribution patterns for Bigeye were very similar in 2008 and 2011.

It is difficult to point out the exact reasons generating the trends in size distribution over the sampling period for each year and overall due to limitation in the data being only length and species over time. However a number of inferences can be made with regards to factors that can or may have influenced the results.

Some of the more direct effects will arise from set type, location and the size of the set. Since 2008 efforts have been made to collect set type and location data for the vessels that were sampled in port. This has achieved some level of success but information is not complete for all purse seiners because not all log sheets were acquired from vessels.

Management measures such as the FAD closure implemented since 2009 also has a direct effect on size distribution since the months where sampling took place were during and directly after the FAD closure. A restriction on the use of FADs requires vessels fishing within the PNG Exclusive Economic Zone (EEZ) to set on free schools or unassociated sets. However the restriction on FADs does not apply to PNG archipelagic waters. The data presented in this paper does not differentiate between archipelagic and EEZ waters. However it is widely accepted that catches from unassociated sets result in larger sizes of the main tuna species as stated by Harley et. al, (2010).

Operational procedures of vessels such as onboard sorting of fish into species and size classes before catch is unloaded in port does happen and is mostly unknown to port samplers. Furthermore larger size fish may be transshipped before vessels reach port and hence certain size classes are not captured in the sampling. Lastly, certain wells or fish holds may not be unloaded.

Sampling error with regards to difficulties in differentiating between small Yellowfin and Bigeye is a common problem faced by port samplers given the state of the fish where the most distinguishable features of the two species have deteriorated making identification harder to carry out. The fast pace of unloading has to be maintained as catch must not be left exposed for long periods of time, therefore samplers also have to be fairly quick with identification and measurement of each individual fish.

It has also been established that general oceanographic conditions such as water temperature, currents and productivity etc, affect the distribution and growth of tuna. Data to this extent is yet to be collected for PNG waters.

Conclusion

The results showed that species composition has varied slightly over time but remained within expected limits for all species. Size distributions have also shown differences over sampling periods for each species. Notably, Skipjack had much higher frequencies of larger fish in 2011 compared to other years and size distributions of bigeye in 2008 and 2011 show similar patterns.

Fonteneau (2008) suggested that one way of avoiding biases in observer sampling, would be to carry out a 'double sampling' of catch by both observers and port samplers. Certainly extensive sampling in port provides another useful independent set of data that can be used to cross check with observer sampling and log sheet data provided by fishing vessels.

The need to improve data collection is recognized through better cooperation with the observer program and vessel fleets for acquisition of catch data. The ongoing training of port samplers in species identification and sampling procedures needs to be improved and maintained to ensure sampling error is minimized. It would also be useful to incorporate the collection of samples to assess growth and reproductive patterns of the main tuna species.

The development and advancement in data collection of the port sampling program has identified that different data pertaining to purse seine catch is collected in PNG but remain largely separated. It is hoped that future developments in data collection and management in PNG will be able to synchronize log sheet, observer, vessel monitoring surveillance and port sampling to resolve data gaps and provide a more accurate assessment of tuna catches.

Acknowledgement

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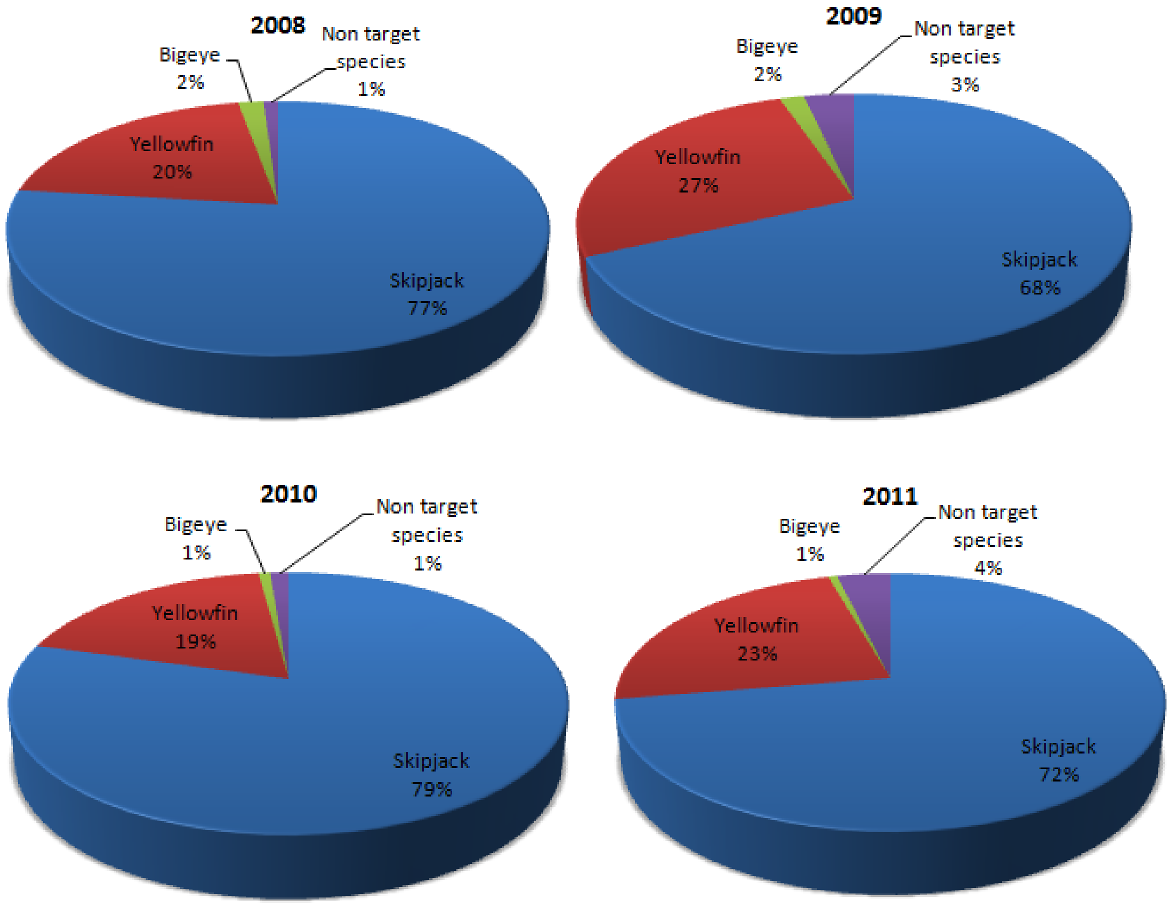

Figure 1: Relative proportions of each tuna species and non target species sampled in each year (2008 to 2011).

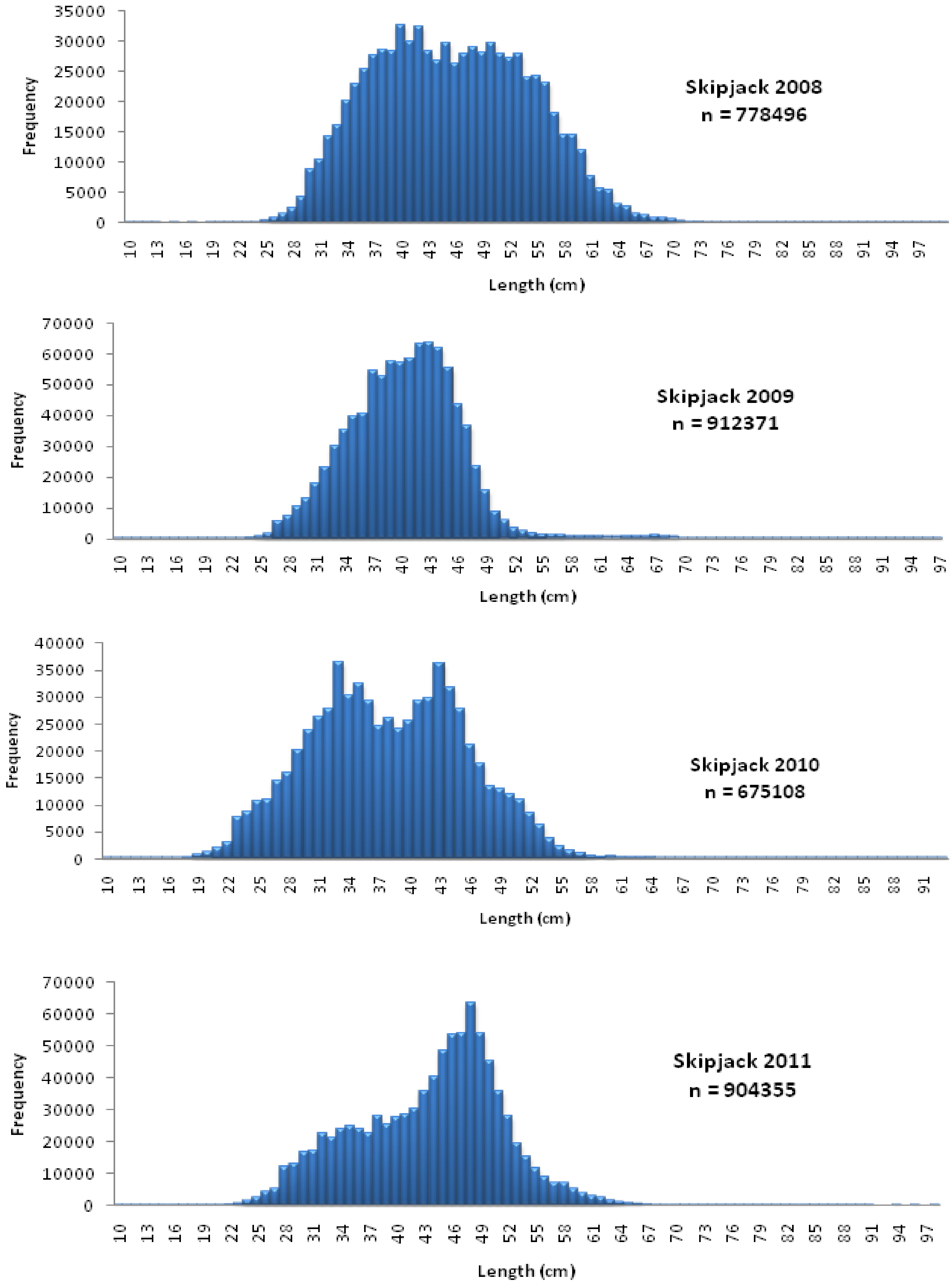

Figure 2: Size or length distribution for Skipjack for 2008 to 2011.

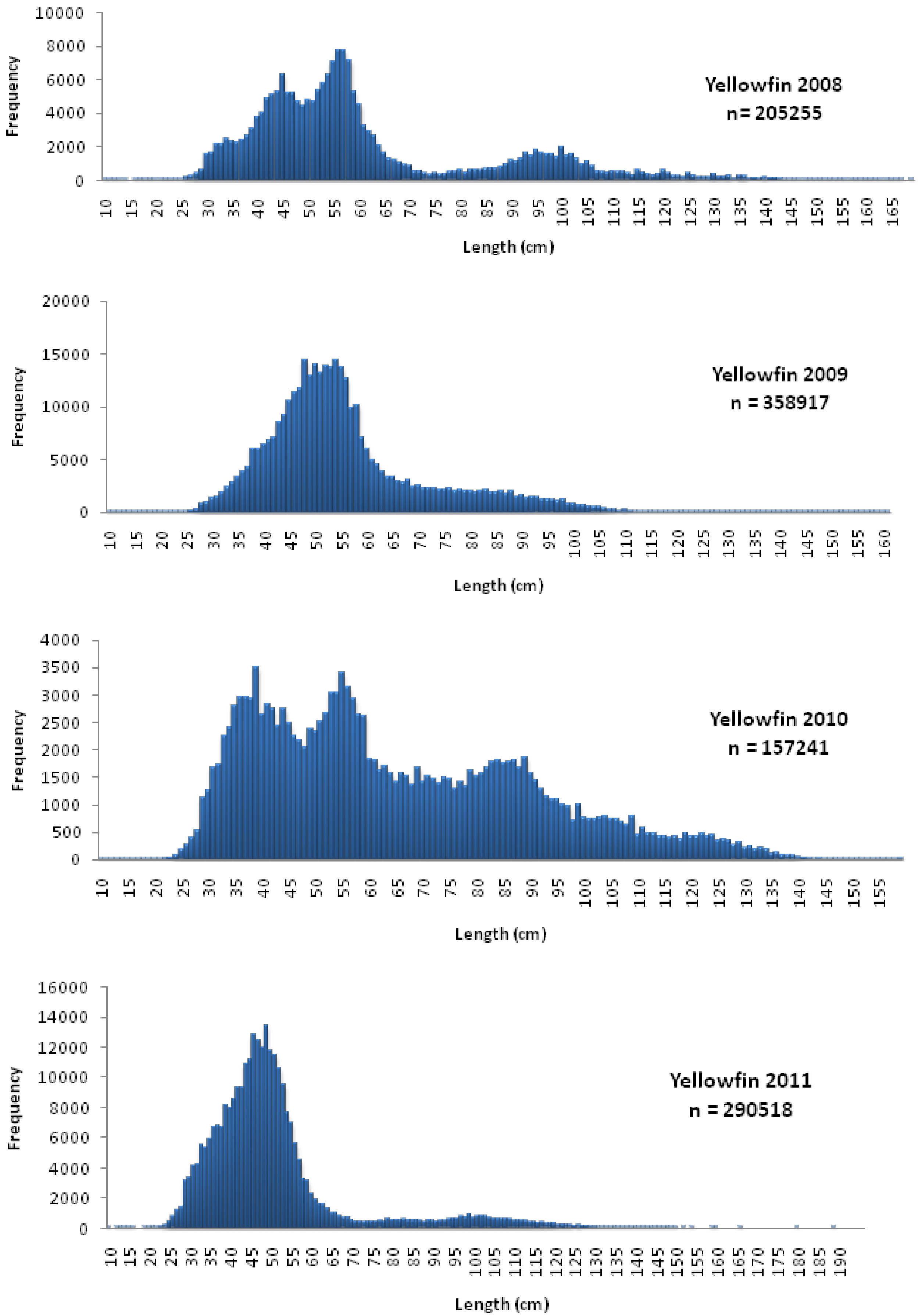

Figure 2: Yellowfin size distribution from 2008 to 2011

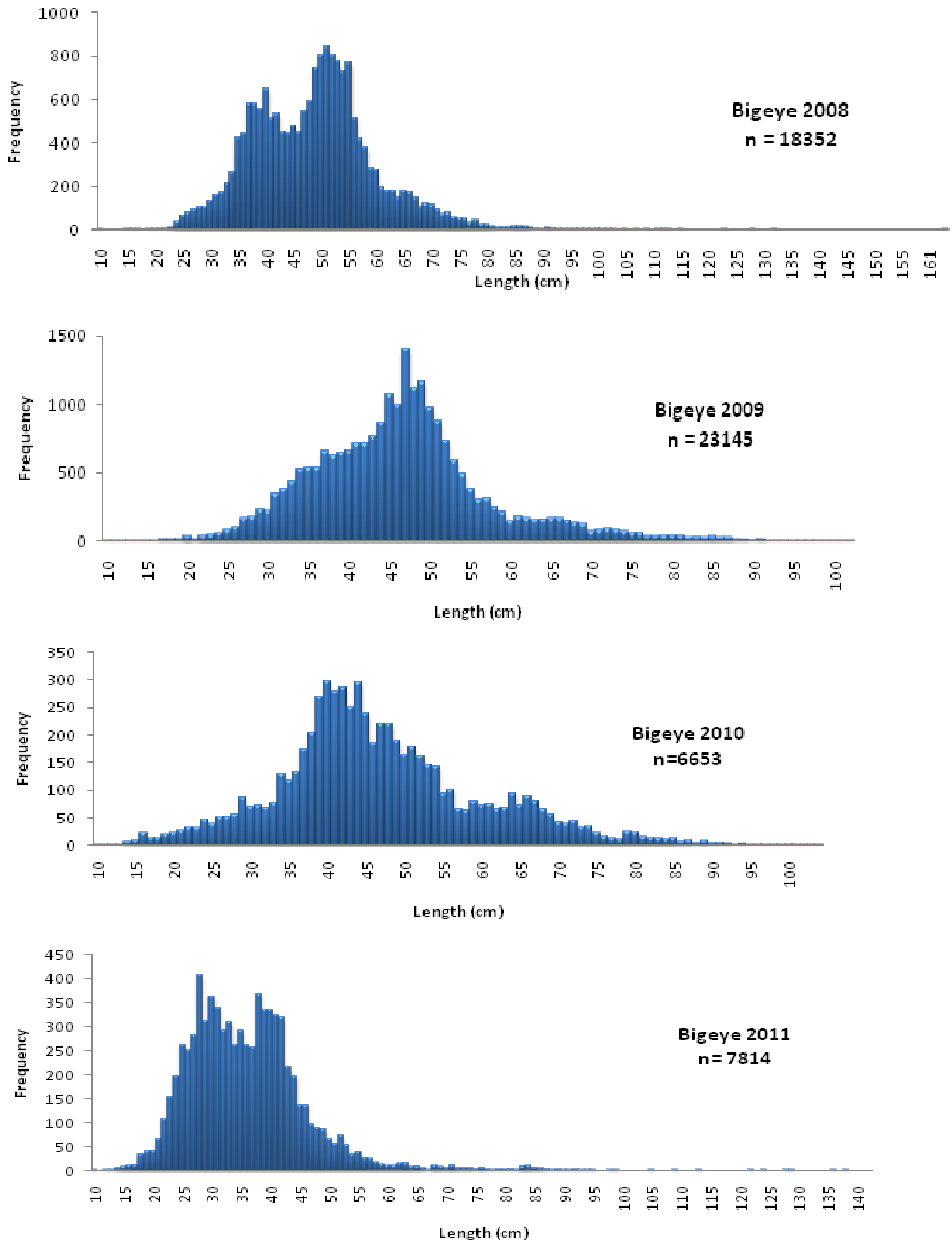

Figure 3: Bigeye Size distribution across 2008 to 2011

Table 1: Summary of Descriptive statistics for main tuna species.

SKIPJACK	*2009*	*2010*	*2011*
Mean	43.50351	45.02819	45.61898
Standard Error	0.00652	0.009553	0.008319
Median	44	45	47
Mode	46	40	50
Standard Deviation	6.227334	7.84901	7.913137
Sample Variance	38.77969	61.60696	62.61773
Kurtosis	3.405384	-0.14124	-0.20747
Skewness	0.749881	0.15159	-0.19977
Range	90	88	88
Minimum	10	12	12
Maximum	100	100	100
Sum	39691342	30398888	41271808
Count	912371	675108	904707
Confidence Level(95.0%)	0.012778	0.018723	0.016306
YELLOWFIN	*2009*	2010	2011
Mean	59.66973	66.22457	52.17711
Standard Error	0.075468	0.064997	0.03483
Median	59	60	48
Mode	60	40	50
Standard Deviation	11.48126	25.76995	18.77269
Sample Variance	131.8194	664.0905	352.4139
Kurtosis	1.677254	-0.06525	4.520173
Skewness	0.805654	0.712329	2.045567
Range	120	190	175
Minimum	22	20	15
Maximum	142	210	190
Sum	1381056	10410171	15157503
Count	23145	157195	290501
Confidence Level(95.0%)	0.147922	0.127393	0.068266
Bigeye	2009	2010	2011
Mean	59.66973	62.94288	48.23056
Standard Error	0.075468	0.167328	0.122381
Median	59	61	47
Mode	60	56	40
Standard Deviation	11.48126	13.64828	10.82228
Sample Variance	131.8194	186.2755	117.1218
Kurtosis	1.677254	1.096672	8.583437
Skewness	0.805654	0.653195	1.905777
Range	120	126	128
Minimum	22	24	22
Maximum	142	150	150
Sum	1381056	418759	377163
Count	23145	6653	7820
Confidence Level(95.0%)	0.147922	0.328017	0.2399