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A compendium of fisheries indicators for bigeye, skipjack, yellowfin, and south Pacific albacore tunas

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Abstract

This paper presents a compendium of fishery indicators for the principal target tuna species – bigeye, skipjack, yellowfin, and south Pacific albacore tuna. The principle purpose of this paper is to provide empirical information on recent patterns in fisheries for each species for the SC's consideration in years in which full stock assessments have not been conducted.

The indicators that are documented include: total catch by gear, nominal CPUE trends, spatial distribution of catch and associated trends, size composition of the catch and trends in average size. These include data loaded into the WCPFC databases as of 9 July 2013.

Due to the complex interactions between the major species-specific fisheries, it is difficult to correctly interpret the stock status-related implications from the trends in any indicators in isolation of other data sets and a population dynamics model. Therefore commentary provided in this paper typically relates to comparisons of the values of various indicators to previous years, in particular comparisons of 2012 values to 2011 and the average over 2007-11.

1. Introduction

The Scientific Committee's Work Programme for 2008-2010, developed at its 3rd session, included Project 24: *development and reporting of stock indicators for those key species not formally assessed*. Reporting of stock indicators was first undertaken at SC4 in 2008 with the paper of Hampton and Williams (2008). In 2011, with no tropical tuna assessment planned for 2012, the Scientific Committee requested that indicators be developed for those stocks for which formal stock assessments were not being undertaken. Harley et al. (2012) responded to that request with a compendium of fishery indicators for the principal target tuna species - skipjack, yellowfin, bigeye and South Pacific albacore tuna – and south Pacific swordfish.

At SC9, while reviewing the work of Harley et al. (2012), the Committee requested that future versions of this paper provide some descriptive text to assist in the interpretation of the key observations. This paper represents the third compendium of fishery indicators and responds to the request from SC9 for further details.

It is difficult to correctly interpret the stock status-related implications of trends in any indicators in isolation of other data sets and a population dynamics model. Therefore commentary provided in this paper typically relates to comparisons of the values of various indicators to previous years, in particular comparisons of 2012 values to 2011 and the average over 2007-11.

2. Indicators and data sources

A range of indicators are provided in the following series of graphs and are based upon an equally wide range of data extracts. Indicators are based on annual catch estimates for the convention area and other ocean

areas as appropriate (e.g. south Pacific for albacore tuna), and aggregate catch and effort data for the gear specific analyses. In some instances individual fleets have been used for particular indicators. Given the large number of indicators and their repetitiveness, we have decided to provide the descriptive text in a tabular form.

Please note that the figures may include or exclude specific fleets that are included in summaries made for other purposes (e.g. CMM tables) and therefore the reported values (catch, effort, CPUE, etc) may not be identical to those presented in other documents. Further, the reported values may change as more data become available.

Bigeye tuna		
Figure	**Indicator**	**Description**
1	Total catch by gear	Total catch in 2012 (163,418t) was a 2% increase over 2011 and a 7% increase over 2007-11. Longline catches (78,338t) are unchanged from 2011 and a 3% decrease on 2007-11. Pole and line catches (3,245t) are down 41% on 2011 and 56% on 2007-11. Purse seine catches (69,164t) are down 2% on 2011 but up 16% on 2007-11. Catches from other gears (12,671t) are considerably higher than 2011 (128%) and 2007-11 (155%).
2 - top	Pole and line CPUE	Japanese CPUE in 2012 (0.007t per day) was a 45% decrease on 2011 and a 43% decrease on 2007-11.
2 – middle	Purse seine CPUE	Free-school CPUE in 2012 (0.193t per day) was a 72% increase on 2011 and a 32% increase on 2007-11. Log CPUE (1.175t per day) was a 15% decrease on 2011 and an 11% decrease on 2007-11. Drifting FAD CPUE (2.68t per day) was a 15% increase on 2011 and a 2% increase on 2007-11. Anchored FAD CPUE (0.535t per day) was a 7% increase on 2011 and a 4% decline on 2007-11.
2 – bottom	Longline CPUE (20S-20N)	Japanese longline CPUE in 2012 (0.343 fish per 100 hooks) was a 15% decline on 2011 and a 17% decline on 2007-11. Korean longline CPUE (0.528 fish per 100 hooks) was a 20% increase on 2011 and a 5% increase on 2007-11.
3	Maps of catch by gear	Compared to the longer time frame, a higher proportion of the catch in recent years has been taken by purse seine, and longline catches have concentrated more in the 10N-10S equatorial band. Purse seine catches have extended further eastward.
4	Longline effort and catch maps	
5	Purse seine effort and catch maps	
6	Concentration of catches	90% of the longline catch in 2012 was taken in 90 5x5 degree squares which was a 5% increase in squares on 2011 and an 8% increase on 2007-11. 90% of the purse seine catch was taken in 602 1x1 degree squares which was a 12% increase on 2011 and a 10% increase on 2007-11.
7	Catch at length by gear type in both numbers and weight	
8	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2012 (5.78kg) is a 34% decrease on 2011 and a 33% decrease on 2007-11. The mean weight of longline caught fish (52.1kg) is a 2% increase on 2011 and a 4% increase on 2007-11. The mean weight of Indonesia / Philippines domestic caught fish (1.11kg) is a 43% increase on 2011 and an 11% decrease on 2007-11. The mean weight of free-school caught fish (22.02kg) is a 76% increase on 2011 and a 98% increase on 2007-11. The mean weight of FAD caught fish (4.02kg) is a 41% decrease on 2011 and a 23% increase on 2007-11.

Skipjack tuna		
Figure	**Indicator**	**Description**
9	Total catch by gear	Total catch in 2012 (1,664,309t) was a 9% increase over 2011 but the same as 2007-11. Pole and line catches (156,579t) are down 24% on 2011 and 26% on 2007-11. Purse seine catches (1,348,554t) are up 16% on 2011 and up 5% on 2007-11.Catches from other gears (157,798t) are up 5% on 2011 but down 4% on 2007-11.
10 - top	Pole and line CPUE	Japanese CPUE in 2012 (5.455t per day) was down 30% on 2011 and 28% lower than 2007-11. Solomon Islands CPUE (1.408t per day) was 52% lower than 2011.
10 – bottom	Purse seine CPUE	Free-school CPUE in 2012 (17.481t per day) was a 46% increase on 2011 and a 4% increase on 2007-11. Log CPUE (21.318t per day) was a 6% increase on 2011 but a 4% decrease from 2007-11. Drifting FAD CPUE (25.901t per day) was a 24% increase from 2011 and a 2% increase on 2007-11. Anchored FAD CPUE (9.651t per day) was a 9% increase on 2011 and a 1% increase on 2007-11.
11	Maps of catch by gear	Compared to the longer time frame, a higher proportion of the catch in recent years has been taken by purse seine and catches have become more concentrated in the 10N-10S equatorial band. There is limited catch taken by the pole and line fishery in the equatorial region beyond Indonesian waters.
12	Purse seine effort and catch maps	The spatial distribution of the purse-seine fishery in the equatorial region has been constrained by the recent closure of the high seas pockets.
13	Concentration of catches	90% of the pole and line catch in 2012 was taken in 260 1x1 degree squares which was a 2% increase on 2011 and a 6% increase on 2007-11. 90% of the purse seine catch was taken in 591 1x1 degree squares which was a 3% decrease on 2011 and similar to 2007-11.
14	Catch at length by gear type in both numbers and weight	There was a mode of relatively large skipjack caught by the PS unassociated fishery in 2012.
15	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2012 (2.00kg) is a 15% decrease on 2011 and an 11% decrease on 2007-11. The mean weight of pole and line caught fish (2.28kg) is a 15% decrease on 2011 and a 5% decrease on 2007-11. The mean weight of Indonesia / Philippines domestic caught fish (0.900kg) is a 20% decrease on 2011 and a 29% decrease on 2007-11. The mean weight of free-school caught fish (3.39kg) is a 6% decrease on 2011 and an 8% decrease on 2007-11. The mean weight of FAD caught fish (2.05kg) is a 29% decrease on 2011 and a 15% decrease on 2007-11.

Yellowfin tuna		
Figure	**Indicator**	**Description**
16	Total catch by gear	Total catch in 2012 (655,672t) was a 26% increase over 2011 and a 22% increase over 2007-11. Longline catches (85,249t) were down 10% on 2011 and 4% on 2007-11. Pole and line catches (35,815t) were down 3% on 2011 but up 38% on 2007-11. Purse seine catches (398,464t) are up 29% on 2011 and 18% on 2007-11.Catches from other gears (136,144t) are up considerably on 2011 (69%) and 2007-11 (61%).
17 - top	Pole and line CPUE	Japanese CPUE in 2012 (0.026t per day) was a 46% decrease on 2011 and a 34% decrease on 2007-11. Solomon Islands CPUE (0.425t per day) was a 43% reduction on 2011.
17 – middle	Purse seine CPUE	Free-school CPUE in 2012 (5.59t per day) was a 64% increase on 2011 and an 18% increase on 2007-11. Log CPUE (4.975t per day) was a 3% decrease on 2011 and a 14% decrease on 2007-11. Drifting FAD CPUE (4.999t per day) was an 11% increase on 2011 and a 6% decrease on 2007-11. Anchored FAD CPUE (5.979t per day) was a 14% increase on 2011 and a 7% increase on 2007-11.
17 – bottom	Longline CPUE	Japanese longline CPUE in 2012 (0.896 fish per 100 hooks) was a 48% increase on 2011 and a 6% increase on 2007-11. Korean longline CPUE (0.38 fish per 100 hooks) was a 1% increase on 2011 and a 17% decrease on 2007-11.
18	Maps of catch by gear	Compared to the longer time frame, a higher proportion of the catch in recent years has been taken by purse seine, and longline catches have concentrated more into the 10N-10S equatorial band and in the west.
19	Longline effort and catch maps	Longline catches have become concentrated within the Solomon Islands EEZ.
20	Purse seine effort and catch maps	Contraction of core catch area
21	Concentration of catches	90% of the longline catch in 2012 was taken in 86 5x5 degree squares which was a 2% decrease on 2011 and an 8% increase on 2007-11. 90% of the purse seine catch was taken in 480 1x1 degree squares which was the same as 2011 and a 1% decrease on 2007-11.
22	Catch at length by gear type in both numbers and weight	
23	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2012 (3.1kg) is a 19% decline on 2011 and a 35% decline on 2007-11. The mean weight of longline caught fish (36.78kg) is a 10% increase on 2011 and a 9% increase on 2007-11. The mean weight of Indonesia / Philippines domestic caught fish (0.82kg) is a 2% increase on 2011 but a 39% decrease on 2007-11. The mean weight of free-school caught fish (27.58kg) is a 26% increase on 2011 and a 33% increase on 2007-11. The mean weight of FAD caught fish (6.69kg) is a 18% decrease on 2011 and a 2% decrease on 2007-11.

Albacore tuna		
Figure	**Indicator**	**Description (South Pacific unless specifically stated)**
24 - top	Total catch by gear (CA)	Total convention area catch in 2012 (132,635t) was a 5% increase over 2011 and a 7% increase over 2007-11. Longline catches (99,617t) increased 7% from 2011 and 10% decrease on 2007-11. Pole and line catches (28,568t) were unchanged from 2011 but a 5% increase on 2007-11. Troll / other catches (4,129t) were down 3% on 2011, but up 5% on 2007-11.
24 - bottom	Total catch by gear (SP)	Total south Pacific catch in 2012 (89,258t) was a 24% increase over 2011 and a 22% increase over 2007-11. Longline catches (86,064t) increased 25% from 2011 and 22% on 2007-11. Troll / other catches (3,158t) were down 8% on 2011, but up 15% on 2007-11.
25	Longline CPUE	Japanese longline CPUE in 2012 (1.155 fish per 100 hooks) was a 33% increase on 2011 and a 38% increase on 2007-11. Korean longline CPUE (0.236 fish per 100 hooks) was a 242% increase on 2011 and a 1% increase on 2007-11. Chinese longline CPUE in 2012 (0.985 fish per 100 hooks) was a 31% increase on 2011 and a 2% increase on 2007-11. Chinese Taipei longline CPUE in 2012 (1.033 fish per 100 hooks) was a 47% increase on 2011 and a 3% increase on 2007-11.
26	Maps of catch by gear	
27	Longline effort and catch maps	
28	Catch at length by gear type in both numbers and weight	
29	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2012 (13.89kg) is a 1% increase on 2011 but a 2% decline on 2007-11. The mean weight of longline caught fish (14.91kg) is a 3% decrease on 2011 and 2007-11. The mean weight of troll caught fish (4.66kg) is a 12% increase on 2011 and a 2% increase on 2007-11.

3. References

Hampton, J., and Williams, P. 2008. A compendium of fisheries indicators for target species. WCPFC-SC4-2008/SA-WP-09.

Harley, S. J., P Williams, and J Hampton. 2012. A compendium of fisheries indicators for bigeye, skipjack, yellowfin, and south Pacific albacore tunas and south Pacific swordfish. WCPFC-SC8-2012/SA-WP-02.

3.1 BIGEYE TUNA

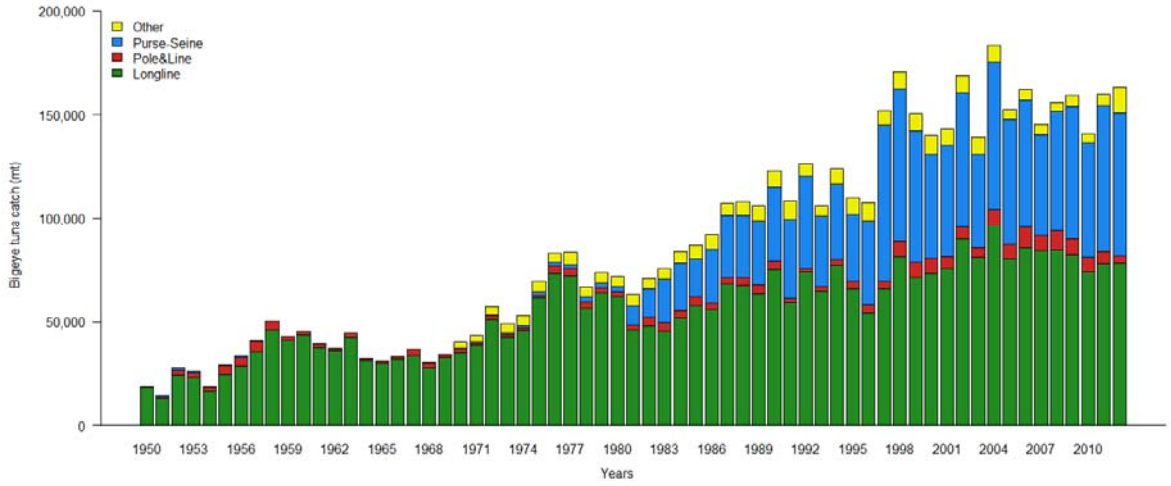
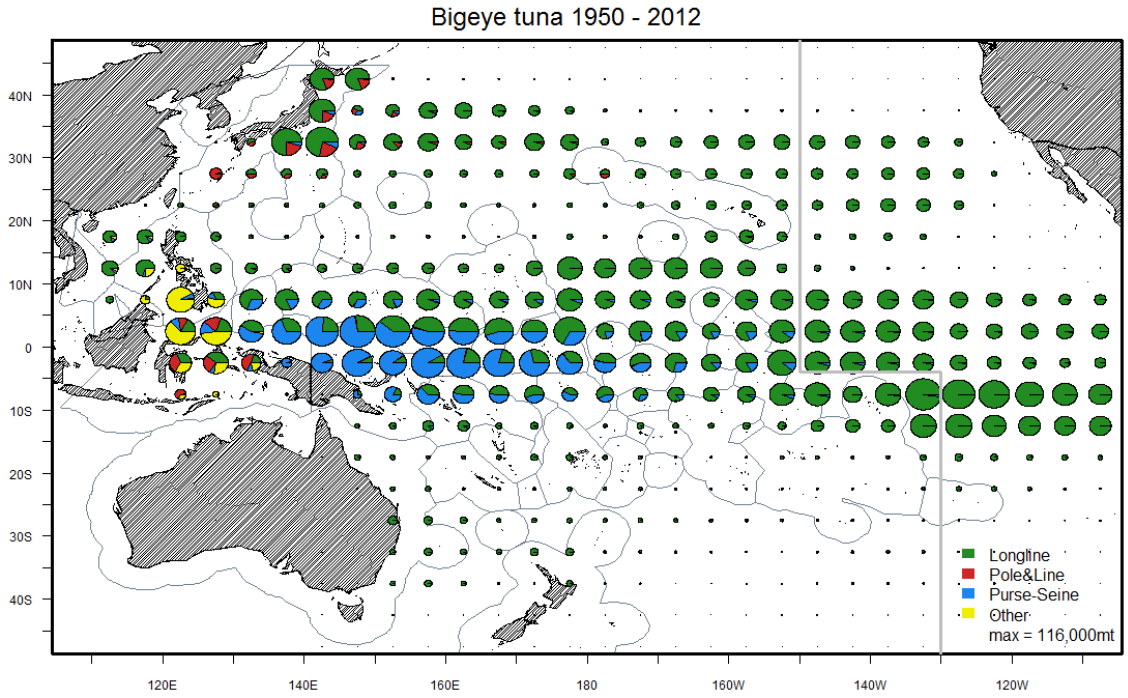


Figure 1 Bigeye tuna catch by gear type and year for WCPFC-Convention Area.

Figure 2 Bigeye tuna catch per unit effort by year for pole and line for the major fishing fleets (top), purse seine for the major set types (middle), and longline for two fleets (bottom).



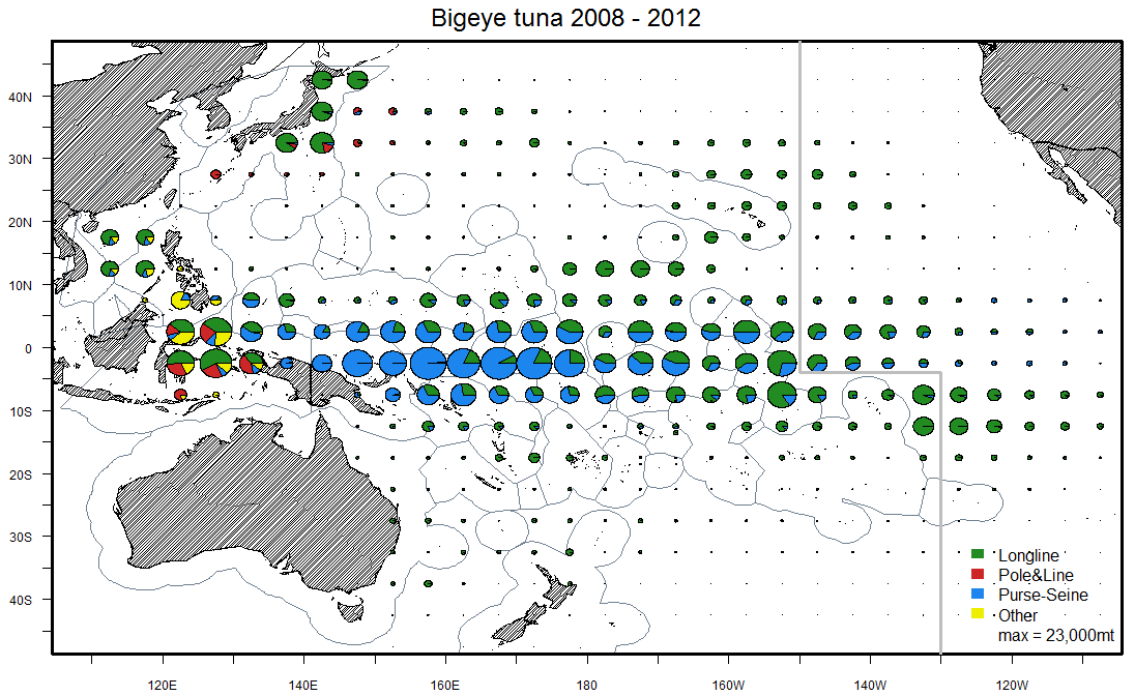
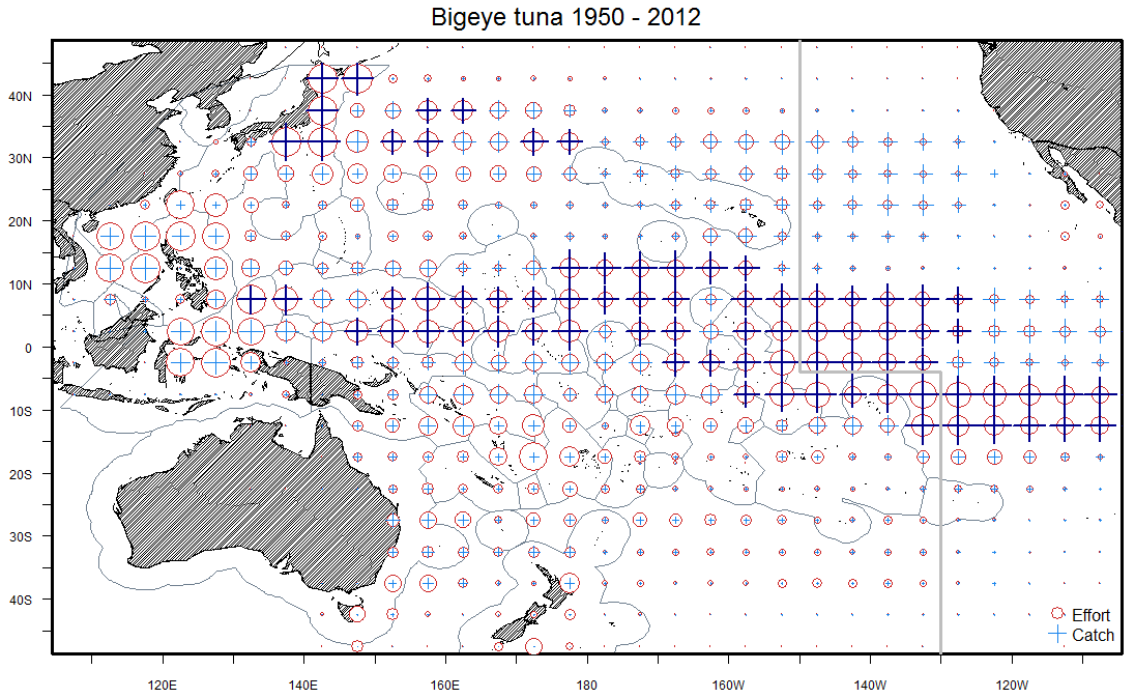


Figure 3 Bigeye tuna catch distribution by gear type and 5x5 degree region for the entire Pacific Ocean for the period 1950-2011 (top) and 2007-2011 (bottom). The maximum circle size is the same for all plots and the figure legend provides the catch associated with this maximum.



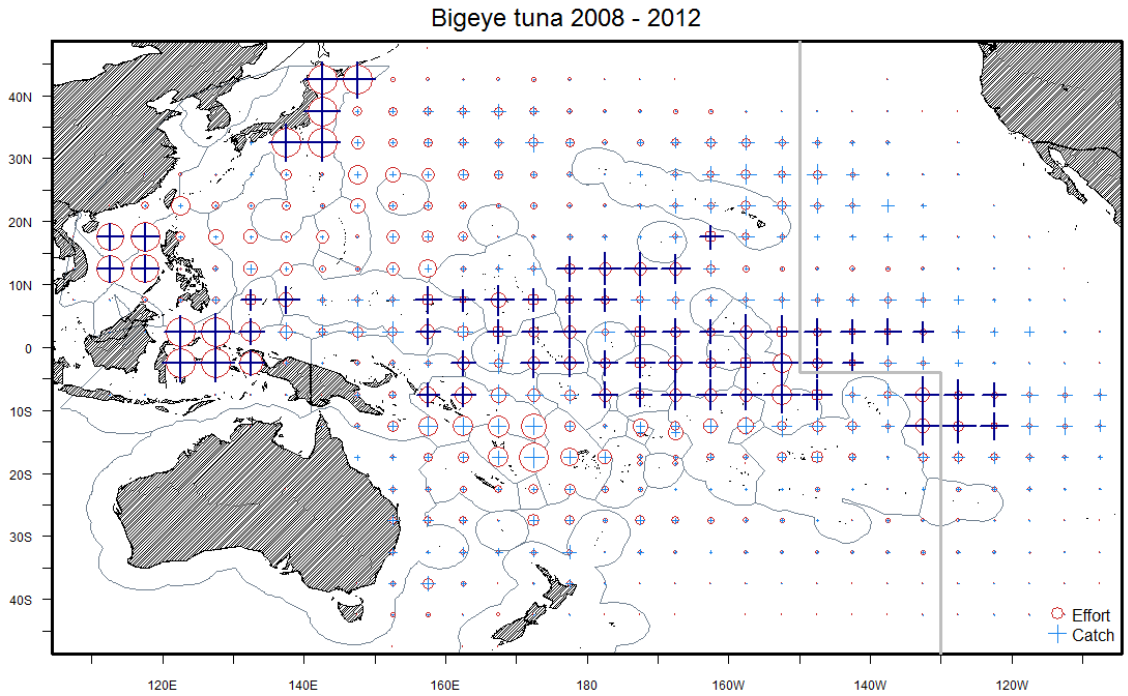
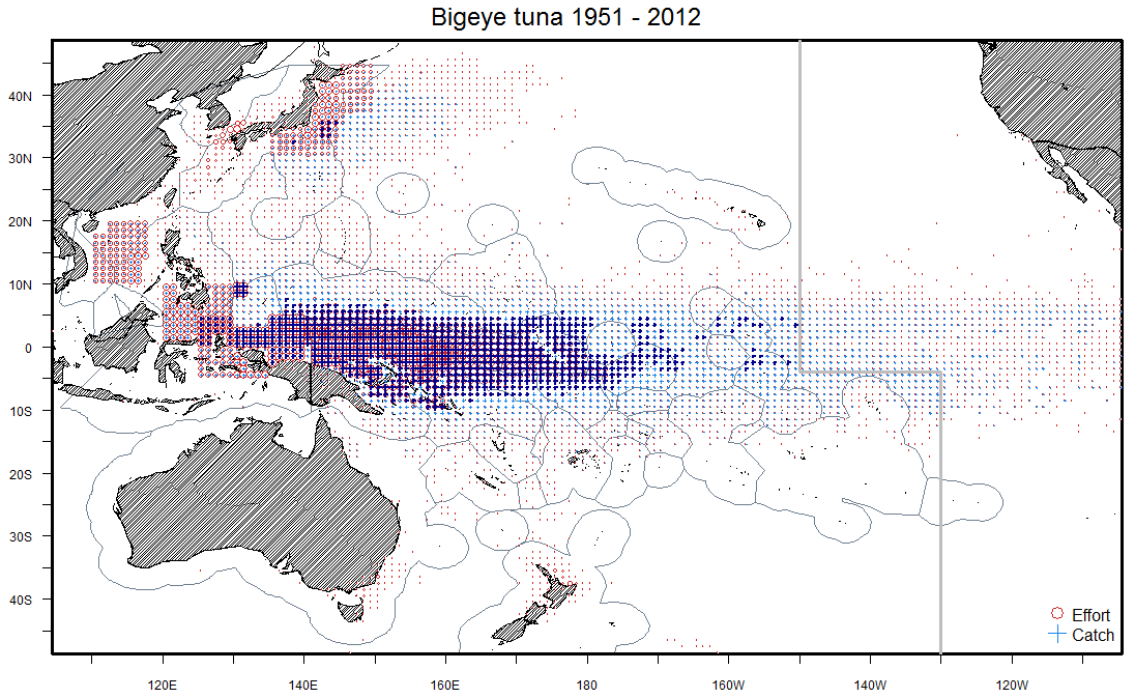


Figure 4 Bigeye tuna longline catch (+) and effort (circles) distribution for the period 1950-2012 (top) and 2008-2012 (bottom). The top 15% of 5x5 degree squares for catch have bolded (+). The relative size of the + and circle give an indication of the CPUE for the square. Where the + is much larger than the circle, CPUE is high.



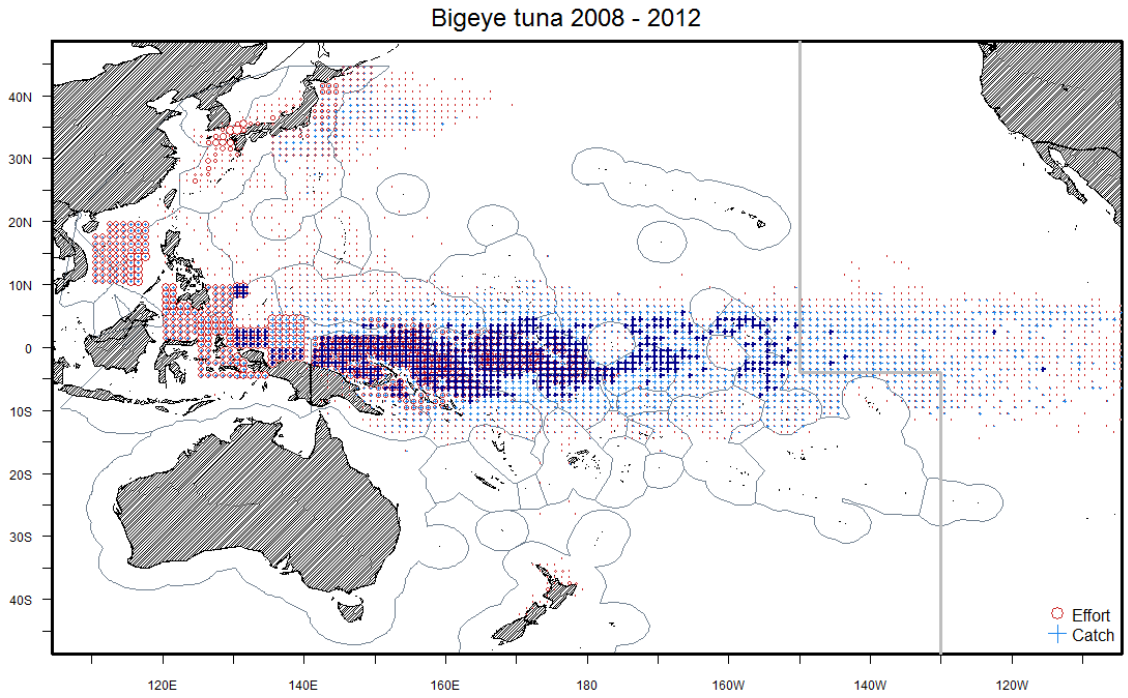


Figure 5 Bigeye tuna purse seine catch (+) and effort (circles) distribution for the period 1950-2012 (top) and 2008-2012 (bottom). The top 15% of 1x1 degree squares for catch have bolded (+). The relative size of the + and circle give an indication of the CPUE for the square. Where the + is much larger than the circle, CPUE is high.

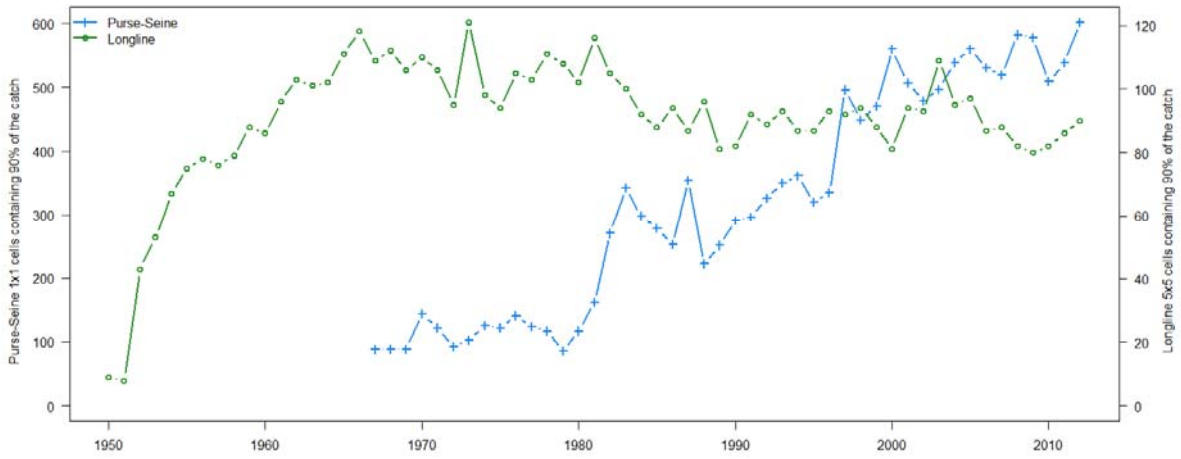


Figure 6 Concentration of bigeye tuna catches for purse seine and longline by year for the WCPO.

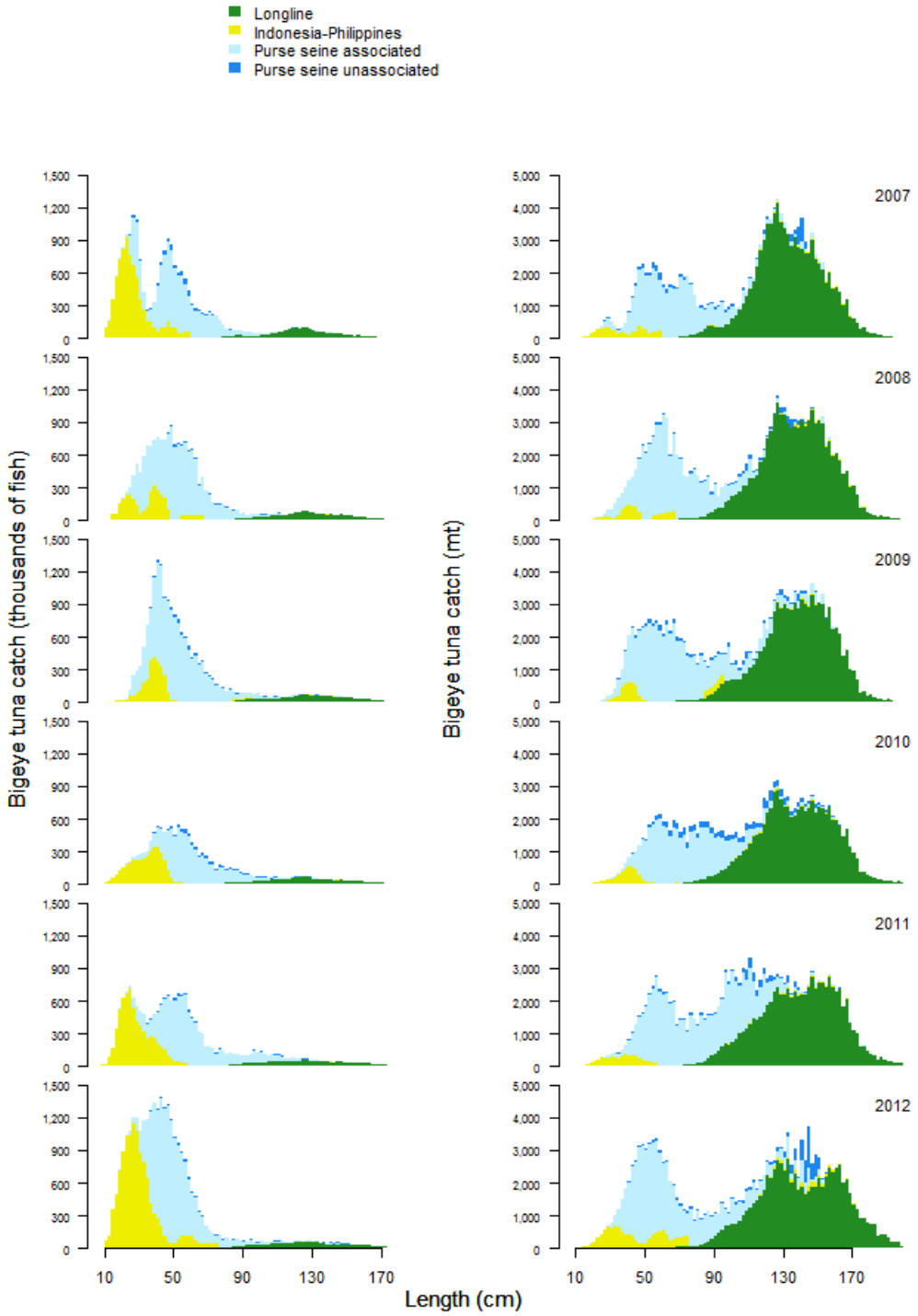


Figure 7 Catch at size of bigeye tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tons (right).

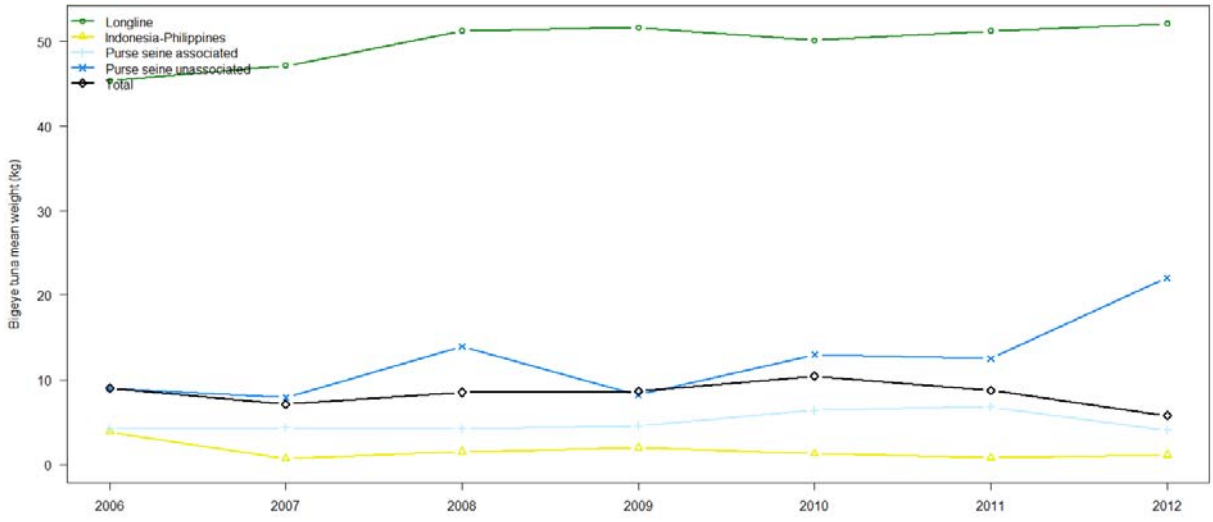


Figure 8 Mean weight of individual bigeye tuna taken by gear and year for the WCPO. The 'total' line represents the overall catch at size.

3.2 SKIPJACK

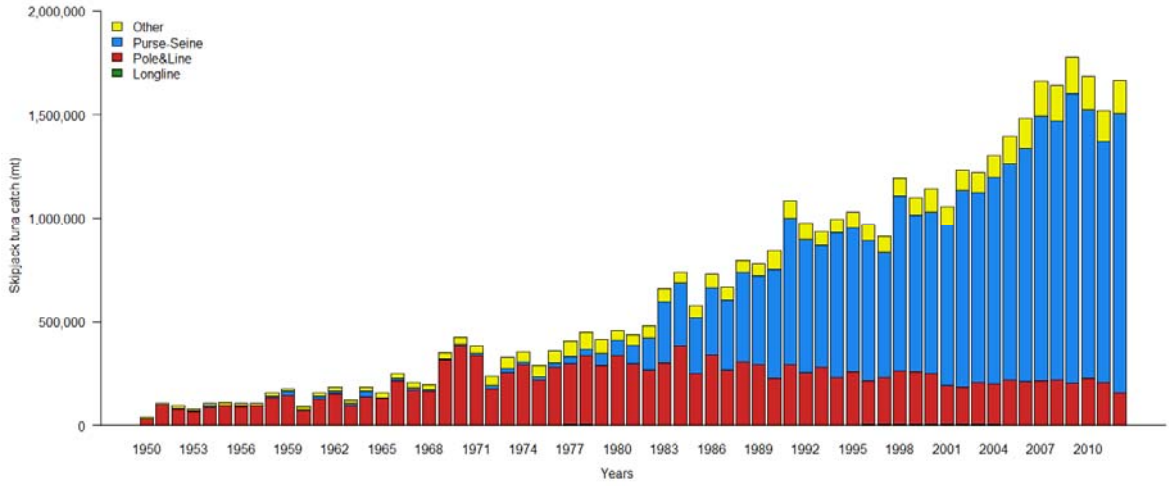


Figure 9 Skipjack tuna catch by gear type and year for WCPFC-Convention Area.

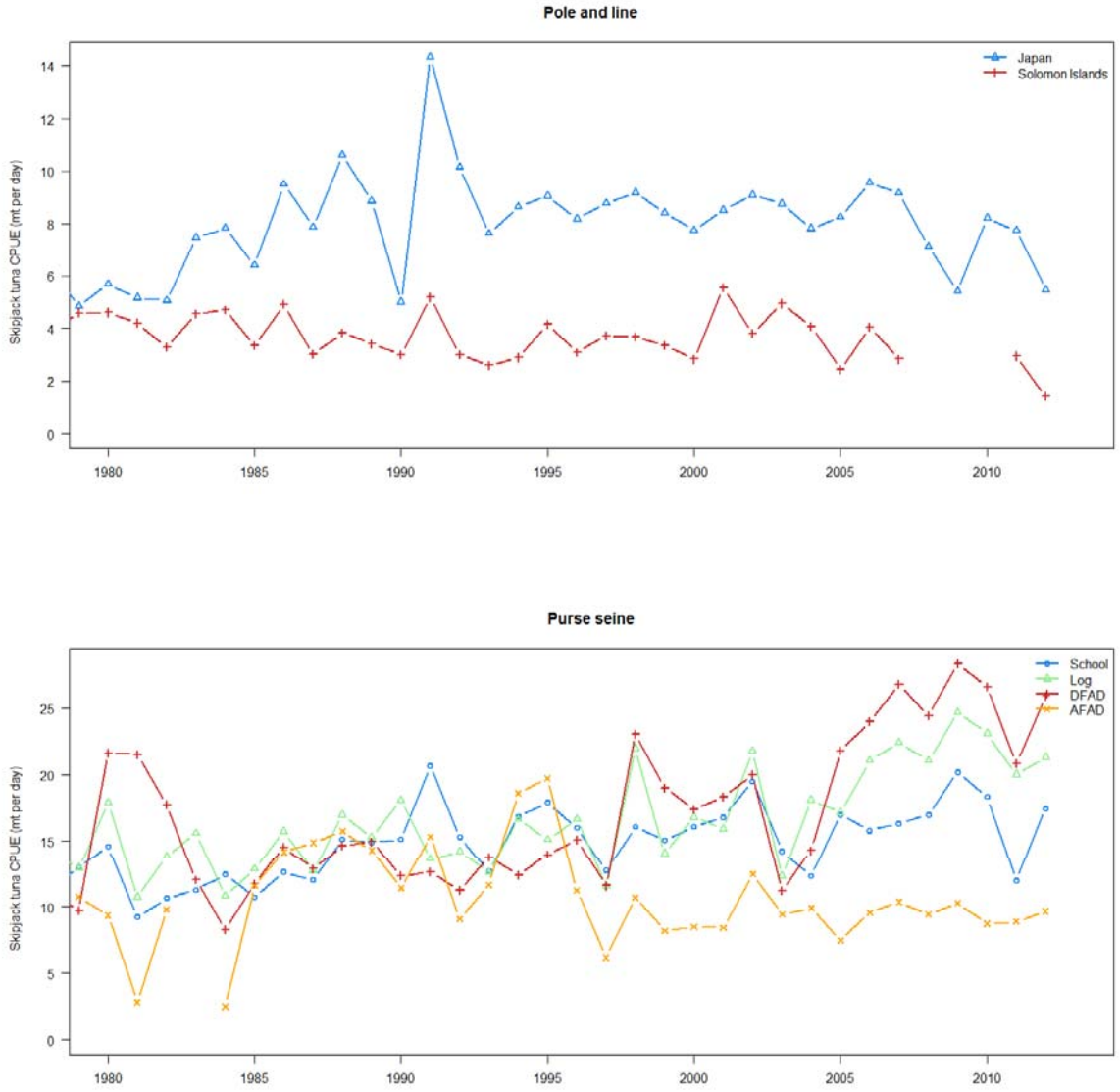
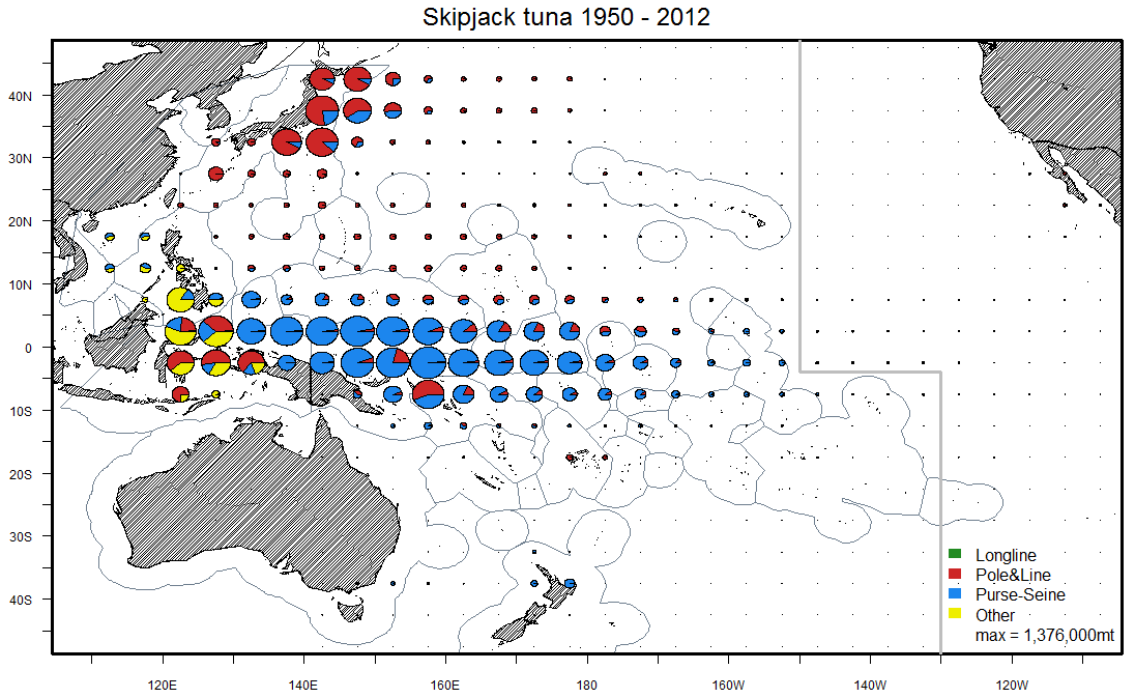


Figure 10 Skipjack tuna catch per unit effort by year for pole and line for two fishing fleets (top) and purse seine for the major set types (bottom).



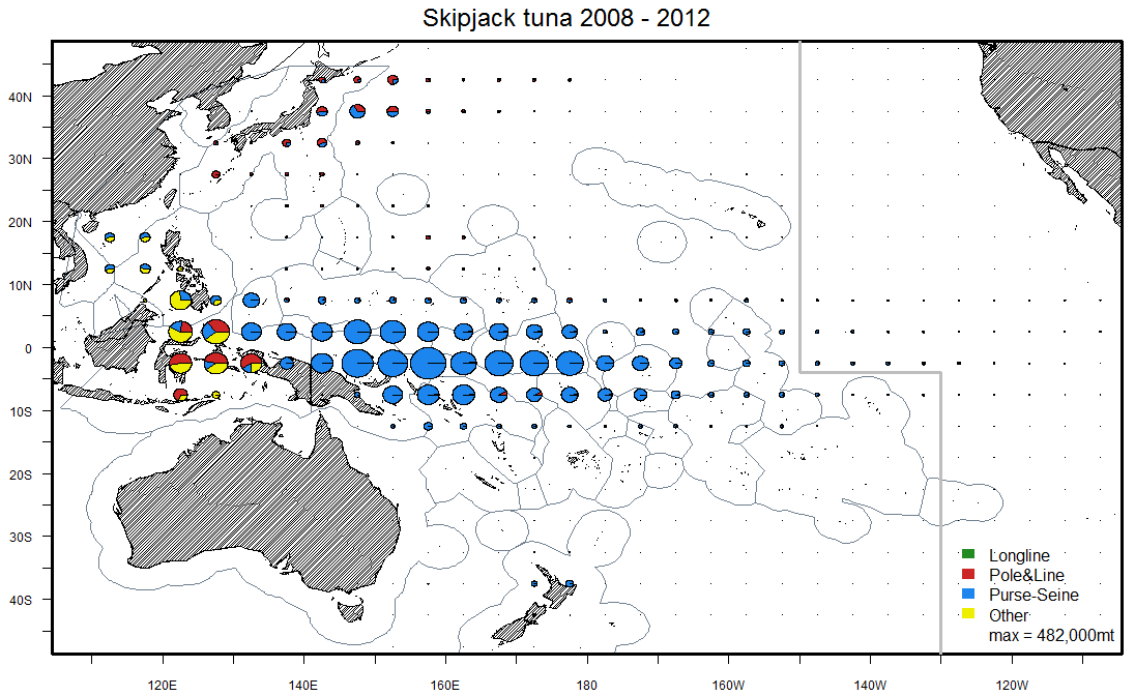
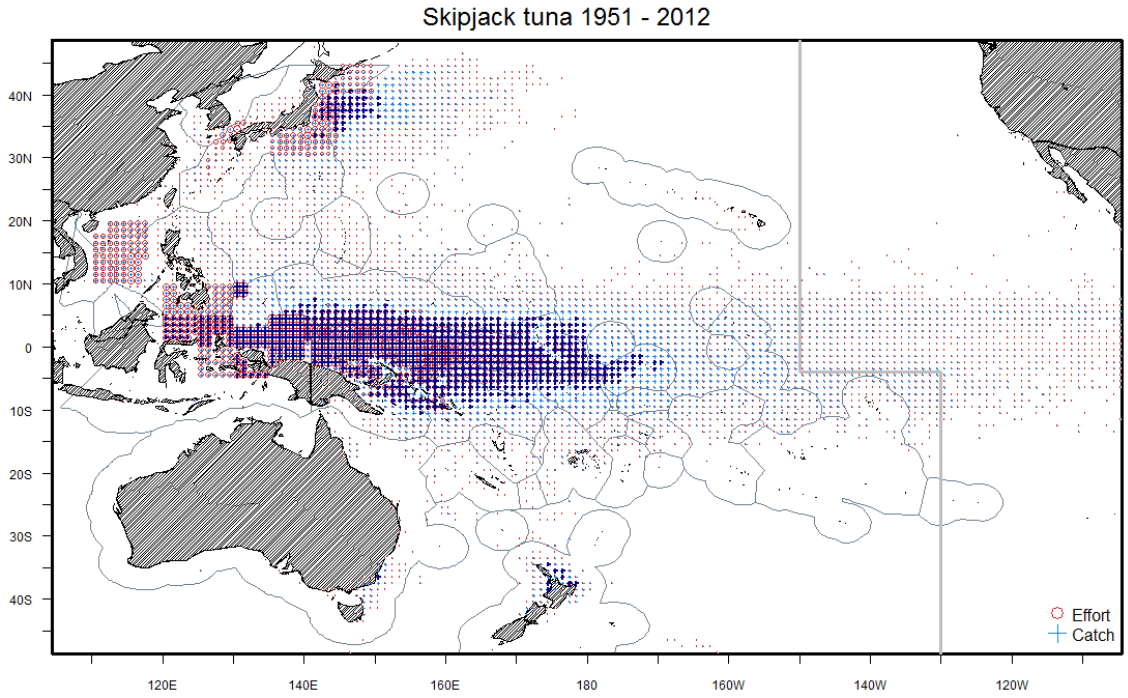


Figure 11 Skipjack tuna catch distribution by gear type and 5x5 degree region for the entire Pacific Ocean for the period 1950-2011 (top) and 2007-2011 (bottom).



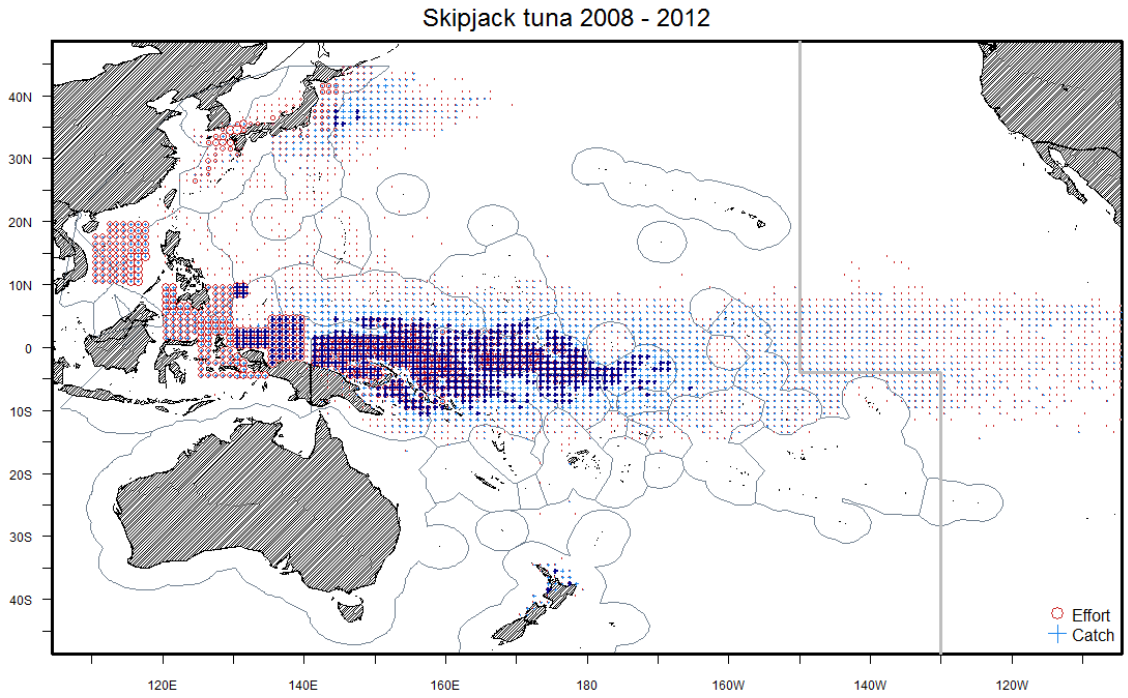


Figure 12 Skipjack tuna purse seine catch (+) and effort (circles) distribution for the period 1950-2012 (top) and 2008-2012 (bottom). The top 15% of 1x1 degree squares for catch have bolded (+). The relative size of the + and circle give an indication of the CPUE for the square. Where the + is much larger than the circle, CPUE is high.

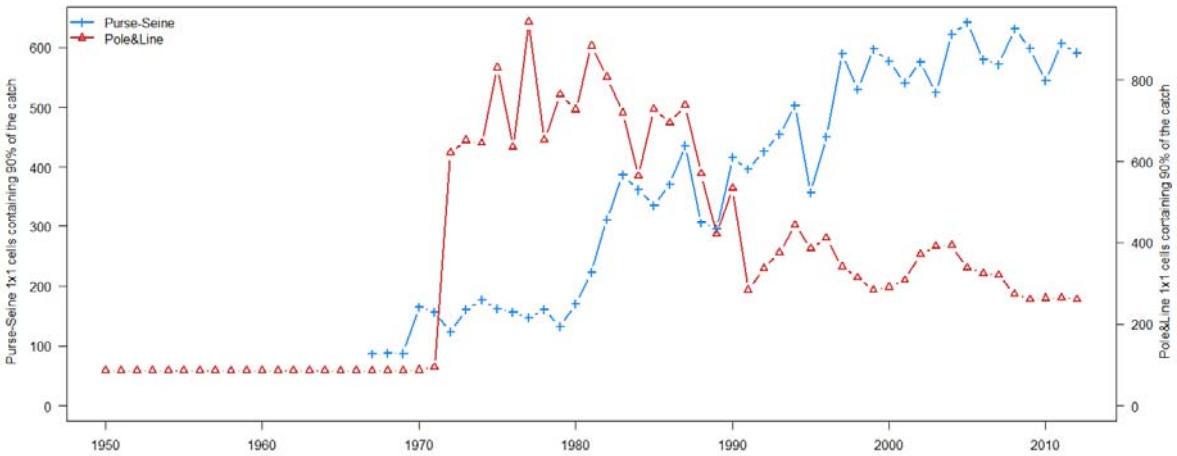


Figure 13 Concentration of skipjack tuna catches for purse seine and pole and line by year for the WCPO.

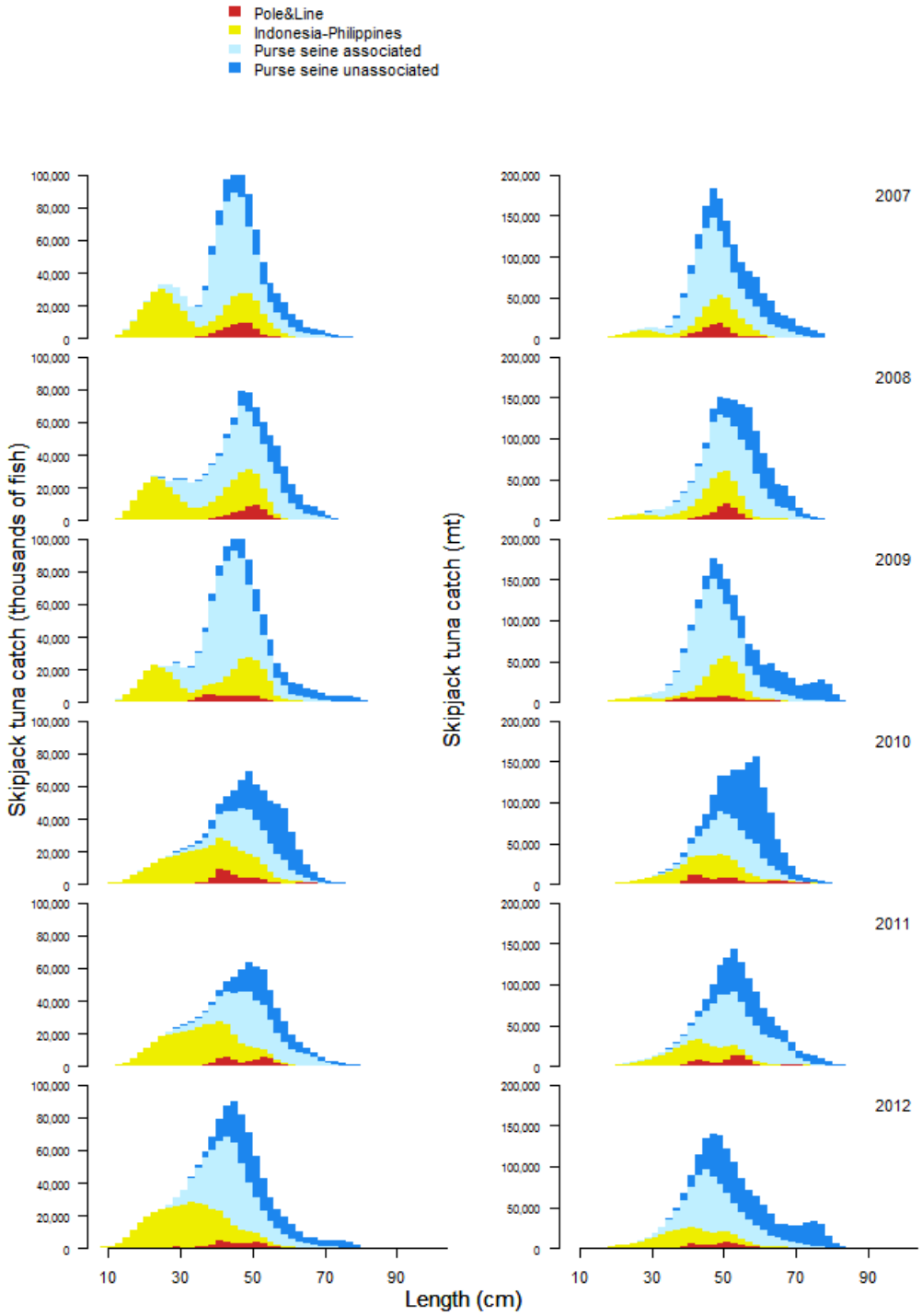


Figure 14 Catch at size of skipjack tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tons (right).

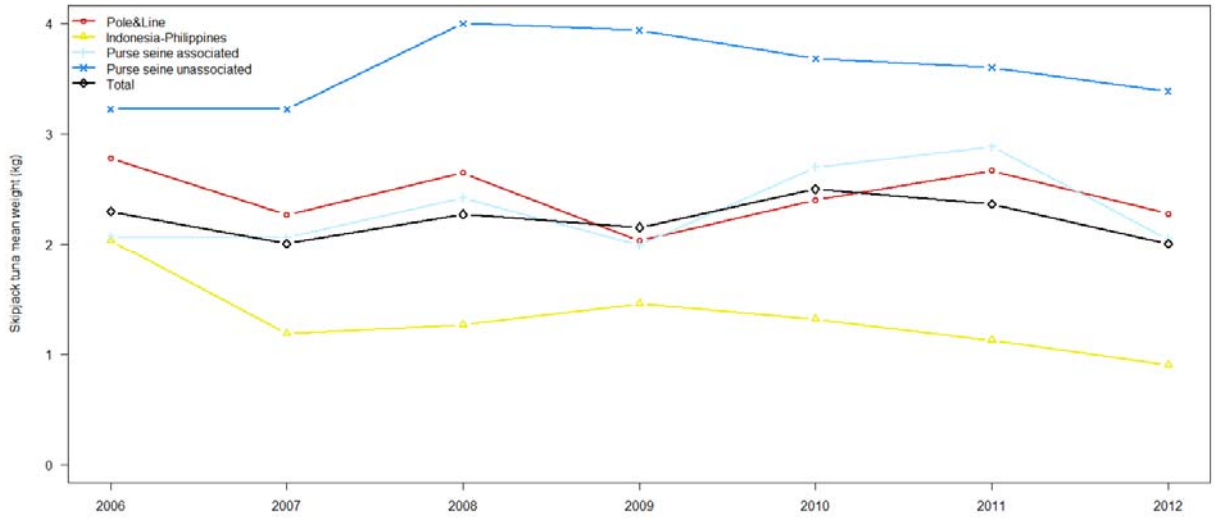


Figure 15 Mean weight of individual skipjack tuna taken by gear and year for the WCPO. The 'total' line represents the overall catch at size.

3.3 YELLOWFIN TUNA

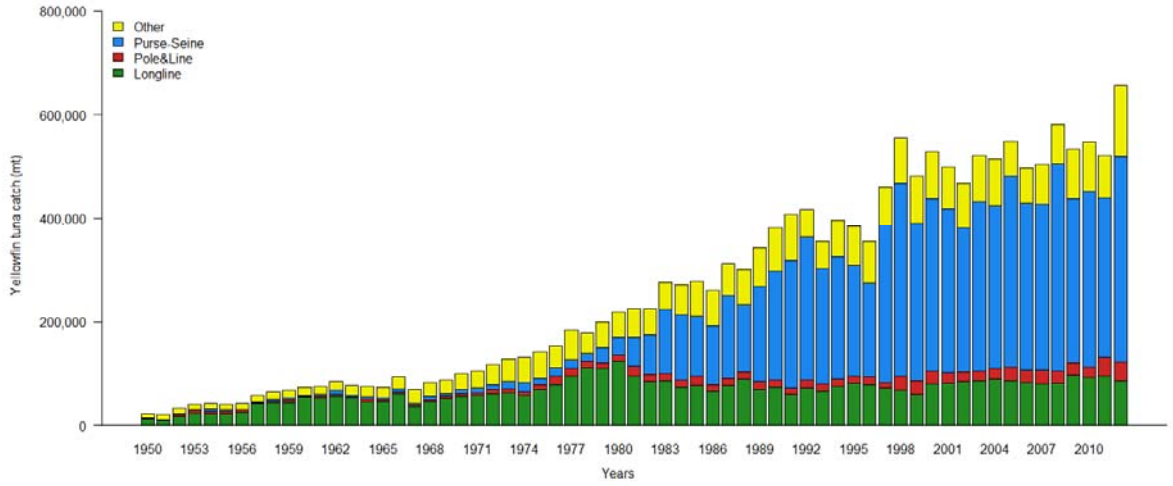


Figure 16 Yellowfin tuna catch by gear type and year for WCPFC-Convention Area.

Figure 17 Yellowfin tuna catch per unit effort by year for pole and line for two fleets (top), purse seine for the major set types (middle), and longline for two fleets (bottom).

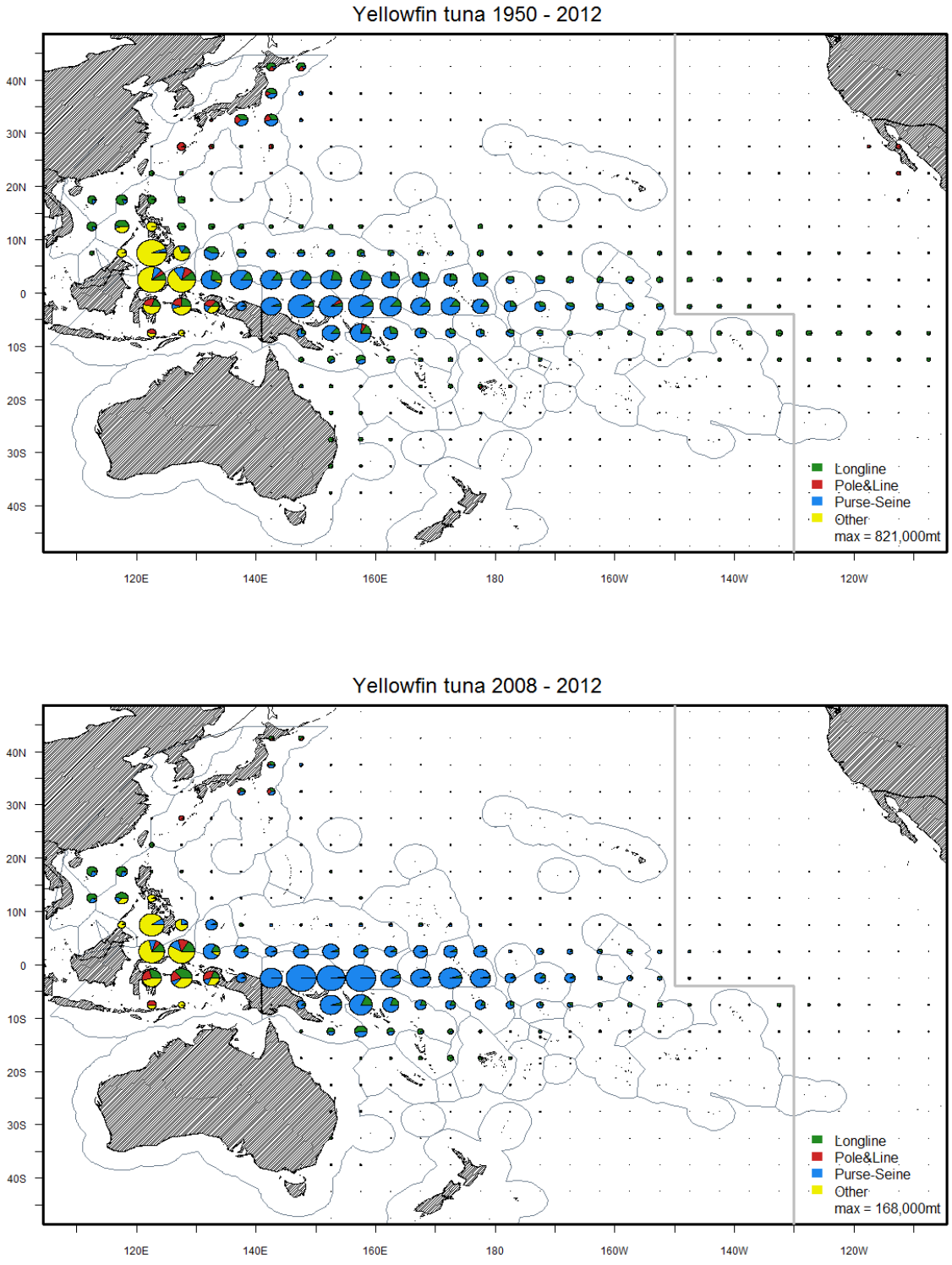


Figure 18 Yellowfin tuna catch distribution by gear type and 5x5 degree region for the entire Pacific Ocean for the period 1950-2011 (top) and 2007-2011 (bottom).

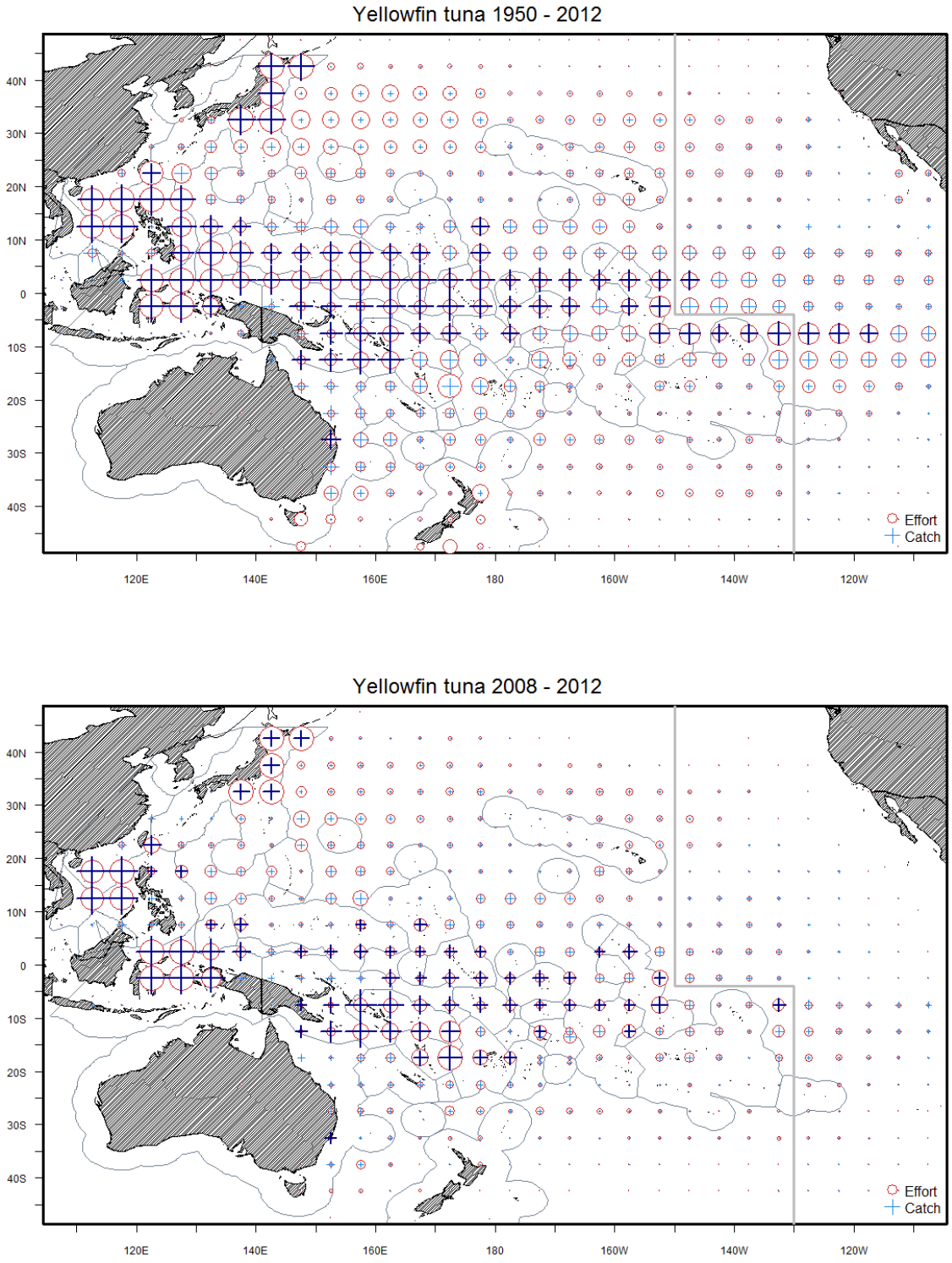


Figure 19 Yellowfin tuna longline catch (+) and effort (circles) distribution for the period 1950-2012 (top) and 2008-2012 (bottom). The top 15% of 5x5 degree squares for catch have bolded (+). The relative size of the + and circle give an indication of the CPUE for the square. Where the + is much larger than the circle, CPUE is high.

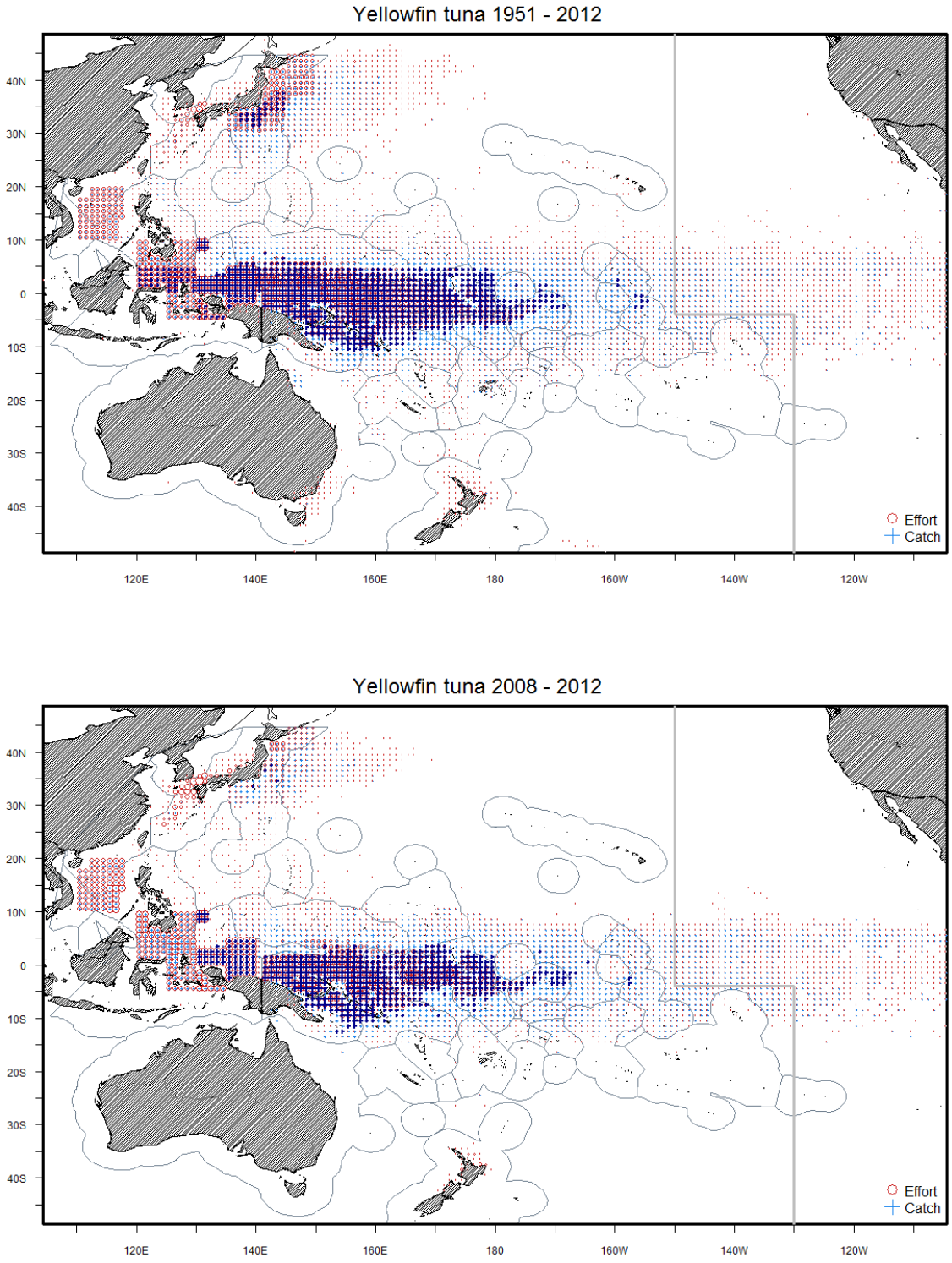


Figure 20 Yellowfin tuna purse seine catch (+) and effort (circles) distribution for the period 1950-2012 (top) and 2008-2012 (bottom). The top 15% of 1x1 degree squares for catch have bolded (+). The relative size of the + and circle give an indication of the CPUE for the square. Where the + is much larger than the circle, CPUE is high.

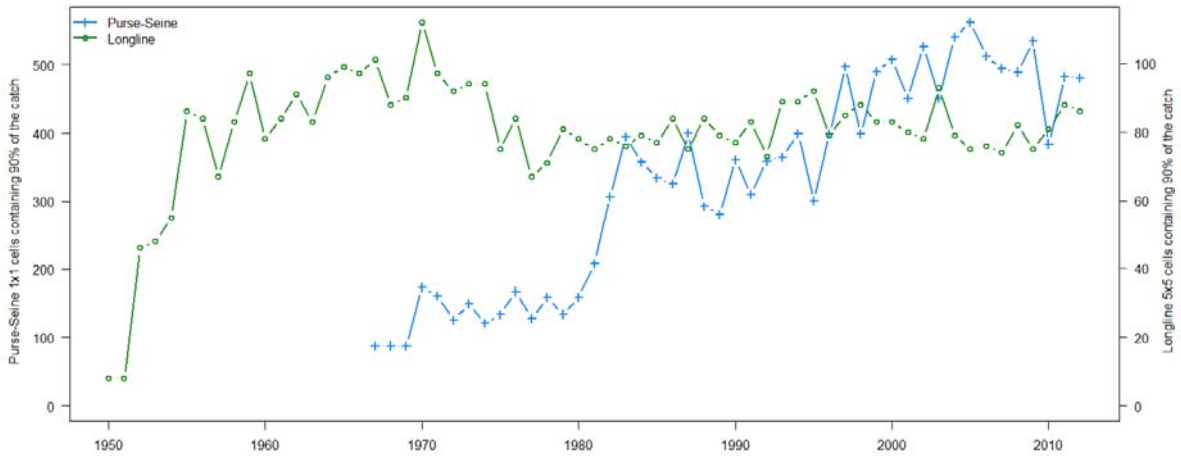


Figure 21 Concentration of yellowfin tuna catches for purse seine and pole and line by year for the WCPO.

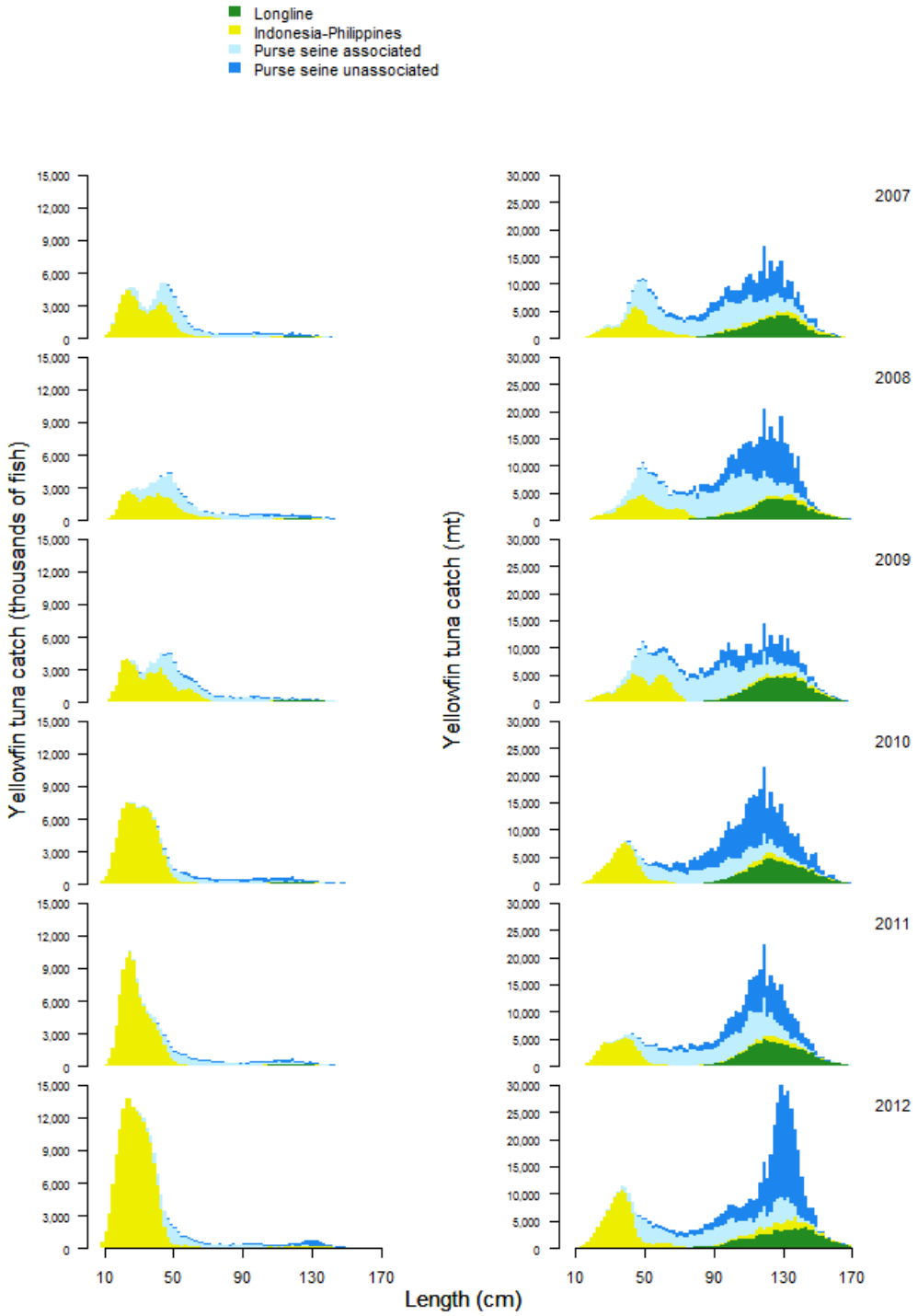


Figure 22 Catch at size of yellowfin tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tons (right).

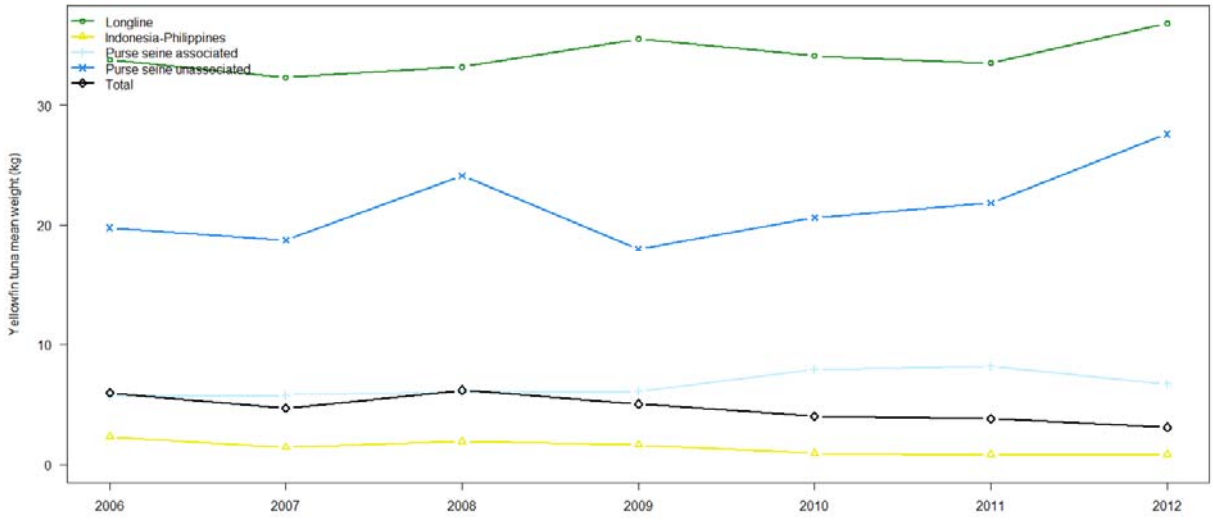


Figure 23 Mean weight of individual yellowfin tuna taken by gear and year for the WCPO. The 'total' line represents the overall catch at size.

3.4 ALBACORE (WITH A SOUTH PACIFIC EMPHASIS)

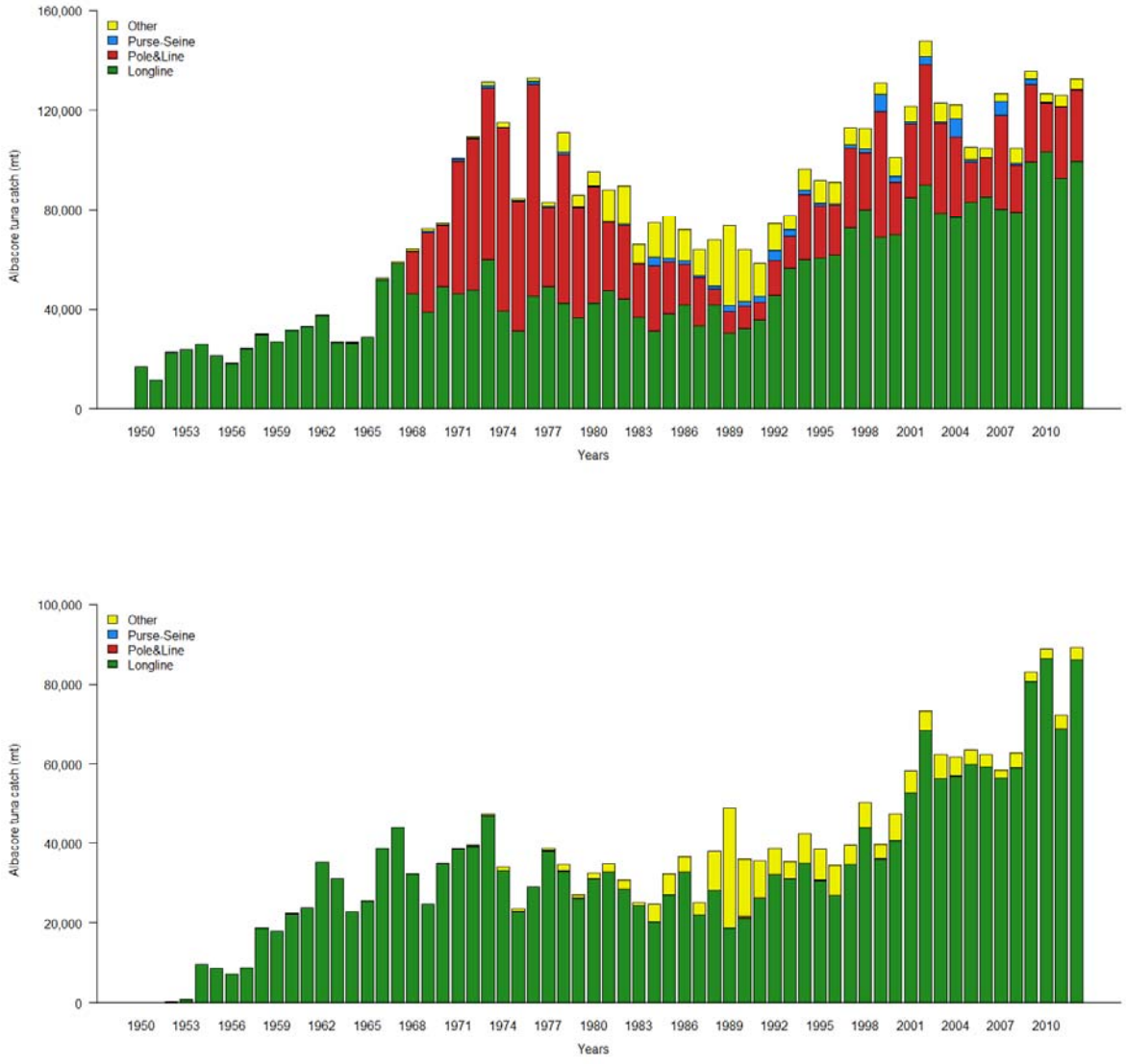


Figure 24 Albacore tuna catch by gear type and year for WCPFC-Convention Area (top) and south Pacific Ocean (bottom).

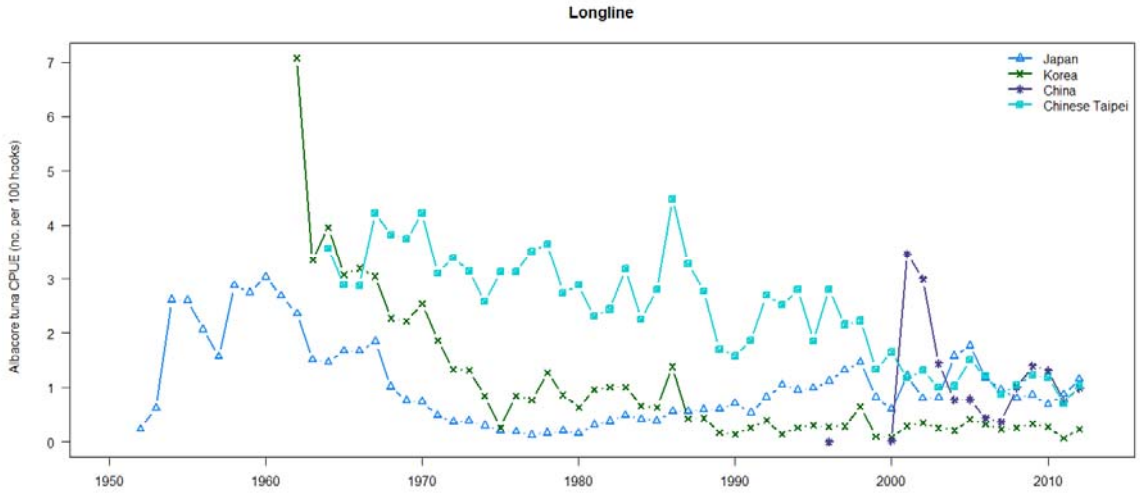


Figure 25 Albacore tuna in the south Pacific Ocean catch per unit effort by year for several fleets.

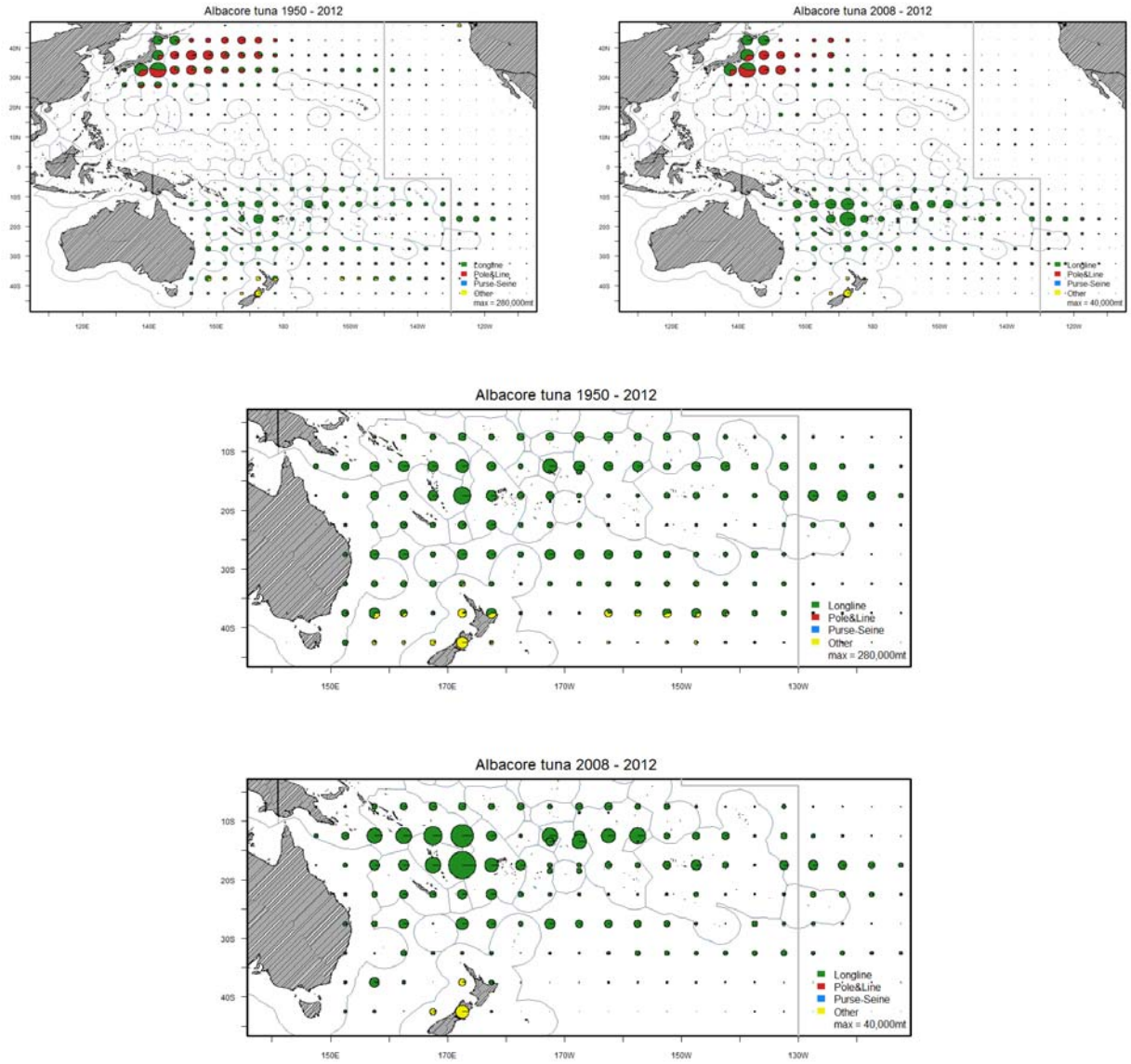


Figure 26 Albacore tuna catch distribution by gear type and 5x5 degree region for the entire Pacific Ocean for the period 1950-2011 (top left) and 2007-2011 (top right) and for the south Pacific ocean for the period 1950-2011 (middle) and 2007-2011 (bottom) .

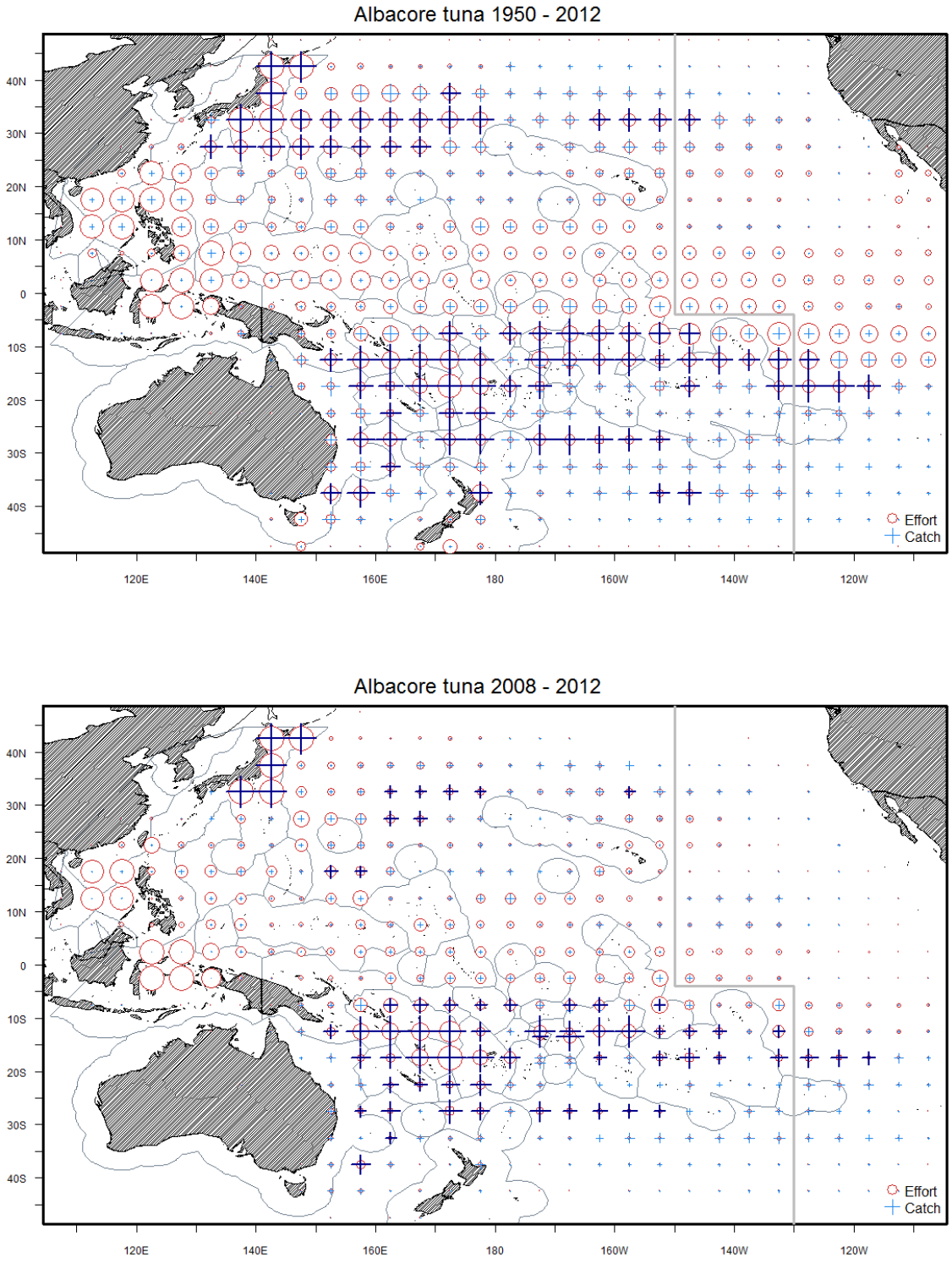


Figure 27 Albacore tuna longline catch (+) and effort (circles) distribution for the period 1950-2012 (top) and 2008-2012 (bottom). The top 15% of 5x5 degree squares for catch have bolded (+). The relative size of the + and circle give an indication of the CPUE for the square. Where the + is much larger than the circle, CPUE is high.

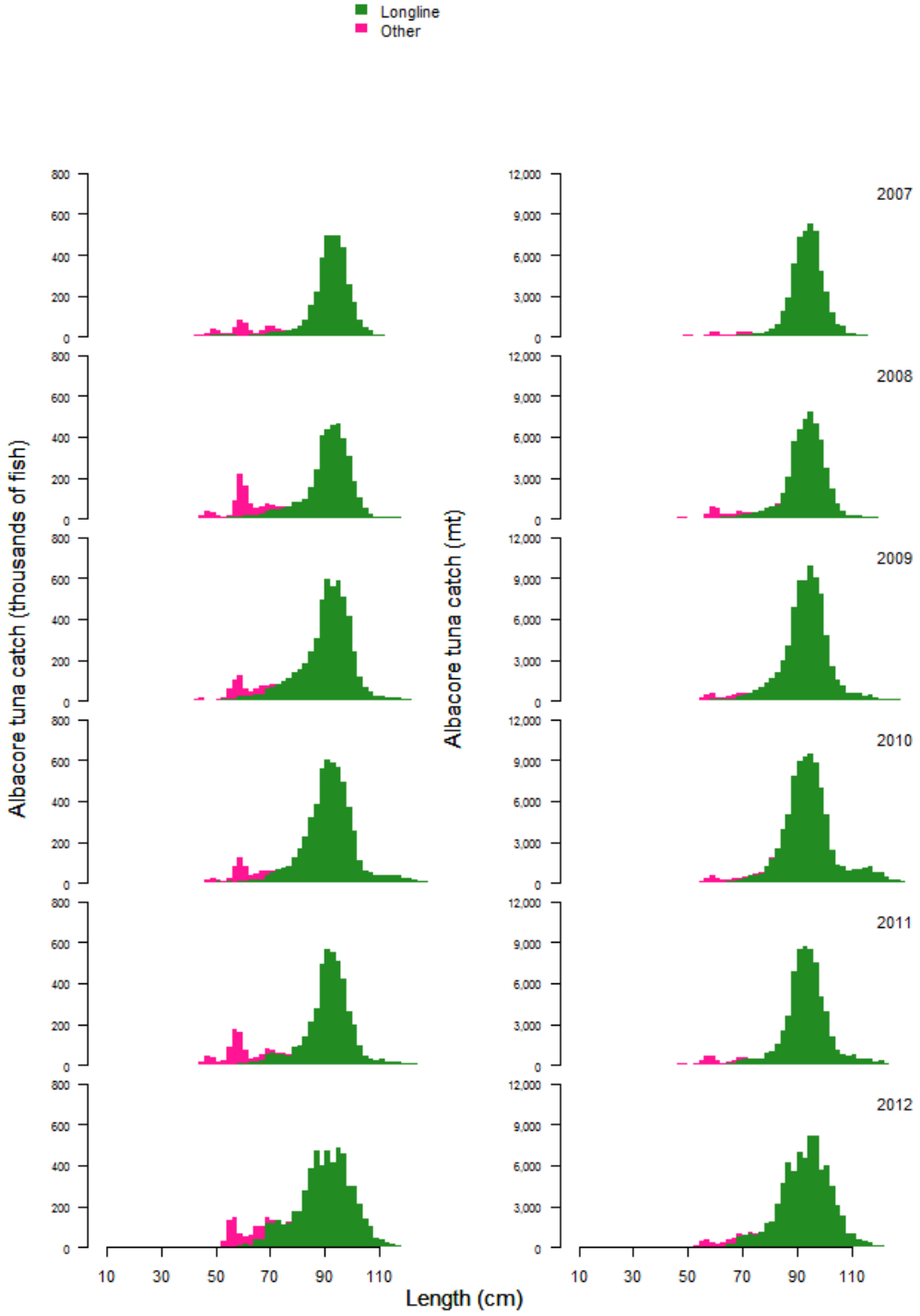


Figure 28 Catch at size of albacore tuna in the south Pacific Ocean by gear type and year. Catch is provided in thousands of fish (left) and metric tons (right).

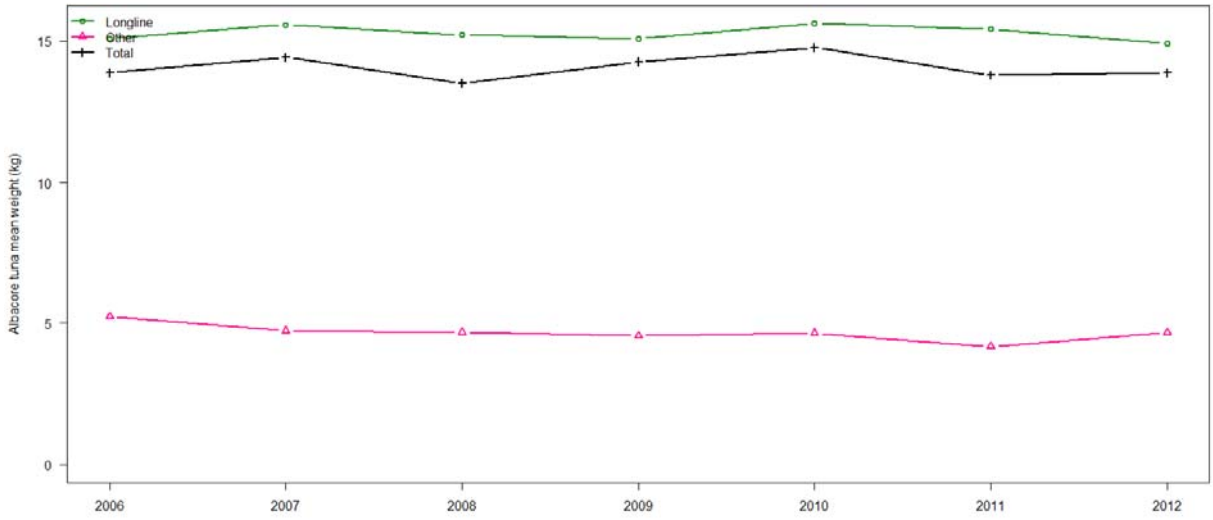


Figure 29 Mean weight of individual albacore tuna in the south Pacific Ocean taken by gear and year. The 'total' line represents the overall catch at size.